Opasraportti

ITEE - Courses in English for exchange students (2017 - 2018)

Courses in English for exchange students at the Faculty of Information Technology and Electrical Engineering (ITEE)

This Course Catalogue lists courses taught in English that are available for exchange students at ITEE during academic year 2017-18.

When preparing your study plan please use the information provided under the **Courses** tab in this catalogue. Read carefully the information of each course you wish to take (language of instruction, target group, course content, timing, preceding studies, additional information etc.).

For information on the exchange application process please see www.oulu.fi/university/studentexchange. All exchange applicants must submit their exchange application through SoleMOVE by the deadline given, proposed study plan is attached to the on-line application.

Accepted exchange students are required to register to all courses. Course registration takes place once you have received your University of Oulu login information close to the start of your exchange period. When registering you will be able to find detailed information on teaching and schedule under **Instruction** tab.

Teaching periods for 2017-18
Autumn term 2017
Period 1: Sept 4 - Oct 27, 2017
Period 2: Oct 30 – Dec 22, 2017

Spring term 2018
Period 3: Jan 8 – March 9, 2018
Period 4: March 12 – May 11, 2018

For arrival and orientation dates see: http://www.oulu.fi/university/studentexchange/academic-calendar

Further information on application process and services for incoming exchange students:
www.oulu.fi/university/studentexchange

international.office(at)oulu.fi

Any questions on courses at ITEE should be addressed to: *international.itee@oulu.fi*

Maritta Juvani

Juha Iisakka

Faculty of Information Technology and Electrical Engineering information: http://www.oulu.fi/eeng/node/12575

- 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/

The available Finnish language courses

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

521285S: Affective Computing, 5 op
521388S: Antennas, 5 op
521281S: Application Specific Signal Processors, 5 op
521151A: Applied Computing Project I, 10 op
521152S: Applied Computing Project II, 10 op
521495A: Artificial Intelligence, 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
521155S: Computer Security, 5 op
811312A: Data Structures and Algorithms, 5 op
521290S: Distributed Systems, 5 op
521073S: Electroceramics and Intelligent Materials, 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
521145A: Human-Computer Interaction, 5 op
812651S: ICT and Behaviour Change, 5 op
817604S: ICT and Organizational Change, 5 op
813623S: Information Security Policy and Management in Organisations, 5 op
813625S: Information Systems Theory, 5 op
812331A: Interaction Design, 5 op
521242A: Introduction to Biomedical Engineering, 5 op
521157A: Introduction to Social Network Analysis, 5 op
521289S: Machine Learning, 5 op
813620S-02: Managing Software Business, exam, 0 op
813620S-01: Managing Software Business, exercise work, 0 op
521096S: Measurement Systems, 5 op
521074S: Microelectronics and Micromechanics, 5 op
521215S: Microelectronics project, 5 op
521072S: Microsensors, 5 op
521385S: Mobile Telecommunication Systems, 5 op
521147S: Mobile and Social Computing, 5 op
521161S: Multi-Modal Data Fusion, 5 op
521288S: Multiprocessor Programming, 5 op
521158S: Natural Language Processing and Text Mining, 5 op
812342A: Object Oriented Analysis and Design, 5 op
815657S: Open Source Software Development, 5 op
521094S: Optoelectronic Measurements, 5 op
811392A: Preparatory Course for MSc Studies, 5 op
521159P: Principles of Digital Fabrication, 5 op
521089S: Printed Electronics, 5 op
521260S: Programmable Web Project, 5 op

817609S: Project Seminar, 3 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
521124S: Sensors and Measuring Techniques, 5 op
521279S: Signal Processing Systems, 5 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
521479S: Software Project, 7 op
815311A: Software Quality and Testing, 5 op
521348S: Statistical Signal Processing, 5 op
817603S: System Design Methods for Information Systems, 5 op
521156S: Towards Data Mining, 5 op
521428S: UBI summer school, 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
521080S: X-ray Diffraction, 5 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 ECTS cr
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods I and II. It is recommended to complete the course at the 1st autumn semester.
Learning outcomes:
After completing the course, student

1. is able to explain the emotion theory and modeling

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

3. 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, 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, Eero Väyrynen, Xiaohua Huang

Working life cooperation:

-

Other information:

-

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

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr
Language of instruction:
In English.
Timing:
Autumn, period 1.
Learning outcomes:
After completing the course, student
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:
Teemu Nyländen
Working life cooperation:
No.
Other information:
-

521151A: Applied Computing Project I, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

  521041A   Applied Computing Project I   8.0 op

ECTS Credits:
10 ECTS cr
Language of instruction:
In English.
Timing:
Autumn and spring, periods 1-4.
Learning outcomes:
1. has basic understanding on how to collaboratively design a small-scale software project,

2. has basic understanding on how to implement and evaluate a small-scale software project,

3. is able to extensively document a small-scale software project,

4. is able to present and "pitch" a project work, i.e. give a good, concise presentation of the work
Contents:
Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.
Mode of delivery:
3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives)
Learning activities and teaching methods:
Practical work in project teams. The course is passed with an approved project work. The implementation is fully in English.
Target group:
3rd year Computer Science and Engineering B.Sc. 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.
Recommended or required reading:
For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www. hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).
Assessment methods and criteria:
The course uses continuous assessment so that the project work is assessed in stages: design (20% of total grade), implementation (40%), evaluation (20%), and final report (20%). Passing criteria: all stages (design, implementation, evaluation, report) must be completed with an approved grade. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Matti Pouke, Denzil Ferreira
Working life cooperation:
No
Other information:
-

521152S: Applied Computing Project II, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
10 ECTS cr
Language of instruction:
English.
Timing:
Autumn and Spring, periods 1-4.
Learning outcomes:
1. has advanced understanding on how to collaboratively design a medium-scale software project,

2. has advanced understanding on how to implement and evaluate a medium-scale software project,

3. is able to extensively document a medium-scale software project,

4. has advanced skills in presenting and pitching a project work, i.e. give a good, concise presentation of the work,
Contents:
Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.
Mode of delivery:

3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives).

Learning activities and teaching methods:
Practical work in project teams. The course is passed with an approved project work. The implementation is fully in English.

Target group:
Computer Science and Engineering MSc students and other Students of the University of Oulu.

Prerequisites and co-requisites:
While no specific courses are not required, 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.

Recommended or required reading:
For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www. hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).

Assessment methods and criteria:
The course uses continuous assessment so that the project work is assessed in stages: design (20% of total grade), implementation (40%), evaluation (20%), and final report (20%). Passing criteria: all stages (design, implementation, evaluation, report) must be completed with an approved grade.
Read more about assessment criteria at the University of Oulu webpage.

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

Person responsible:
Matti Pouke, Denzil Ferreira

Working life cooperation:
No

Other information:
-

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Abdenour Hadid

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A   Artificial Intellig (OPEN UNI)   5.0 op

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
Period 3.
Learning outcomes:
1. is able to identify the types of problems that can be solved using methods of artificial intelligence.
2. knows the basic concepts of intelligent agents, the common search methods used in artificial intelligence, logic based reasoning and applying planning techniques to problems of artificial intelligence.
3. can also apply simple methods to reasoning under uncertainty and machine learning from observation.
4. In addition the student will be able to implement the most common search methods.
Contents:
1) Introduction, 2) Rational (Intelligent) Agents and Uninformed Search, 3) Informed Search, 4) Programming Project 1 (Pacman 1), 5) Adversarial Search (Games), 6) Programming Project 2 (Pacman 2), 7) Uncertainty and Utilities, 8) Markov Decision Processes, 9) Reinforcement Learning, 10) Bayesian Networks, 11) Machine Learning (learning from Observation), 12) Advanced Applications, 13) Conclusions
Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
24 hours of lectures and a programming exercise (approximately 25 hours) during period 3, the rest as independent work.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
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:
The course material is based on the Artificial Intelligence course of Berkely University and the book "Artificial Intelligence, A Modern Approach" by Russell & Norvig.
1) http://ai.berkely.edu
2) Russell S., Norvig P.: Artificial Intelligence, A Modern Approach, Second Edition, Prentice Hall, 2003.
Assessment methods and criteria:
The course is passed with a final exam and a passed programming exercise.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5 / fail.
Person responsible:
Abdenour Hadid
Zinelabidine Boulkenafet
Working life cooperation:
-
Other information:
-

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 (in Finnish), 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: Fundamentals 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:
Juha 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: Ekaterina Gilman

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
Upon completion of the course, the student:
1. is able to explain the big data phenomenon, its challenges and opportunities.
2. is able to explain the requirements and common principles for data intensive systems design and implementation, and evaluate the benefits, risks and restrictions of available solutions.
3. can explain the principles of big data management and processing technologies and utilize them on a basic level.

Contents:
General introduction into big data, namely: big data fundatmenals, data storage, batch and stream data processing, data analysis, privacy and security, big data use cases.
Mode of delivery:
Face-to-face teaching, independent and group work

Learning activities and teaching methods:
Lectures, exercises, seminars, independent and group work
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu
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 slides and exercise material will be provided. Each lecture will include the refernce list for recommended reading. Instructions to necessary installations will be given.
Assessment methods and criteria:
This course assesses students continuously by the completion of exercises, seminar presentations and short reports on a selected topic (group work), and answering two quizzes during the course. To pass the course, it is enough to get 50% of available points for each part. No exam.

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

Person responsible:
 Ekaterina Gilman

Working life cooperation:
The course includes also invited lectures from industry.
Other information:
-

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 ECTS credits
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
Other information:
-

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 ECTS credits / 50 hours of work
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the end of studies.
Learning outcomes:
After completing the course, student
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. All task assignments are compulsory. The course ends with a written exam.
Read more about [assessment criteria](#) at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Tapio Seppänen
Working life cooperation:
No.
Other information:
-

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 ECTS cr
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:
After completing the course, student
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:
-
Other information:
-

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: Rajatheva Rajatheva, Satya Joshi

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:
Introduction to Detection and Estimation Theory, Fading Multipath Channels, Propagation, Path Loss Models, Wireless Systems and Standards: 3G, LTE, Orthogonal Frequency Division Duplexing, 5G
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32h, Assignments.
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: Principles of Mobile Communications, G. Stuber, Springer, 2012. Detection, Estimation, and Modulation Theory, Part I, 2nd Edition by Harry L. Van Trees, Kristine L. Bell, and Zhi Tian, Wiley, 2013. Wireless Communications, A. Molisch, John Wiley & Sons, 2nd Edition, 2011.
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.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Nandana Rajatheva
Working life cooperation:
-
Other information:
-

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 spring semester, during period 4. It is recommended to complete the course at the 3rd spring semester.

Learning outcomes:
After completing the course, students are able to model and design business processes. The student is able to use a computer-based process modeling tool. The student is able to distinguish between business process change on the enterprise level, business process level and the implementation level. The student is able to design process architecture in teamwork with other students.

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 26 h (or exam), exercises 13 h, individual assignments (lecture assignments, small process model, etc.) 34 h, large process model (group work) 60 h

Target group:
BSc students.

Recommended optional programme components:
-

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, and will create a process architecture / model 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:
Minna Pakanen

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:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 1st spring semester of the master studies.

Learning outcomes:

Upon completion the student will

1. understand the key design problems and constraints of the design of baseband parts of a communications transceiver.
2. have the skills to apply estimation, detection and other statistical signal processing methods to communications transceiver and system design.
3. can use linear algebra, basics of optimization and statistical signal processing to derive receiver algorithms, in particular for soft output equalization/detection and receiver synchronization.
4. can use numerical analysis to approximate optimal algorithms with iterative solutions including (un) supervised adaptive algorithms.
5. understands the basic requirements for the convergence of an iterative and adaptive algorithm.
6. can model the operation of a transceiver using Matlab and other simulators to assess the performance of transceiver algorithms.

Contents:

Review of linear algebra, matrix computations and basics of constrained optimization; transceiver baseband design targets, filter optimization, adaptive filters and algorithms, iterative algorithms, algorithm convergence, equalization and detection algorithms, channel estimation, receiver carrier and timing synchronization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Face-face-teaching (lectures and exercises) 50h, Matlab simulation exercises in groups 30 h, independent work & passed assignment 50 h.

Target group:

Electrical, communications and computer science and engineering students.

Prerequisites and co-requisites:

The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal analysis, 031021P Statistics, 031078P Matrix algebra, 521330A Telecommunication engineering, 521348S Statistical signal processing. The recommended prerequisite is the completition of 521323S Wireless communications I.

Recommended optional programme components:

-

Recommended or required reading:

Parts from books:

1. Prandoni, Paolo & Vetterli, Martin, "Signal Processing for Communications", CRC Press 2008.
2. Haykin, Simon, Adaptive Filter Theory, 3rd ed. or newer, Prentice Hall 1996.
3. Kailath, Thomas, Sayed, Ali H. & Hassibi, Babak, "Linear Estimation", Prentice Hall 2000.
4. Golub, Gene H. & Van Loan, Charles F., "Matrix computations", 3rd ed. or newer, Johns Hopkins University Press 1996.
5. Meyr, Heinrich, Moeneclaey, Marc & Fechtel, Stefan A., Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998

Other literature, lecture notes and material.

Assessment methods and criteria:

Continuous evaluation by solving homework problems and completing the simulation projects, and a final exam. 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 (0) stands for a fail.

Person responsible:

Markku Juntti

Working life cooperation:

No

Other information:

-

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 ECTS cr / 130 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 of the master studies.
Learning outcomes:
Upon completion the student
1. knows the functional structure of communications transceiver and understands the requirements for various wireless systems for the transceiver.
2. knows the architectural and functional design of (all-)digital transceiver with synchronization, channel estimation and connection establishment.
3. can derive digital domain algorithms for separate functionalities and match them to operate together via agreed interfaces.
4. can model the operation of the algorithms and the whole transceiver using Matlab and C other to assess their performance by computer simulations.
5. knows how to interface the software models to the common implementation architectures.

Contents:
Wireless transceiver functional split, digital parts and architecture, multirate filtering, transceiver digital front-end architecture and design, algorithm-architecture co-simulation.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Face-face-teaching (lectures and exercises) 25h, Simulation and design exercises in groups 80 h, independent work & passed assignment 35 h.
Target group:
Electrical, communications and computer science and engineering students.
Prerequisites and co-requisites:
The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal analysis, 031021P Statistics, 031078P Matrix algebra, 521330A Telecommunication engineering, 521348S Statistical signal processing, 521324S Communications signal processing I. The recommended prerequisite is the completition of 521323S Wireless communications I.
Recommended optional programme components:
-
Recommended or required reading:
Parts from books:
1. Prandoni, Paolo & Vetterli, Martin, "Signal Processing for Communications", CRC Press 2008.
2. P. P. Vaidyanathan, S.-M. Phoong & Y.-P. Lin, Signal Processing and Optimization for Transceiver Systems, Cambridge University Press, 2010.
3. Meyr, Heinrich, Moeneclaey, Marc & Fechtel, Stefan A., Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998
Other literature, lecture notes and material.
Assessment methods and criteria:
Continuous evaluation by solving homework problems and completing the simulation projects, and a final exam.
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 (0) stands for a fail.

Person responsible:
Markku Juntti
Working life cooperation:

The project focuses on timely design problems in wireless industry. Industrial visiting lectures are organized.
Other information:
-

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ylianttila

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr
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 explain the mobile network evolution through previous and existing generations of mobile networks (1G, 2G, 3G, and 4G) towards 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, emerging technologies such as Cloud Radio Access Networks (CRAN), and core network functionalities and entities such as operator network control entities.
4. The student knows the basic properties of routing protocols in fixed, wireless and ad hoc networks.
5. Students will achieve skills to describe the main principles of network programmability, mobility control, and network security.
6. The course also gives the student the ability to explain the essential features of core network elements.
7. The student is able to simulate different types of networks in simulation environments.

Contents:
Communications architecture and protocols, adaptive network and transport layers, mobility management, cellular /multihop cellular networks, network security, network management and ad hoc and sensor networks. Introduction to cloud computing, edge computing, and Mobile Edge Computing, and the concepts of cognitive networks, Software Defined Networks, and Network Function Virtualization. The goal is to present the fundamentals of the new communication architectures, trends and technologies accepted by academia and industry. 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:
Mainly from: S. Glisic & B. Lorenzo: Wireless Networks: 4G Technologies (2nd ed.), 2009; Partly from S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technologies (2nd ed.), 2007; Partly from the book "Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture" M Liyanage, A Gurtov, M Ylianttila – 2015.
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:

Mika Ylianttila
Working life cooperation:
No
Other information:
-

521377S: Communications Networks II, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ylianttila

Opintokohteen kielet: English

ECTS Credits:
7 ECTS cr
Language of instruction:
English
Timing:
Spring, periods 3-4
Learning outcomes:
1. Upon completing the required coursework, the student is able to understand programmable networking, their benefits, and the openness of networks for innovations through programmable networks. 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 future trends in communication networks.
2. The student knows the network function virtualization, the benefits of virtualization for operator networks and how MEC benefits from virtualization. Students will understand the importance of MEC in future networks, design and develop MEC use-cases, and leverage from OpenFlow models in communication networks.
3. The student understands the dynamics of simple programmable networks, the importance of queuing systems in the current model of programmable networks such as OpenFlow-based SDNs. The student is also able to design a queuing system for SDN-based network control plane to provide services in a balanced way to the underlying data plane the control plane is responsible for.
4. Student achieves skill to design and implement simple SDNs and test for performance in both network simulators and real-life network environment. The descriptive material is used to illustrate the underlying concepts, and the practical material is used to generate a deeper interest of students in communication networks by giving them the chance to innovate themselves.

Contents:
Introduction to the concepts of queueing theory and queueing systems, programmable networks, software defined networking (SDN), the OpenFlow based SDN architecture, control protocol, SDN control plane and data plane (OpenFlow switches), SDN-based mobile networks i.e. Software Defined Mobile Networks (SDMNs) and 5th Generation (5G) mobile networks, the benefits of SDN in mobile networks, mobile network architecture changes due to SDN, introduction to network function virtualization (NFV), the benefits of NFV for mobile networks, the importance of MEC in 5G, and use case of MEC in 5G

The course will also give idea of how SDN and MEC can enable innovation in networking by providing the students with basics on to explore the networking field and perform experiments, write novel protocols and use their innovative capabilities. The course will also present interesting research areas in SDMN and MEC, such as network security, network load-balancing. Furthermore, the course will give hands-on experience on enabling programmable networks in a Lab environment or personal PCs/laptops using the SDN prototyping environment i. e. Mininet. For MEC, we are looking forward to utilize the 5G test network for experiments and exercise work.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, exercises 15 h and the compulsory design work either with a simulation program or testbed implementation (30 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 the book "Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture" M Liyanage, A Gurtov, M Ylianttila – 2015. Couple of research papers that initiated the drive towards programmable networks and SDN. Material for MEC will be provided before the course starts. Lab material will be prepared, and more will be given soon.
Assessment methods and criteria:
The course is passed with a final examination and the accepted emulation/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:
Mika Ylianttila
Working life cooperation:
No
Other information:
-

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao, Yingyue Xu, Xiaopeng Hong

Opintokohteen kielet: English

Leikkaavuudet:

  521140S   Computer Graphics   5.0 op

ECTS Credits:
7 ECTS credits
Language of instruction:
In English.
Timing:
Spring, period 4.
Learning outcomes:

Upon completion of the course, the student:
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. possesses 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 104h.
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: target=_blank>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, Xiaopeng Hong, Yingyue Xu
Working life cooperation:
No
Other information:
-

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning, Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Autumn semester, period I.
Learning outcomes:
Upon completion of this course, students are familiar with key areas of computer security and have practiced practical skills in these areas with assignments.
Contents:
The course covers the essential aspects of computer security and computer security research in theory and through practical examples.
Mode of delivery:
Lectures and practical assignments
Target group:
The course is intended for computer engineering masters students and additionally to any student interested in computer security that has the sufficient technical background to complete the course exercises.
Prerequisites and co-requisites:
As prior knowledge students should have a basic understanding of how computers and operating systems work and basic skills in programming. Examples of suitable courses to cover these fundamentals are Operating Systems 521453A, Introduction to Programming 521141P and Computer Engineering 521267A.
Recommended optional programme components:
The course is an independent entity.
Recommended or required reading:
-
Assessment methods and criteria:
Grading of the course is made based on the course practical assignments.

Grading:
Numerical scale 1-5, with 0 denoting failure to pass.
Person responsible:
Juha Röning, Teemu Tokola

Working life cooperation:
Visiting lectures from computer security –related companies arranged during the course whenever possible.
Other information:
-

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 is able to - describe the concept of algorithm - explain correctness and time complexity of an algorithm - describe the complexity classes of the sorting algorithms presented - prove algorithm correctness - estimate the running time of an algorithm related to the size of the input - describe the data structures presented - argue how to choose a data structure or an algorithm to an application - apply basic graph algorithms - construct a program that applies appropriate data structures to solve a given problem

Contents:
1. Algorithms and their analysis 2. Search and sort algorithms and their time complexity 3. Basic data structures 4. Hash tables 5. Binary search trees 6. Graphs and their algorithms 7. Algorithm design paradigms

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:
811120P Discrete structures or similar knowledge. Basic skills in programming

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.
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: Xiang Su

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 ECTS cr
Language of instruction:
In English.
Timing:
Spring, period 3.
Learning outcomes:
After completing the course, the student
1. is able to explain the key principles of distributed systems
2. apply the principles in evaluating major design paradigms used in implementing distributed systems
3. solve distributed systems related problems
4. design and implement a small distributed system
Contents:
Introduction, architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, case studies.
Mode of delivery:
Face-to-face.
Learning activities and teaching methods:
Lectures 22 h, exercises 16 h, project work 50 h, self-study 47 h.
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: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems – Principles and Paradigms, Third Edition, 2017.
Assessment methods and criteria:

The course uses continuous assessment so that there are 2 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.
Other information:
-

521073S: Electroceramics and Intelligent Materials, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jantunen, Heli Maarit

Opintokohteen kielet: Finnish

Leikkaavuudet:

521103S   Electroceramics and Intelligent Materials   4.0 op

ECTS Credits:
5 ECTS credits / 132.5 hours of work
Language of instruction:
Finnish and English
Timing:
The course is held in the period 1 biannually. The course is held next on autumn 2017.
Learning outcomes:
1. Student is able to estimate the properties and usability of functional ceramics in different electronics components applications and perform calculatory structural dimensioning for them.

2. Student is able to compare and choose applicable processing methods for the fabrication of functional structures.

3. Student is able to interpret new research results of the field and recognize their application areas.
Contents:
Microstructures and special features of ceramic materials. Dielectric, polarization and electrical conductivity properties and influence of lattice defects on them. Fabrication and processing of ceramics. Ceramic conductors and insulators, piezoelectric and ferroelectric ceramics, pyroelectric and electro-optic ceramics, magnetic ceramics.
Mode of delivery:
The course will be implemented as face to face teaching.
Learning activities and teaching methods:
The implementation methods of the course vary. The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 30 hours of guided teaching events and 102.5 hours of teaching without guidance either privately or in a group.
Target group:
Master's level students.
Prerequisites and co-requisites:
The recommended prerequisite is to familiarize with the course 521104P Introduction to Materials Physics
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes. Text book A.J. Moulson and J.M. Herbert: Electroceramics, Wiley, 2003.
Assessment methods and criteria:
Final exam.
Read more about [assessment criteria](#) at the University of Oulu webpage.
Grading:
The final exam utilizes a numerical grading scale 1-5.
Person responsible:
Heli Jantunen
Working life cooperation:
No
Other information:
THE COURSE LECTURES ARE IN ROOM TS2104

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, Rajatheva Rajatheva

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, LDPC and Polar 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, LDPC and Polar 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:
1st year WCE-RAN students and M.Sc. students (i.e., 4th year in EE degree programme)
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:
Timo Kokkonen (Coding) / Nandana Rajatheva (Information theory)
Working life cooperation:
No
Other information:
-

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 and iOS. In addition, the course covers memory and power management, core services of the platform, networking 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.
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:
-A shift in thinking about the web and emerging technologies -How the social web is transforming businesses, software design, our perception of people as well as skills required of us -How to accelerate innovation creation through web-based and other emerging technologies: Ecosystem thinking, strategies, core business values - 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 21h, independent work and exam (required reading) 80h.

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. It is a recommended to compelete the course at the 1st autumn semester.
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 24 h, exercises 18 h, essays 30 h, project 30 h, independent study 31 h
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 24 h, exercises 18 h, lecture questions 15 h, lab reports 15 h, project 3 0h
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:
  Umar Farooq
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 spring 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 20 h, exercises 18 h, homework 25 h, essays 34 h, examination 36 h.
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

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
Opettajat: Simo Hosio, Denzil Teixeira Ferreira
Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr
Language of instruction:
In English.
Timing:
Autumn, period 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:
Denzil Ferreira

Working life cooperation:
-
Other information:
-

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

Ei opintojaksokuvauksia.

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
Opettajat: Karin Väyrynen
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 20 h, seminars 14 h, individual work 100 h (for a review and analysis of selected course materials and making a presentation for the seminar).

Prerequisites and co-requisites:
Recommended 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.

Grading:
Numerical scale 1-5 or fail.

Person responsible:
Karin Väyrynen

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 BCM (Business Continuity Management) and SA (Systems Availability) strategy; • Develop organization specific information security policies in organizations; • Conduct Information Security (and risk) Analysis; • Conduct Information Security Audits; • Understand information security standards, regulations, and policies; • Improving employees' compliance with the information security procedures through training, campaigning and other means; • Certifications related to information security (such as ISO27001); • Public-key infrastructure (PKI), Digital signature, & Certification authority (CA)

Contents:
1. Business Continuity Management (BCM) and Systems Availability (SA)
2. Information Security Life Cycle
3. Conduct Information Security (and risk) Analysis;
4. Information security standards, regulations, and policies
5. Security Planning and policy development
6. Security Audits (Active Security Assessment)
7. Information Security Certification (ISO27001)
8. Public-key infrastructure (PKI), Digital signature, & Certification authority (CA)

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures (24 h), exercises (23 h), homework (30 h), Essay (20 h), examination (36 h)
Target group:
 MSc students
Prerequisites and co-requisites:
Understanding of information security issues, principles, techiniques, or similar knowledge, is helpful.

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
Opettajat: Dorina Rajanen
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 leading academic 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:
Lectures and Selection of scientific articles
Assessment methods and criteria:
Accepted assignments
Grading:
Numerical scale 1-5 or fail
Person responsible:
Dorina Rajanen
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. (2015) Interaction Design, chapters 1-2, 4-5, 7-13 (pages 1-64, 100-157, 226-473)

Assessment methods and criteria:
Accepted assignments.

Grading:
Numerical scale 1-5 or fail.

Person responsible:
Netta Iivari

Working life cooperation:
Invited lectures, assignments

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.

521242A: Introduction to Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Myllylä

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr

Language of instruction:
English

Timing:
Period 1

Learning outcomes:
After completing the course, the student has a basic knowledge of the biomedical engineering discipline and the applications of engineering science to biomedical problems.

Contents:
Biomedical engineering is a highly multidisciplinary field of study that ranges from theory to applications at the interface between such as engineering, biophotonics, medicine and biology. This course will introduce the subdisciplines within biomedical engineering, including systems physiology, bioinstrumentation, bioimaging and biomedical signal analysis. General issues of each of the subdisciplines will be illustrated together with selected examples and clinical applications. A number of lectures will be given by different lecturers working in health tech companies, University of Oulu and Oulu University Hospital, presenting the fields of the biomedical engineering. In addition, course offerings of biomedical engineering at the University of Oulu are introduced.

Mode of delivery:

Face-to-face teaching
Learning activities and teaching methods:
The course includes lectures, demonstrations and a group project.
Target group:
-
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
University exam
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:
Teemu Myllylä
Working life cooperation:
Guest lecturers
Other information:
-

521157A: Introduction to Social Network Analysis, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 120 hours of works
Language of instruction:
English
Timing:
Period 2. It is recommended to complete the course at the end of period 2
Learning outcomes:
Upon completing the course, the student is expected to i) understand social aspects of the web; ii) learn to
collect, clean and represent social media data; iii) quantify important properties of social media; iv) find
and analyze (online) communities; v) understand the diffusion process in social network; vi) familiarize with
simple modelling toolkits for social media analysis
Contents:
The course describes basics of social network analysis, allowing the students to understand structure
and evolution of the network, while enabling them to use appropriate tools and techniques to draw
inferences and discover hidden patterns from the network. The course is designed to accommodate
computer science, mathematical and social science student background, which helps in emergence of
multi-disciplinary research in the university
Mode of delivery:
Face- to-face teaching and laboratory sessions
Learning activities and teaching methods:
Lectures (24 h), tutorial/laboratory sessions (10h), and practical work. The course is passed with an approved
practical work and class test. The implementation is fully in English.
Target group:
Students with moderate logical reasoning skills
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:
R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014
Assessment methods and criteria:
One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Mourad Oussalah
Working life cooperation:
-
Other information:
We hope to attract students from humanties, economics and political in order to encourage multidisciplinary studies and enforce interesting student projects where each group contains at least one student from computer science and one from another faculty.

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 ECTS cr
Language of instruction:
English. Examination can be taken in English or Finnish.
Timing:
The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.
Learning outcomes:
After completing the course, student
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
Other information:
-

813620S-02: Managing Software Business, exam, 0 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Marianne Kinnula
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

813620S-01: Managing Software Business, exercise work, 0 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

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:
-
Other information:
-

521215S: Microelectronics project, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Juuti
Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 132,5 hours of work
Language of instruction:

Finnish or English

Timing:

The course is held in the spring semester, durin periods 3 and 4. It is recommended to complete the course at the 4th spring semester (1. year of MSc studies)

Learning outcomes:

After completing the course, the student

1. Is able to carry out all the stages needed to develop electronics components or materials beginning from design the material or component to realization and characterization.

2. Student is able to use independently professional and research methods, software, equipment and tools.

3. Student is able to do technical documentation of the work and keep laboratory work book during the work.

Contents:

Independent manufacturing, design, characterization or modelling work for electronics materials or components.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Project work for 132,5 hours

Target group:

Masters students on Electrical engineering

Prerequisites and co-requisites:

Bachelors degree in electrical engineering or equivalent.

Recommended optional programme components:

The course is an independent entity.

Recommended or required reading:

Given in the beginning of the course.

Assessment methods and criteria:

Project work is assessed by the achievement of the project targets and quality of the report.

Grading:

The course utilizes verbal grading scale "Laudatur/pass/fail".

Person responsible:

Jari Juuti

Working life cooperation:

Some of the project work can be made in cooperation with companies.

Other information:

-

521072S: Microsensors, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

Leikkaavuudet:

521228S   Microsensors   4.0 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

English. Guidance and exams also possible in Finnish.

Timing:

The course is held in the 2nd period. Teaching is available every second year. The next time course is arranged on autumn 2018.

Learning outcomes:

1. After completing the course, student can explain the basic concepts of sensor theory and technology, classification of sensors, properties of ideal and real sensors, pros and cons of integrated smart sensor systems, and the interface between sensor and pro

2. Student can explain the main fabrication methods, including thin-film technologies, micromachining methods,

wet and dry etching techniques, and both laser and ion beam milling methods and their applications in microsensor fabrication.

3. Students can explain the basic structures, physical operation principles, and fabrication processes of main sensor types for different forms of energy.

Contents:
The principles of microsensors, physical magnitudes which can be measured and manufacturing technologies for microsensors.

Mode of delivery:
Blended teaching (web-based and face-to-face teaching).

Learning activities and teaching methods:
The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 14 hours of guided teaching events and 118,5 hours of teaching with web-based guidance either privately or in a group.

Target group:
Master students in electrical engineering.

Prerequisites and co-requisites:
Recommended prerequisite is Bachelors degree in Electrical 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:
Will be informed at the beginning of the course.

Assessment methods and criteria:
This course utilizes continuous assessment. The method will be informed at the beginning of the course.

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

Person responsible:
Jari Hannu

Working life cooperation:
No

Other information:
-

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 laboratory work (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 laboratory 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 ECTS cr

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.
Other information:
-

521161S: Multi-Modal Data Fusion, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Abdenour Hadid

Opintokohteen kielet: English

ECTS Credits:
5 ECTS / 135 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn Semester either in Period I or Period II (preferably in Period I).
Learning outcomes:
Upon completion the student should be able to understand the problem of combining data (such as images and audios) of different natures and coming from different sources. The student should be able to implement basic solutions towards the accomplishment of a given task requiring the integration and combination of data.
Contents:
This course will provide a comprehensive introduction to the concepts and ideas of multi-sensor data fusion. The course will be illustrated with many real-life examples taken from a diverse range of applications. The course will be self-contained as much as possible (no previous knowledge of multisensor data fusion is assumed). Basic knowledge on related topics like image processing and signal processing will be a plus.
The course will discuss the following topics:

Introduction
Sensors
Architecture
Common Representational Format
Spatial Alignment
Temporal Alignment
Semantic Alignment
Radiometric Normalization
Bayesian Inference
Parameter Estimation
Robust Statistics
Sequential Bayesian Inference
Bayesian Decision Theory
Ensemble Learning
Sensor Management

Mode of delivery:
The course will be based on a combination of lectures (face-to-face teaching), home exercises and a final project.

Learning activities and teaching methods:
Face-to-face teaching: 20 h, home exercises: 80 h, final project: 35h

Target group:
Computer Science and Engineering, Ubiquitous Computing (M.Sc level, study years 4-5).

Prerequisites and co-requisites:
The course will be self-contained as much as possible (no previous knowledge is assumed). Basic knowledge on related topics like image processing and signal processing will be a plus.

Recommended optional programme components:
-

Recommended or required reading:
The course will be based on the following text book: H.B. Mitchell. Data Fusion: Concepts and Ideas. Springer (2012)

Assessment methods and criteria:
To pass the course, the student should retrun the exercices, complete a final programming project and pass an exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course will utilize a numercial grading scale 1-5.

Person responsible:
Abdenour Hadid (lecturer), Zinelabidine Boulkenafet (Assistant)

Working life cooperation:
The course includes one or two guest lectures from experts with practical experience.

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

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S   DSP Laboratory Work   5.0 op

ECTS Credits:
5 ECTS cr / 135 hours of work
Language of instruction:
English
Timing:
Spring semester, periods 3-4
Learning outcomes:

Upon completition of the course, the student:

1. has basic understanding of multiprocessor architectures and heterogeneous computing,

2. has basic understanding on how to design and implement algorithms for heterogeneous platforms,

3. understands the possible challenges and shortcomings related to the current heterogeneous systems,

4. is able to use the OpenCL framework for designing, implementing and optimizing signal processing algorithms for heterogeneous platforms

Contents:

Algorithm design, general purpose computing on graphics processing units, heterogeneous computing, OpenCL programming and optimization

Mode of delivery:

Opening lecture and independent exercise project, which is divided into smaller sub-entities. The exercise project is performed using both desktop and mobile platforms. After each sub-entity, a short seminar is held where the students discuss their results and possible ways to optimize the performance of their implementation.

Learning activities and teaching methods:

Opening lecture (2h), seminars (8h) and independent exercise project (125h).

Target group:

Computer Science and Engineering students and 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 interested in signal processing, processor architectures and embedded systems programming.

Prerequisites and co-requisites:

Matrix Algebra 031078P, Elementary programming 521141P, Computer Systems 521286A, Digital Filters 521337A

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:

-

Assessment methods and criteria:

Students complete the course exercises after the attending to the opening lecture in groups of two students. Assessment is based on the quality of the completed exercises and exercise reports. More detailed information on assessment will be announced at the beginning of the course.

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:

-

Other information:

-

521158S: Natural Language Processing and Text Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 120 hours of works

Language of instruction:

English

Timing:

Period 1. It is recommended to complete the course at the end of period 1

Learning outcomes:

Upon completing the course, the student is expected to i) comprehend, design and implement basic (online) text retrieval and query systems; ii) account for linguistic aspects and perform word sense disambiguation; iii) perform

basic (statistical) inferences using corpus; iv) manipulate (statistical) language modelling toolkits, online lexical databases and various natural language processing tools.

Contents:
Foundation of text retrieval systems, Lexical ontologies, word sense disambiguation, Text categorization, Corpus-based inferences and Natural Language Processing tools

Mode of delivery:
Face- to-face teaching and laboratory sessions

Learning activities and teaching methods:
Lectures (24 h), tutorial/laboratory sessions (10h), and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.

Target group:
students with (moderate to advanced) programming skills in Python

Prerequisites and co-requisites:
Programming skills (preferably) in Python

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:
Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze. Cambridge University Press, 2008. (Free from http://nlp.stanford.edu/IR-book/) Foundations of statistical natural language processing, by Manning, Christopher D., Schütze, Hinrich. Cambridge, Mass.: MIT Press, 2000

Assessment methods and criteria:
One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.

Grading:
1-5

Person responsible:
Mourad Oussalah

Working life cooperation:
-

Other information:
-

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 (in Finnish) 30h, exercises and assignments 28h, independent work 85 h

Target group:
Bachelor students.
Prerequisites and co-requisites:
Elementary course of 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.It is recommended to complete the course in the 1st autumn semester.
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 an 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.
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

521094S: Optoelectronic Measurements, 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:

521238S	Optoelectronic Measurements	4.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Period 4
Learning outcomes:
Objective: The goal of this course is to make the student familiar with optical measurement principles, sensors and device configurations used in industrial inspection tasks.
Learning outcomes: Upon completion of the course, the student is able to explain the operating principles of the most common optical measurement methods used in industrial production, name the factors affecting their performance, design certain sensor systems and evaluate the applicability of measurement methods for various measurement tasks. Additionally he is able to independently find information and discover the operating principles of various optical measurements and to condense the collected information into written and verbal report.
Contents:
Principles of optical measurements. Surface inspection, distance and profile measurements. Non-destructive testing methods. Optical measurements for process control. Material analyses with optical methods.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
The course includes 42 h lectures or calculation exercises and 100 h self-studies.
Target group:
4th year students
Prerequisites and co-requisites:
Completion of the course 766329A Wave Motion and Optics is recommended.
Recommended optional programme components:
Course replaces earlier by same name but different code and credit points.
Recommended or required reading:
Lecture handouts and discourse material prepared by students. Delivery through Optima.
Assessment methods and criteria:
Final exam and a passed discourse.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5.
Person responsible:

Igor Meglinski
Working life cooperation:
No.

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 mandatory for GS3D students, and recommended for students with a Finnish University of Applied Sciences (AMK) background.

Recommended optional programme components:
Especially recommended to take before Master's level project courses.
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

521159P: Principles of Digital Fabrication, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Georgi Georgiev

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521159P   Principles of Digital Fabrication (OPEN UNI)   5.0 op

ECTS Credits:
5 ECTS credits/ 135 hours of work
Language of instruction:
Finnish/English
Timing:
The course will be held in the spring semester, during period IV.

Learning outcomes:
In this course the students will learn the whole process of digital fabrication in FabLab. They will learn how to create an interactive 3D prototype, design mechanical parts for prototype, create basic electronics, implement a control logic for open hardware embedded board, and work in teams on project.
Contents:
The course teaches students to (1) design mechanical components with solid modeling tools, (2) build necessary electronics, and (3) implement software to a microcontroller, to create in FabLab a physical gadget that interacts with the world around it.
Mode of delivery:
Face-to-face teaching (Lectures)/ Individual work towards project
Learning activities and teaching methods:
Lectures 12h / Individual work 123h. There are sessions each week in FabLab where guidance is available.
Target group:
This course is included in the computer science bachelor degree program. It is also available for all degree programs in the university. The course is offered to high-school 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:
There is no recommended or required reading. The tutorials for tools and software (or links to such tutorials) will be provided in the course.
Assessment methods and criteria:
The course will be evaluated on the basis of the project delivered by the teams of students. Essential part of this reporting is the documentation of the project.
Grading:
The course is evaluated pass/fail only
Person responsible:
Georgi Georgiev
Working life cooperation:
-
Other information:
The course is also offered to high-school students with special study right and gives 5 ECTS credits that can be included in some bachelor's degrees at University of Oulu.

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 3.
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 ECTS cr
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

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, during period 3. It is recommended to complete the course at the 2nd spring semester.
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 (4 h) and the expert seminar (1-2 full days) is mandatory. Independently writing the seminar paper and preparing the seminar presentation (abt. 50 h).

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 for the course.

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Minna Pakanen
Working life cooperation:
Seminar topics are related to the Master's students projects all of which are authentic project works in unique R&D project assignments from real customers (univerisity, companies and organizations like schools, library etc.)

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, Aarno Pärssinen

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 2
Learning outcomes:
1. learns key components of radio transceivers used in wireless communications including LTE and 5G.
2. knows different kind of impedance matching methods and can design the impedance matching network using lumped components and microstrip lines.

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

3. will be able to 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. knows the operating principle of a single ended, balanced and double balanced mixer and the advantages and the disadvantages of these mixers.

6. will be able to design a power divider and a directional coupler.

7. knows the operating principle of an automatic gain control (AGC).

8. can classify power amplifiers and will be able 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:
-
Recommended or required reading:
Lecture notes. Parts from D.M. Pozar: Microwave Engineering, 4th edition, John Wiley & Sons, Inc., 2012. 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, Aarno Pärssinen.
Working life cooperation:
No
Other information:
-

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: Aarno Pärssinen, 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 ECTS cr
Language of instruction:
 English
Timing:
Spring, period 3
Learning outcomes:
1. understands radio system and RF design for modern wireless equipment like cellular phones.
2. recognizes the blocks of a transceiver and can explain the operating principle of a transceiver.

3. can classify different architectures used in a single and a multi-antenna transceiver and understand the basis for them.

4. will be able to 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.

5. knows nonlinear distortion and can design the automatic gain control in the system level.

6. will be able to 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.

7. understands the principles of frequency synthesis in a transceiver.
8. understands principles of key implementation technologies of radio transceivers and relation to electronics.
Contents:
Designing a transceiver at the system level, transceiver architectures, performance characteristics of transceivers, nonlinearities, factors which limit the performance of a transceiver, placement of the A/D-converter in a receiver, frequency synthesis, design and implementation examples.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 32 h and the compulsory design exercise with ADS simulation software (40 h).
Target group:
1st year M.Sc. and WCE students
Prerequisites and co-requisites:
Radio Engineering I
Recommended optional programme components:
-
Recommended or required reading:

Lecture notes. Other material will be defined later.
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, Aarno Pärssinen.
Working life cooperation:
No
Other information:
-

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 40 h, design exercises 15 h, student project 80 h.
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

Working life cooperation:
One or two industrial guest lecturers

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 processing sciences. The student is able to identify and describe the main research approaches and methods in information processing sciences, 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, lecture videos
Learning activities and teaching methods:
Lectures 40 h, exercises 30 h and individual work 65 h. 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 or required reading:
Lecture slides and specified literature
Assessment methods and criteria:
Accepted learning diary
Grading:
Pass or fail
Person responsible:
Arto Lanamäki

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 260 h per student. Working hours reported during the project. Attendance at the starting lecture (4 h) is mandatory. Praparing a project portfolio in the end (3 h).
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.

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Myllylä, Igor Meglinski

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English.

Timing:
Period 1.
Learning outcomes:
After the course the student is capable to explain the operating principles of different sensors and can select a right sensor for each measuring target. He/she is able to quantify the requirements that affect sensor selection as well as recognize and evaluate the uncertainty of a measurement. In addition the student is able to plan and design sensor signal conditioning circuits.
Contents:
Methods for measuring displacement, velocity, acceleration, torque, liquid level, pressure, flow, humidity, sound and temperature. Ultrasound, optical and nuclear measurement techniques and applications, material analyses such as pH measurement and gas concentration, pulp and paper measurements and smart sensors.
Mode of delivery:
Pure face-to-face teaching.
Learning activities and teaching methods:
Lectures 26h, exercises 12h and self-study 100h.
Target group:
4 year students.
Prerequisites and co-requisites:
No.
Recommended optional programme components:
No.
Recommended or required reading:
H. N. Norton: Handbook of Transducers, Prentice Hall P T R, 1989 or 2002; lecture and exercise notes.
Assessment methods and criteria:
The course is passed by a final exam and passed exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Igor Meglinski, Teemu Myllylä
Working life cooperation:
No.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Olli Silven
Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
Autumn, period 2
Learning outcomes:
1. Student can explain the challenges of signal processing hardware, software, and design methodologies.

2. Student is able to transform a digital filter designed with floating point arithmetic into a fixed point precision implementation, optimizing the word lengths to achieve the performance specifications.

3. Student is able to explain the most important algorithm implementation structures and can identify their usage contexts.

4. Student has rudimentary practical skills in modeling, designing, and judging finite word length signal processing algorithms with Matlab and Simulink software tools.
Contents:
Binary and floating point arithmetic, DSP programming models and co-design, digital signal processors, algorithms and implementations, including CORDIC, transforms (FFT and DCT), multi-rate signal processing, polyphase filters, filter banks, adaptive algorithms and applications. The software environments of the course are Matlab with the Fixed Point Toolbox extension and Simulink with the DSP Blockset extension.
Mode of delivery:
Lectures, independent work, group work.
Learning activities and teaching methods:
The course consists of lectures (30 h) and design exercises (6-12 h). the rest as independent work (33h).
Target group:
Computer Science and Engineering students: This is an advanced-level course intended for masters-level students, especially to those that are specializing into signal processing. + Other Students of the University of Oulu.
Prerequisites and co-requisites:
521337A Digital Filters, 521267A Computer Engineering or 521286A Computer Systems, 8 ECTS cr or 521287A Introduction to Computer Systems, 5 ECTS cr
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 and exercise materials. Material is in English.
Assessment methods and criteria:
Final exam and approved design exercises.
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:
Olli Silven
Working life cooperation:
None.
Other information:
-

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, requirement specification, analysis and design methods, quality management and project management, their importance and know how to use them for small-scale task solving. - 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. - 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:
Lectures (in Finnish) 32 h, exercises 24 h, study group working 40 h (or alternatively essay 60 h) and self-study 24 h

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:
A guest lecture by an industry representative, where he discusses his work and some aspect of software engineering in it. The intent is that the representative is a dept. alumnus.

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 understanding of quality based on individual techniques (e.g. reviews) so that after completing the course the student is able to: - Understand professional software development processes in agile, lean and traditional environments - 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
Working life cooperation:
Yes, visiting lecture from industry.

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
Opettajat: Oivo, Markku Tapani, Muhammad Ahmad
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 28 h, exercises/ assignments 78 h, weekly study 42 h
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.
Grading:
Numerical scale 1-5 or fail.

Person responsible:
Markku Oivo and Muhammed Ovais Ahmad

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

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

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 maintenance
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h, exercises/ assignments 18 h, weekly study and learning diary 4 2h, term project 45 h.
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:
Maëlick Claes

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Christian Wieser

Opintokohteen kielet: English

ECTS Credits:
7
Language of instruction:
Finnish/English, material available in English.
Timing:
Autumn, periods 1-2.
Learning outcomes:
After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.
Contents:
Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.
Mode of delivery:
Face-to-face and independent studies.
Learning activities and teaching methods:
Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:

521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.

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:
Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.
Assessment methods and criteria:
Project work and documentation.
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:
Christian Wieser
Working life cooperation:
-
Other information:
-

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: Umar Farooq

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

521348S: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: Finnish

Leikkaavuudet:

   521484A   Statistical Signal Processing   5.0 op

  ECTS Credits:
  5 ECTS
  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 of the master studies.
Learning outcomes:
Upon completion the student will
1. understand the key concepts in estimation theory such as the classical and Bayesian framework.
2. masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators.
3. can derive an estimator for a given criterion and basic data models.
4. can use the methodology of estimation theory to analyze the performance of estimators
5. can choose a proper estimator for a given purpose
6. understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), matched filtering, estimator-correlator
Contents:
Estimation theory, minimum variance unbiased estimator, Cramer-Rao lower bound, linear models, general minimum variance unbiased estimation, best linear unbiased estimators, maximum likelihood estimation, leas squares estimation, Bayesian estimation, linear Bayesian estimation, Kalman filters, statistical decision theory, receiver operating characteristics, hypothesis testing, matched filter, estimator-correlator.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Face-face-teaching (lectures and exercises) 50h, Matlab simulation exercises in groups 30 h, independent work 50 h.
Target group:

Electrical, communications, computer and system engineering as well as mathematics, physics and computer science students with knowledge of statistics in master or senior undergraduate level.
Prerequisites and co-requisites:
The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal analysis, 031021P Statistics, 031078P Matrix algebra
Recommended optional programme components:
-
Recommended or required reading:
Parts from books Kay, Steven M. "Fundamentals of statistical signal processing, volume I: estimation theory." (1993), Kay, Steven M. "Fundamentals of statistical signal processing: Detection theory, vol. 2." (1998), Van Trees, Harry L. Detection, estimation, and modulation theory. John Wiley & Sons, 2004.
Assessment methods and criteria:
Continuous evaluation by solving homework problems, successful completion of simulation projects, a final exam.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero (0) stands for a fail.
Person responsible:
Markku Juntti
Working life cooperation:
-
Other information:
-

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.

Learning outcomes:
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 these defects and to other challenges 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 20 h, exercises 18 h, homework 36 h, essay 26 h, examination 34 h
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

521156S: Towards Data Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Tamminen, Heli Koskimäki

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish or English
Timing:
Autumn, period I.
Learning outcomes:
Student can recognize the type of the data before further analysis and the required preprocessing. The concrete learning outcomes are:
1. Student can design and implement the data gathering
2. Student can combine data from different sources
3. Student can normalize and transfor data, and handle missing or incorrect data.
4. Student can ensure the generalizability of the results.
Contents:
Course provides good ability to start Master's Thesis or graduate studies. Topics at the course include data mining process in general level, data gathering and different data types, quality and reliability of the data, data preparation including the processing of missing values, outliers, and privacy issues, combination of signals from several sources, utilization of data bases in data mining process, and normalization and transformation of data and interdependence of the observations and their distributions. Additionally, topics concerning the generality of the results are covered, as well as, the principles of data division, for example, train-test-validate, cross-validation and leave-one-out methods.
Mode of delivery:
Lectures, independent work, group work
Learning activities and teaching methods:
16h lectures, 16h exercises, independent studying.
Target group:

The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.

Prerequisites and co-requisites:
031021P Probability and Mathematical Statistics or similar

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 hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. The material is mostly in English.

Assessment methods and criteria:
Participation in mandatory classes and final exam.
Read more about assessment criteria at the University of Oulu webpage.

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

Person responsible:
Tamminen Satu and Koskimäki Heli

Working life cooperation:
-

Other information:
-

521428S: UBI summer school, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

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 ECTS cr
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.

Other information:
-

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 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:
User interface elements, foundations of user interface libraries, user interface design principles, user interface
layout, the relationship between user interfaces and software architectures, event-driven programming, web
usability, web user interfaces, web programming.

Mode of delivery:
Blended teaching
Learning activities and teaching methods:

Exercise 24h, coursework 75h, independent study 35h.
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:
Provided reading material during the course. 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:
-
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 a final examination and the accepted design work report. In the final grade of the course, the weight for the examination is 0.6 and that for the design work report 0.4.
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:
Jari Iinatti
Working life cooperation:
No
Other information:
-

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.

521080S: X-ray Diffraction, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 132,5 hours of work
Language of instruction:
Finnish, English if needed
Timing:
Autumn semester period 2. Lectured every other year.
Learning outcomes:
1. explain the general principles of interaction between X-rays and solid matter and the physics underlying behind these phenomena

2. explain how the crystal structure, phase ratio, grain size and stress state in a solid material with X-ray diffraction (XRD) method can be experimentally determined
Contents:
Generation, detection and properties of x-rays. X-ray scattering and diffraction methods. Determination of crystal structure and phase composition. Analysis of grain size, texture and stresses. Electron and neutron diffraction.
Mode of delivery:
Lectures, exercises and laboratory work.
Learning activities and teaching methods:
Lectures and exercises altogether 32 h / laboratory work 18 h / self-access writing of work report 30 h / self-access learning 52,5 h.
Target group:
Primarily for students in electrical engineering.
Prerequisites and co-requisites:
Basic physics and mathematics.
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. For reference, parts from books B.E. Warren: X-ray diffraction, Addison-Wesley, 1969., B.D. Cullity and S.R. Stock: Elements of X-Ray Diffraction, 3rd Edition, 2001, Prentice Hall and some other books informed by lecturer.

Assessment methods and criteria:
Final grade of the course will be a weighted average of theoretical examination (2/3) and laboratory exercises (1/3). 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:
Juha Hagberg
Working life cooperation:
No
Other information:
The course is held next on autumn 2017.