Opasraportti

ITEE - Courses in English for exchange students (2019 - 2020)

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

This Course Catalogue lists courses taught in English that are available for exchange students at the Faculty of Information Technology and Electrical Engineering during academic year 2019-20.

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, this takes place 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 2019-20
Autumn term 2019
Period 1: Sept 2 - Oct 25, 2019
Period 2: Oct 28 – Dec 20, 2019

Spring term 2020
Period 3: Jan 7 – March 6, 2020
Period 4: March 9 – May 8, 2020

For arrival and orientation dates see www.oulu.fi/university/studentexchange/academic-calender

Any questions on courses at the Faculty of Information Technology and Electrical Engineering should be addressed to:
Virpi Parkkila
study.itee(at)oulu.fi

Further information on application process and services for incoming exchange students:
www.oulu.fi/university/studentexchange or international.office(at)oulu.fi

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

521016A: Advanced Practical Training, 3 op
812649S: Advanced Research Methods, 5 op
812650S: Advanced Topics in Digital Cultures and Design, 5 op
521026S: Advanced practical training, 5 op
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
523990A: Bachelor's Thesis / Electronics and Communications Engineering, 8 op
521283S: Big Data Processing and Applications, 5 op
521284S: Biomedical Engineering Project, 5 op
521093S: Biomedical Instrumentation, 5 op
521240S: Biophotonics and Biomedical Optics, 5 op
521273S: Biosignal Processing I, 5 op
521282S: Biosignal Processing II, 5 op
813316A: Business Process Modeling, 5 op
521340S: Communications Networks I, 5 op
521377S: Communications Networks II, 7 op
521140S: Computer Graphics, 5 op
521155S: Computer Security, 5 op
521042S: Creative Design, 5 op
811312A: Data Structures and Algorithms, 5 op
521153S: Deep Learning, 5 op
521467A: Digital Image Processing, 5 op
521290S: Distributed Systems, 5 op
521115S: EMC Design, 5 op
521038A: Electrical Engineering Project Studies, 1 - 5 op
521039A: Electrical Engineering Project Studies 2, 1 - 5 op
521109A: Electrical Measurement Principles, 5 op
521092A: Electronic Measurement Techniques, 5 op
521401S: Electronics Design II, 6 op
521435S: Electronics Design III, 6 op
815303A: Embedded Software Development Environments, 5 op
521423S: Embedded System Project, 5 op
813626S: Emerging Technologies and Issues, 5 op
811600S: Emerging Trends in Software Engineering, 5 op
521033A: Engineering Study, Electronics and Communications, 3 - 10 op
812351A: Enterprise Systems, 5 op
521017S: Expert Training, 1,5 - 5 op
521145A: Human-Computer Interaction, 5 op
812651S: ICT and Behaviour Change, 5 op
817604S: ICT and Organizational Change, 5 op
812349A: IT Infrastructure, 5 op
813623S: Information Security Policy and Management in Organisations, 5 op
813625S: Information Systems Theory, 5 op
812331A: Interaction Design, 5 op
521043S: Internet of Things, 5 op
521242A: Introduction to Biomedical Engineering, 5 op
521079S: Introduction to Nanotechnology, 5 op
031025A: Introduction to Optimization, 5 op
521157A: Introduction to Social Network Analysis, 5 op
521289S: Machine Learning, 5 op
521466S: Machine Vision, 5 op
521096S: Measurement Systems, 5 op
521075S: Microelectronics Packaging Technologies, 5 op
521074S: Microelectronics and Micromechanics, 5 op
521215S: Microelectronics project, 5 op
521072S: Microsensors, 5 op
521045S: Mobile Computing, 5 op
521318S: Modern Topics in Telecommunications and Radio Engineering, 3 - 7 op
521161S: Multi-Modal Data Fusion, 5 op

521288S: Multiprocessor Programming, 5 op
521158S: Natural Language Processing and Text Mining, 5 op
031051S: Numerical Matrix Analysis, 5 op
815657S: Open Source Software Development, 5 op
521108S: Optical Measurement Technology Exercise, 5 - 10 op
521241A: Optical systems, 5 op
521094S: Optoelectronic Sensors of Future, 5 op
521448S: Physical Design of Digital Integrated Circuits, 5 op
521025S: Power Electronics, 5 op
521015A: Practical Training, 3 op
521018A: Practical training, 5 op
521159P: Principles of Digital Fabrication, 5 op
521089S: Printed Electronics, 5 op
521175S: Printed electronics design and construction exercise, 5 op
521260S: Programmable Web Project, 5 op
811330A: Project management, 5 op
521225S: RF Components and Measurements, 5 op
521386S: Radio Channels, 5 op
521326S: Radio Engineering 1, 5 op
521327S: Radio Engineering II, 6 op
813621S: Research Methods, 5 op
817612S: Research and Development Project, 10 op
816630S: Scientific paper writing, 1 - 3 op
521350S: Seminar in Telecommunication and Radio Engineering, 1 op
521124S: Sensors and Measuring Techniques, 5 op
521279S: Signal Processing Systems, 5 op
521328A: Simulations and Tools for Telecommunications, 5 op
521028S: Small/Medium Power Energy Harvesting and Storage Devices, 5 op
521044A: Social Computing, 5 op
813630S: Software Business Development, 5 op
817602S: Software Development in Global Environment, 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 1, 5 op
521324S: Statistical Signal Processing II, 5 op
817603S: System Design Methods for Information Systems, 5 op
521322S: Telecommunication Engineering Project, 5 op
521402S: Telecommunications Circuit Design, 6 op
521098S: Testing Techniques of Electronics and Printed Electronics, 5 op
521006A: The Maturity Test for BachelorŽs Degree, 0 op
521156S: Towards Data Mining, 5 op
521154S: UBISS - International UBI Summer School, 5 op
521148S: Ubiquitous Computing Fundamentals, 5 op
812671S: User Experience (UX) and Usability Evaluation, 5 op
521395S: Wireless Communications I, 5 op
521317S: Wireless Communications II, 8 op
521097S: Wireless Measurements, 5 op
814601S: Work Experience in ICT responsibilities, 5 op
521080S: X-ray Diffraction, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

521016A: Advanced Practical Training, 3 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies
Laji: Practical training
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannu Sorvoja
Opintokohteen kielet: Finnish
Leikkaavuudet:

521026S Advanced practical training 5.0 op

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
1-4
Learning outcomes:
After advanced practical training the student can describe one possible future job, or another kind of position in an already familiar working environment. The student can identify problems in the working environment and solve them. The student can apply theoretical knowledge acquired in the studies to practical tasks. The student can identify roles of a diploma-engineer in the work place.
Contents:
Training in the research laboratories, development laboratories and process laboratories, among others, of the industry and institutions in the field of their study is recommended to the students. The basic requirement is that the practice must be performed in a job supervised by a person who has taken an engineering degree.
The technical goal of practical training is to give a general insight of the field in which the trainee will work after having taken the degree and to support and to promote theoretical studying. Likewise, the training has to acquaint the trainee with the social points of the industrial production and with industrial safety and has to give a sufficient picture of the technical details of the performing of different work. Furthermore, the training has to give a general idea of the technical and economic organizing, administration and management of a company and its production.
Mode of delivery:
Independent work.

Learning activities and teaching methods:
The students acquire their training job themselves.
Target group:
MSc students.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Students write a report on the compulsory MSc stage practical training lasting at least two months. This report is reviewed by degree program representatives. More detailed instructions for the report are available on the WWW pages of the degree program.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:

Hannu Sorvoja
Working life cooperation:
Yes.
Other information:
-

812649S: Advanced Research Methods, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Faculty of Information Technology and Electrical Engineering

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 spring semester, during periods 3 and 4. It is recommended to complete the course at the 2nd spring semester of the Master's studies.
Learning outcomes:
After completing the course, the student is able to:
* describe the background, philosophical assumptions and guiding principles of quantitative, qualitative and design science research, their role in information systems and software engineering research and the variety involved in them;
* evaluate the strengths and weaknesses of the research approaches and methods in relation to her or his research topic as well as select the suitable approach and methods;
* use more advanced data analysis methods;
* prepare a research plan for a research project, including formulating research problems, specifying research designs and choosing appropriate data collection and analysis methods for solving the problems;
* describe state-of-the-art ways of reporting the results;
* evaluate the methodological quality of her or his research and research publications more generally; as well as
* search more information on research methods from scientific literature as well as to adapt and refine methods for her or his research problems and interests.
Contents:
Introduction to qualitative, quantitative and design science research in information systems and software engineering, their scientific background,
philosophical assumptions and guiding principles, variety involved in them, relationships between the research approaches and associated frameworks, methods, processes and practices, advanced data analysis methods, reporting and evaluating research within the approaches.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 16 h, exercises 12 h, seminar 18 h, individual and group assignments 100 h
Target group:
MSc students, PhD students
Prerequisites and co-requisites:
The required prerequisite is that the learning outcomes of the following courses are accomplished: Research Methods. In addition, the student must have a preliminary thesis topic.
Recommended optional programme components:
Recommended to take before Master's thesis.
Recommended or required reading:
Selected scientific articles or research method books.
Assessment methods and criteria:
Assignments
Grading:
Pass or fail
Person responsible:

Netta Iivari

812650S: Advanced Topics in Digital Cultures and Design, 5 op

Voimassaolo: 01.08.2011 -
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 spring semester, during period 3. It is recommended to complete the course at the 1st spring semester of the Master's studies.

Learning outcomes:
After completing the course, the student is able to:
* describe state-of-the-art research results related to digital cultures and design;
* understand the strengths and limitations of various methods and frameworks used;
* show competence in critiquing research articles published in some of the leading academic journals and conference proceedings;
* show competence in critical thinking, and analysis and synthesis of academic sources;
* show competence in verbally presenting arguments in an academic fashion;
* write a literature review on a relevant research topic;
* acquire knowledge and critically read relevant research articles on digital culture and design related research topics; as well as
* describe ethical aspects involved with work related to digital cultures and design.

Contents:
The content of the course will change with time. The initial set of current themes include: User experience as an object of analysis and design, Participatory design, end-user-design and living labs, Information ecologies and infrastructures, Design for all, Iterative and incremental design and development, The impact of human-centred design, Current development contexts such as: Open source software development, Game development, Development of ICT for children, Ubiquitous computing

Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Lectures 20 h, assignments 107 h, seminars 6 h.

Target group:
MSc students
Prerequisites and co-requisites:
The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended optional programme components:

Recommended or required reading:
Selected scientific articles.
Assessment methods and criteria:
Assignments

Grading:
Numerical scale 1-5 or fail

Person responsible:
Mikko Rajanen

521026S: Advanced practical training, 5 op

Voimassaolo: 01.01.2017 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannu Sorvoja
Opintokohteen kielet: Finnish
Leikkaavuudet:

521016A Advanced Practical Training 3.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish or English
Timing:
This course can be taken in periods I-IV. The recommended time to take this course is during summer of the fourth year.
Learning outcomes:
Student can apply knowledge and skills learned during university studies to complete work assignments in his/her own field.
Student can evaluate and develop himself/herself as a learner and worker.
Student can plan and evaluate his/her time management and working methods.
Student is capable of working in systematic and goal-oriented manner in group as well as independently.
Student can name important factors that direct the actions of work community and the employer.
Student can name duties where he/she can work after graduating from university.

Contents:
Planning and preparation, carrying out work assignments in the students field of studies, documentation of own accomplishments, writing report and reflection.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Student independently finds a place to work to complete the course. To pass the course minimum of two months of full time work is required. Work can also be carried out in multiple periods. The course works includes a) Making a practice plan for the working period 4 h, b) Documentation of progress during working 20 h, c) Learning while working 108 h, d) Final raport and reflection 8 h.
Target group:
Master level students.
Prerequisites and co-requisites:
-
Recommended optional programme components:
The course does not require additional studies carried out at the same time. While carrying out the course working assigments are compared to already completed studies.
Recommended or required reading:
No required material.
Assessment methods and criteria:
Course is carried out by working minimum of two months in a work accepted by study program responsible person. Before starting the actual work the student needs to make a plan for the working period and return it to the responsible person. A weekly report is required from every working week. These reports have to turned in before the working period ends. After the working period is over the student writes a final report and returns it to the responsible person. Signed testimonial from the employer is also required with the final report.
Grading:
The course is graded as ”pass/fail”
Person responsible:
Hannu Sorvoja

Working life cooperation:
The course is carried out as practical training.
Other information:
This course is alternative to 521016A Advanced Practical Training, 3 ECTS.

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 credits
Language of instruction:
In English
Timing:
Fall, periods 1
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, and 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, fusion of multi-modalities; 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 with Python, 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:
The course unit utilizes a numerical grading scale 1-5, zero stands for fail.
Person responsible:
Guoying Zhao, Henglin Shi, Yante Li
Working life cooperation:
No

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:
After completing the course, student
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 (3rd or 4th). John Wiley & Sons, 2005 or 2016. Chapters 1-6 and 14.Recommended literature: C.A. Balanis: Antenna Theory, Analysis and Design (Third Edition). John Wiley & Sons, 2005 or 2016. 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:

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521281S: Application Specific Signal Processors, 5 op

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

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
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, exercises, 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 lab exercises and project works.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Mehdi Safarpour
Working life cooperation:
No.

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

Opettajat: Matti Pouke, Denzil Teixeira Ferreira

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

Opettajat: Aku Visuri, Matti Pouke

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 and Aku Visuri
Working life cooperation:
No

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

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:
28 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.berkeley.edu/home.html
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:
Pekka Sangi and Jaakko Suutala (lecturer)
Mohammad Tavakolian (assistant)
Working life cooperation:
-
Other information:
-

523990A: Bachelor's Thesis / Electronics and Communications Engineering, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8
Language of instruction:
Finnish, can be written in English if needed.
Timing:

Periods 1-6
Learning outcomes:
The student is able to set objectives for a given assignment. He/she is able to analyze the theme coherently, with emphasis on the key issues. The student is able to use sources of information critically. The student is able to present the planned and implemented solution clearly and to justify the choices he/she took, and to assess the functionality of the solution using relevant testing and evaluation methods. In addition, he/she is able to compare the results against the set objectives. The student is able to produce impeccable, clear and finalized text, in line with technical and scientific writing practices.
Contents:
The student chooses the theme for the thesis in cooperation with his/her supervisor.
Mode of delivery:
The thesis is written towards the end of the BSc studies, typically during the third year.
Learning activities and teaching methods:
Independent work.
Target group:
Students of Electrical Engineering.
Prerequisites and co-requisites:
Basic studies.
Recommended optional programme components:
BSc preparatory module, Technical communication.
Recommended or required reading:
-
Assessment methods and criteria:
BSc thesis and related maturity essay.
Grading:
Grading: pass/fail.
Person responsible:
Professors and researchers in the Departments of Electrocal Engineering and Communications Engineering.
Working life cooperation:
Yes.
Other information:
-

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 credits
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.
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 small project work, seminar presentations and short reports on a selected topic (group work). Answering two quizzes during the course is optional and provides additional points for final grade. To pass the course, it is enough to get 50 % of available points. No 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:
Ekaterina Gilman
Working life cooperation:
The course includes also invited lectures from industry.

521284S: Biomedical Engineering Project, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:
5 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

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Myllylä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S Biomedical Instrumentation 6.0 op

ECTS Credits:
5
Language of instruction:
English.
Timing:
Period 4.
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:
Teemu Myllylä
Working life cooperation:
No.

521240S: Biophotonics and Biomedical Optics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Aliaksandr Bykau, Alexey Popov

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English
Timing:
Period 2
Learning outcomes:
On successful completion of the course, students will be able to categorize the basic principles of modern optical and laser-based diagnostic modalities and instruments used in advanced biomedical research and clinical medicine. They will be able to demonstrate detailed understanding and evaluate the key biophotonics techniques underlying day-to-day clinical diagnostic and therapies and industrial applications in pharmacy, health care and cosmetic products. They can operate with the selected techniques of their choice.
Contents:
The course includes in-depth coverage of state-of-the-art optical imaging and spectroscopy systems for advanced biomedical research and clinical diagnosis, fundamental properties of light such as coherence, polarization, angular momentum, details of light interaction with tissue, and modern imaging system. Coherent Optical Tomography (OCT), Laser Doppler Flowmetry, Laser Speckle Imaging (LSI), Photo-Acoustic Tomography (PAT), Tissue polarimetry; Optical and Near-Infra-Red Spectroscopy (NIRS), Confocal and Fluorescence Microscopies; Tissue Optics: Light/matter interactions, index of refraction, reflection, optical clearing, absorption, Mie scattering, Rayleigh scattering, Monte Carlo modelling.
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:
A new course
Recommended or required reading:
V.V Tuchin: Handbook of Optical Biomedical Diagnostics, SPIE Press, 2002; V.V Tuchin: Handbook of Coherent Domain Optical Methods, Springer, 2nd edition, 2013. D.A Boas, C. Pitris, N. Ramanujam, Handbook of Biomedical Optics, CRC Press, 2011.
Assessment methods and criteria:
The course is passed by the final exam and with the assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5
Person responsible:
Aliaksandr Bykau and Alexey Popov
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. The laboratory work can alternatively be performed on an online system.
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.

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:
-

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
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 spring semester, during period 4. It is recommended to complete the course at the 3rd spring semester of the Bachelor's studies.
Learning outcomes:
After completing the course, the student are able to:
* model and design business processes;
* use a computer-based process modeling tool;
* distinguish between business process change on the enterprise level, business process level and the implementation level; as well as
* 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 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:
Dorina Rajanen

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. Students understand how the modern communications networks have evolved and how the architecture has changed through the recent paradigm shift towards software-centric communications.
2. Students are able to describe the basic system architecture elements of mobile networks, and understands the significance of emerging technologies such as Network Function Virtualization (NFV), Software Defined Networking (SDN), and core network functionalities such as Evolved Packet Core (EPC).

3. Students can describe the main principles of mobility management, network management and orchestration, and network security, and can apply and solve related engineering problems.
4. Students know the basic properties of routing algorithms, and can use graph theory to solve network routing problems.
5. Students are able to simulate different types of networks in simulation environments and solve basic network programming problems. Upon completing the required coursework, students understand the basic functionalities in TCP/IP protocol stack.

Contents:
Communications architecture in mobile, wireless local area and personal area networks. Introduction to cloud and edge computing, network function virtualization and software defined networking. Basic principles of mobility management, network security, network management and orchestration. The goal is to present the basics of the modern communications architectures, and their technical implementation.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 30 h and the compulsory design work (15 h). Design work can be done alternatively either as NS-2 simulation or TCP/IP programming exercise. Design work instructions are provided in digital learning environment (Optima / Moodle).
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:
Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture, M Liyanage, A Gurtov, M Ylianttila – 2015; A comprehensive Guide to 5G Security, M Liyanage, I Ahmad, A Abro, A Gurtov, M Ylianttila – 2018; In addition, selected supportive online reading materials from recent standards and publications are provided in digital learning environment (Optima / Moodle).
Assessment methods and criteria:
The course is passed with a final examination and the accepted design 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 students understand basic principles of programmable networking. The students understand the challenges in existing architectures and how Software Defined Networking (SDN) can solve those challenges.

2. Students understand the idea of SDN network control and data planes, and what it means in practice. The students learn how the network control-data plane separation is possible with SDN. The students have knowledge of how different control plane architectures can be developed or used for different networked environments.
3. Students understand the novel features in the 5G architecture, such as Multi-Access Edge Computing (MEC) and Network Function Virtualization (NFV) and the benefits of MEC and NFV for mobile networks. Students understand the importance of edge computing and virtualization techniques in achieving the low-latency and reliability requirements of 5G standard. Students know the planned use cases of multi-access edge computing in 5G systems and can describe some of the system architecture components.
4. Students understand the significance of network security, network load-balancing and network slicing in modern and emerging communications networks and how they need to be taken into consideration when using SDN and NFV.
5. Students understand 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.
6. Students understand the basic principles of queueing theory, such as Birth and Death Process, the M/M/1, M/M/c, M/M/c/K and queuing networks models. Students understand concept of Markov model and its application in communication network analysis. Students can apply queueing theory to model SDN or virtualized networks.
7. Students learn skills to design and implement simple SDNs and analyze performance in network emulation and simulation environments.

Contents:
Introduction to the concepts of Software Defined Networking (SDN): the OpenFlow based SDN architecture, SDN control plane and data plane (OpenFlow switches), Software Defined Monitoring, SDN and Network Function Virtualization (NFV) integration in cellular systems. Introduction to Multi-Access Edge computing (MEC), and the use cases of MEC in 5G, and MEC-IoT integration. Introduction to queueing theory and queueing systems and application of queueing theory to model software defined mobile network or virtualized networks (Jackson network). Furthermore, the course discusses the significance of network security, network load-balancing and network slicing in modern and emerging communications networks. Course provides hands-on experience on virtual networks using SDN with Mininet network emulator.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30 h, exercises 15 h and the compulsory design work with a simulation program (30 h). Description of Mininet exercises and Simulink simulation design work are provided in digital learning environment (Optima / Moodle).
Target group:
1 st year M.Sc. and WCE students.
Prerequisites and co-requisites:
Communications 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:
Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture" M Liyanage, A Gurtov, M Ylianttila – 2015.; A comprehensive Guide to 5G Security, M Liyanage, I Ahmad, A Abro, A Gurtov, M Ylianttila – 2018; In addition, selected supportive online reading materials from recent standards and publications are provided in digital learning environment (Optima / Moodle).
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:
-

521140S: Computer Graphics, 5 op

Voimassaolo: 01.08.2018 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Guoying Zhao
Opintokohteen kielet: English
Leikkaavuudet:

521493S Computer Graphics 7.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
In English
Timing:
Spring, period 4.
Learning outcomes:
Upon comletion 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 PyOpenGL

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 (PyOpenGL) for implementation.
Mode of delivery:
Face to face teaching.
Learning activities and teaching methods:
Lectures 22 h / Programming lessons 6 hours / Self-study and programming assignments 107h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Programming skills using Python; basic data structures; simple linear algebra.
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) Online PyOpenGL tutorials (e.g. http://pyopengl.sourceforge.net/context/tutorials/index.html)
Assessment methods and criteria:
The assessment of the course is based on the exam (100%) with mandatory returned programming assignments. 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, Nhat Vo, Yingyue Xu
Working life cooperation:
No

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 cr / 135 hours of work
Language of instruction:
English
Timing:
Autumn Semester, period 1.
Learning outcomes:
Upon completion of this course, students know and understand the basics and advanced concepts of the following key areas of the course and cybersecurity, know key terminology and can write about the topics clearly and with justifications:

- Finding software errors and vulnerabilities with fuzz-testing
- Vulnerabilities and testing of websites and communication protocols
- Principles of hardware level vulnerabilities and their testing and detection
- Principles of different software vulnerabilities, malware programs and shellcode and memory protection measures
- Cyber crime, cyber forensics and botnets
- Mobile and IoT security and manufacturing security, testing and protection measures

Additionally, students that have attained grades 2 or 3 have demonstrated technical capacity to perform practical work relevant to the course key areas. Students that have attained grades 4 or 5 have additionally demonstrated capacity for independent, ambitious work on the key areas working on advanced and challenging security research questions.
Contents:
The course covers the essential aspects of computer security and computer security research in theory and through practical examples.

Mode of delivery:
Contact teaching and independent work
Learning activities and teaching methods:
14 hours of lectures ja 28 hours of laboratory exercises, rest independent work alone or in groups.
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, operating systems and the Internet 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 grade 0-5, where 0 stands for a fail.
Person responsible:
Juha Röning, Teemu Tokola

Working life cooperation:
-

521042S: Creative Design, 5 op

Voimassaolo: 01.08.2018 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Georgi Georgiev
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/ 135 hours of work
Language of instruction:
English
Timing:
Period 1
Learning outcomes:
Upon completion of this course, students are able to:
- Understand and apply in practice basic creative problem-solving and design thinking approaches.
- Systematically ideate and implement creative solutions to a problem, both independently and within a team.
- Apply creative design thinking and low-resolution prototyping, with emphasis on empathy, iterative strategies, and interactions.
Contents:
The course teaches students of (1) Creative problem-solving; (2) Design thinking and low-resolution prototyping; (3) Teamwork problem-solving; (4) Systematic ideation approaches.
Mode of delivery:
Face-to-face teaching, teamwork/individual work, and independent studying.
Learning activities and teaching methods:
Lectures 21h / Individual work 124h. There are TA hours each week where guidance is available.
Target group:
Primary target group is first year master's level students of computer science and engineering with the applied computing orientation.
Prerequisites and co-requisites:
There are no prerequisites or co-requisites.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
20% attendance of 7 lecture-exercises; 40% exercise completion and performance; 40% individual project outcome.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for fail.
Person responsible:
Georgi Georgiev
Working life cooperation:
-

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 autumn semester of the Bachelor's studies.
Learning outcomes:
After completing the course the student is able to
- Select a data structure and an algorithm to an application
- Analyze correctness and time complexity of an algorithm implemented in a program
- Apply induction when proving algorithm correctness and define recursive algorithms
- Describe the most common sorting algorithms
- Describe trees, graphs and their basic algorithms, and apply them in a program
Contents:
* Basic data structures
* Analysis of algorithms
* Sorting algorithms
* Hash tables
* Binary search trees
* Graphs and their algorithms
* Algorithm design paradigms
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 48 h, exercises 21 h, exercise work 27 h, independent study 39 h.

Target group:
BSc students.
Prerequisites and co-requisites:
The required prerequisite is that the learning outcomes of the following courses are accomplished: Databases

Recommended optional programme components:

Recommended or required reading:
Cormen, Leiserson, Rivest, Stein: Introduction to algorithms, Second edition, MIT Press 2001 (or newer) and other material defined during the course.

Assessment methods and criteria:
1. Exam and assignment OR 2. Mid-term exams (2) and assignment
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Ari Vesanen

521153S: Deep Learning, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Li Liu

Opintokohteen kielet: English

ECTS Credits:
5ECTS credits/135 hours of work

Language of instruction:
English
Timing:
autumn, period 2
Learning outcomes:
Upon completion of the course, the students will be able to: learn the theories, models, algorithms, implementation and recent progress of deep learning; obtain empirical experience on training deep neural networks; know applications of deep learning to typical computer vision problems such as object detection and segmentation and know important directions deep learning research towards; learn to implement, train and debug their own neural networks in TPyTorch.

Contents:
Topics covered will include linear classifiers, multilayer neural networks, back propagation and stochastic gradient descent, convolutional neural networks, recurrent neural networks, and generative adversarial networks. Applications of deep learning to typical computer vision problems such as object detection and segmentation will also be included.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
20h lectures, 12h exercise sessions, independent studying 95 hours.
Target group:
B.Sc. and M.Sc. students of Computer Science and Engineering. The course fits also for Statistics and Math M. Sc. students interested in learning deep learning techniques.
Prerequisites and co-requisites:
The Bachelor level knowledge of Computer science and engineering study programmes. Good programming skills in a chosen language.
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, complementary reading list, and exercise material will be provided.
Assessment methods and criteria:
Attending lectures and exercise sessions, and returning the weekly exercises and final project.
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:
Li Liu
Working life cooperation:
The course may include the invited guest lectures from industry and other top universities.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A Digital Image Processing (OPEN UNI) 5.0 op

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.
Timing:
Spring, period 4.
Learning outcomes:
Upon completion of the course the student:

- understands the basic theory of digital image processing and knows its main applications,
- is able to apply spatial and frequency domain and wavelet based methods in image enhancement, restoration, compression and segmentation.

Contents:
1. Fundamentals of digital images, 2. Image enhancement in spatial and frequency domains, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression, 7. Morphological image processing and 8. Image segmentation.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 24 h, exercises 14 h and homework assignments 30 h. The rest is independent work.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Basic Python programming skills.
Recommended optional programme components:
In order to obtain deep understanding of the content, it is a benefit if the student has completed the mathematics courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.
Recommended or required reading:
Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Third Edition, Prentice-Hall, 2008, Chapters 1-10.
Lecture notes and exercise
Assessment methods and criteria:
The course is completed by passing the exam and homework assignments.
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:
Janne Heikkilä
Working life cooperation:
None.

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:
Xiang Su
Working life cooperation:
None.

521115S: EMC Design, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Sorvoja

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:
5
Language of instruction:
Finnish. English, if there are more than 2 foreign students.
Timing:
Period 4.
Learning outcomes:
1. is able to name common EMC standards

2. is able to use EMC testing equipment and methods

3. can explain the noise coupling mechanisms

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

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

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

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

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

Mode of delivery:
face-to-face teaching

Learning activities and teaching methods:
The course includes 30 h lectures and 100 h self-studies.

Target group:
Primarily students studying electrical engineering. In addition, other students studying in the University of Oulu can carry out the course.

Prerequisites and co-requisites:
The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronics Design I, Digital Techniques I, Electronic Measurement Techniques, Measuring and Testing Systems, RF Components and Measurements.

Recommended optional programme components:
The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:
Tim Williams: EMC for Product Designers, 5th edition, Oxford: Newnes, 2017. Lecture slides.

Assessment methods and criteria:
Final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
Grade is based on exam and grade is on numerical scale 1-5.

Person responsible:
Hannu Sorvoja

Working life cooperation:
Company visits if possible.

Other information:
-

521038A: Electrical Engineering Project Studies, 1 - 5 op

Voimassaolo: 01.01.2018 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521039A: Electrical Engineering Project Studies 2, 1 - 5 op

Voimassaolo: 01.01.2018 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521109A: Electrical Measurement Principles, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Saarela
Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 136h
Language of instruction:
Course is lectured in Finnish. Lecture notes are available in English. Laboratory exercises and the exam can be done in English.
Timing:
Periods 1-2.
Learning outcomes:
1. is able to measure basic measurements with a multimeter,

2. is able to measure basic measurements with an oscilloscope,

3. is able to operate signal and function generators.

4. is able to estimate the validity of their measurements.
Contents:
Units of measures, standards of measures, analysis of errors, most commonly used analog and digital measuring methods, equipment and electrical safety regulations.
Mode of delivery:
Pure face-to-face teaching.
Learning activities and teaching methods:
Lectures 20h, laboratory exercises 16 h and self-study 100h.
Target group:
Course is compulsory for electrical engineering, information engineering and wellness technology students.
Course is open for all students in University of Oulu.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
None.
Recommended or required reading:
Course material is in English and Finnish and can be found in Optima.
Assessment methods and criteria:
Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grade is based on exam and grade is on numerical scale 1-5.
Person responsible:
Juha Saarela
Working life cooperation:
None.
Other information:
-

521092A: Electronic Measurement Techniques, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521171A	Electronic Measurement Techniques	6.5 op
521171A-01	Electronic measurement techniques, exam	0.0 op
521171A-02	Electronic measurement techniques, exercise work	0.0 op
521430A	Electronic Measurement Techniques	6.0 op

ECTS Credits:
5 ECTS credits / 136 h
Language of instruction:
Course is lectured in Finnish. Lecture notes are available in English. Calculation exercises, laboratory exercises and the exam can be done in English.
Timing:
Period 4
Learning outcomes:
1. can name the electrical measurement technique terminology associated to measurement systems, sensors and buses to candidate level.

2. can plan and implement complicated measurements with oscilloscopes

3. can plan and implement basic measurements with spectrum analyzers

4. can plan and implement basic measurements with light detectors

5. can name common sources of noise and interference

6. name means to control noise and interference

7. can name methods to realize electrical quantities
Contents:
Broad view to electronic measurements.
Mode of delivery:
Pure face-to-face teaching.
Learning activities and teaching methods:
Lectures and calculation exercises 30h, laboratory exercises 16 h and self-study 90h
Target group:
Course is compulsory for electrical engineering students. Course is open for all students in University of Oulu.
Prerequisites and co-requisites:
Courses of Electrical Measurement Principles and Analogue Electronics I are recommended.
Recommended optional programme components:
The course replaces previous courses with same name, but different credits and code.
Recommended or required reading:
Course material is in English and Finnish and can be found in Optima.
Assessment methods and criteria:
Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grade is based on exam and grade is on numerical scale 1-5.
Person responsible:
Juha Saarela
Working life cooperation:
None.
Other information:
-

521401S: Electronics Design II, 6 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jan Nissinen, Ilkka Nissinen

Opintokohteen kielet: English

ECTS Credits:
6 ECTS
Language of instruction:
In Finnish (In English if needed).
Timing:
Autumn, period 1
Learning outcomes:
Student
1. should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies
2. should be able to analyze and design integrated electronic blocks based on these components, such as operational amplifiers, comparators and sampling circuits
3. should be able to estimate and minimize the effects of noise in electrical circuits
4. should be able to explain the terminology used with DA and AD conversion and converters
5. should be able to analyze and outline the main architectural principles and also to evaluate the characteristics of DA and AD converters
Contents:
Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Face-to-face teaching: Lectures 30h, exercises 20h. Self study: a small design work 30h. Learning without guidance either privately or in a group 80h.
Target group:
Students of Electrical engineering. Other students of the University of Oulu may also participate.
Prerequisites and co-requisites:
Principles of electronics design, Electronics design I
Recommended optional programme components:
-
Recommended or required reading:
Lecture handout,T. C. Carusone, D. A. Johns & K.W. Martin: Analog integrated circuit design , Wiley cop. 2012. 2nd ed., chapters 1, 3, 6, 9, 10, 15, 16 and 17, parts of 4 ja 11; P.E. Allen & D.R. Holberg: CMOS Analog Circuit Design, Oxford University Press 2002, chapters 1,3,4,5, 6, 8 and 10.
Assessment methods and criteria:
The course unit is passed by a final exam or by a two midterm exams and a passed design work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Ilkka Nissinen
Working life cooperation:
No
Other information:
-

521435S: Electronics Design III, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Nissinen

Opintokohteen kielet: Finnish

ECTS Credits:
6
Language of instruction:
In Finnish (English as a book examination)
Timing:
Autumn, period 2
Learning outcomes:
1. On completion of the study module students should be able to detail the advantages of differential signal processing in IC realizations and
2. to analyze and design differential amplifiers and other electronic blocks for implementation in an IC environment.
3. They should be able to explain how an SC (switched capacitor) technology functions and to apply such a technology to sampling and filtering.
4. They should also be able to describe the principles for realizing continuous filters in IC technologies, to explain the principles of the delta–sigma technology
5. and to apply it for realizing integrated DA and AD converters.
6. They should be able to account for the functioning, use and architecture of a phase-locked loop,
7. to explain the functioning of an MOS transistor in the area of weak inversion and to indicate how use can be made of this functional area in circuit design.
Contents:
Advanced operational amplifier topologies, especially differential ones, bandgap and PTAT bias circuits and references, problems related to the design of multi-stage amplifiers (output stages, LP/LV implementations), signal sampling and error sources related to it, SC-techniques (especially in filters), implementation principles of continuous time IC filters, DS techniques in general and particularly in AD/DA converters, operations with frequency/phase domain signals, design of IC layout.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 30h and Exercises 20 h and 4h layout demo. Self-study or in a group of two persons: laboratory exercise 36 h (CAD tools used in IC design and familiarization into the complete analogue IC design flow) and learning without guidance either privately or in a group 69 h.
Target group:
Electrical Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Electronics Design II, Filters, Introduction to Microfabrication Techniques (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:
Lecture notes
Course books: T. Carusone, D. Johns and K. Martin "Analog integrated circuit design” Wiley Sons, 2nd edition, chapters 2, 13, 14, 18 and 19 partly 7 and 12
or D. A. Johns K. Martin: Analog integrated circuit design, Wiley Sons 1997 1st edition chapter 6, chapter 8 partially, 9, 10, 14, 15
and also P. E. Allen D. R. Holberg: CMOS Analog Circuit Design, Oxford university press 2002, chapters 2, 7, and 9, proper parts of other chapters of the book.
Assessment methods and criteria:
Passed final exam or 2 midterm exams and exercise work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5.
Person responsible:
Ilkka Nissinen
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.
Language of instruction:
English.
Timing:
The course is held in the spring semester, during period 4. It is recommended to complete the course at the 1st spring semester.
Learning outcomes:
After completing the course, 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

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
Lecturing in Finnish, material available in English
Timing:
Spring, periods 3-4.
Learning outcomes:

1. After passing the course, the student is familiar with the design process of an embedded system, from specifying the application leading to the requirement specification for the device, and then to having produced a functional prototype of the defined system.
2. The student is more familiar with the roles of the client and the system developer during the requirement specification, and the role of the iterations as a part of the whole design process. From the specifications, the student is familiar with the process of choosing the suitable hardware components, circuit design and implementation. In the end, the student is also able to know the factors arising from the SW/HW partitioning process of the actual implementation, and the concept of SW/HW dualism. The student can then better utilize the basic development tools used for embedded system design and recognize their possible advantages and disadvantages.
3. The student is more familiar with the testing and problem solving methodology related to the prototype implementation of an embedded system, to have the prototype working correctly according to the specifications.

Contents:
The embedded system design process, from initial specification to implementation of a first functional prototype and demonstrating its functionality in practice. The application can be suggested by the student group, or chosen from the topics suggested by the course organizers. During the work, the students familiarize themselves with modern design tools and methodologies related to embedded system design (according to the microcontroller the student group has chosen to utilize in their work). Most commonly used platforms on the course include STM, Atmel and Microchip based platforms.

Mode of delivery:
Lectures, face-to-face tutoring and self-study.
Learning activities and teaching methods:
The course is run as a project work in groups of three with progress follow-up reporting meetings. Lectures 10 h, laboratory exercise in period 3-4 120 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
811122P Introduction to Programming
521412A Digital Techniques I
Also recommended; 521275A Embedded Software Project, 521432A Electronics Design 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:
-
Assessment methods and criteria:
Project work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Juha Röning
Working life cooperation:
None.

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, Oinas-Kukkonen, Harri Ilmari

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 1st spring semester of the Master's studies.
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-based and other information 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 24 h, exercises 8 h, reflective personal exercises 21 h, independent work and exam (required reading) 80 h.

Target group:
MSc students
Recommended optional programme components:

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

Assessment methods and criteria:
Exam.

Grading:
Numerical scale 1-5 or fail.
Person responsible:
Harri Oinas-Kukkonen

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 work.
Language of instruction:
English
Timing:
The course is held in the autumn semester, during periods 1 and 2. It is a recommended to compelete the course at the 1st autumn semester.
Learning outcomes:

After completing the course, the student understands the recent trends in software engineering. The student is able to perform computer supported trend mining to discover new trends of any given topic. The student is able to critically think about the trends.
Contents:
- Software engineering trends (varies yearly)
- Automated trend mining from online databases
- 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 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

521033A: Engineering Study, Electronics and Communications, 3 - 10 op

Voimassaolo: 01.08.2008 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Antti Mäntyniemi, Jari Hannu
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

812351A: Enterprise Systems, 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.
Language of instruction:
English
Timing:
E-exam
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:
E-exam
Target group:
MSc students
Prerequisites and co-requisites:
Understanding of the business process modeling helps.

Recommended optional programme components:

Assessment methods and criteria:

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

521017S: Expert Training, 1,5 - 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Practical training
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Matti Isohookana
Opintokohteen kielet: Finnish

ECTS Credits:
1-5
Language of instruction:
Finnish or English
Timing:
Periods 1-4
Learning outcomes:
After completing the Specialist training, the student has achieved extensive and varied experience in the electrical engineering subject areas.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Students acquire the work place themselves.
Target group:

MSc students of electrical engineering.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
The student writes a report/application to describe the tasks accomplished as well as how the the tasks and responsibilities have evolved. Also certified copies of work certificates are needed, stating the main tasks, time and possible part/full time work.
Grading:
Pass/fail
Person responsible:
Jari Iinatti
Working life cooperation:
Yes
Other information:
-

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

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 (12 h), exercises (16 h), and practical work (105 h). The course is passed with an approved practical work (several assignments). 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 several individual exercises throughout the semester: 1: Using questionnaires; 2: Fitts law; 3: Advanced, team-based design exercise and essay. Passing criteria: all 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:
Simo Hosio (Dr. Tech.)
Working life cooperation:
If relevant, guest lectures may be organized (optional).

812651S: ICT and Behaviour Change, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Piiastiina Tikka

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work

Language of instruction:
English

Timing:
The course is held in the spring semester, during period 4. It is recommended to complete the course at the 1st spring semester of the Master's studies.

Learning outcomes:
After completing the course, the student is able to:
* grasp the core theories of behaviour change and how they are/can be applied in goal-oriented behaviour change,
* understand ethical concerns inherent in behaviour change and persuasive systems, and
* understand the possible negative effects of ICT use not only as regards persuasive systems, but also with social media and other use.
Contents:
The focus of the course is role of ICT in supporting people with their endeavours to change their habits or lifestyles. The course introduces the main theories and models regarding behaviour change in order to provide students with a solid base for understanding how behaviour change can also work through ICT. The course also introduces some of the more problematic topics in ICT and behaviour, such as the dark side of ICT use and ethics of persuasion.
The course aims at providing existing knowledge and theoretical starting points to the development and use of persuasive systems. With such base, the student will be able to review the field from a broad perspective with the view to applying appropriate theories and approaches when analysing or developing persuasive systems.
Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 14 h, seminars 20 h, individual and group assignments 100 h; or in self-study mode opening lecture 2 h, assignments 132 h

Target group:
MSc students

Prerequisites and co-requisites:
The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems
Recommended optional programme components:

The MSc courses "Persuasive Systems Design" and "Emerging Technologies and Issues" would be helpful, but is not required.

Recommended or required reading:
Research articles to be announced more specifcally during the course implementation

Assessment methods and criteria:
Research articles to be announced more specifcally during the course implementation

Grading:
Numerical scale 1-5 or fail

Person responsible:
Harri Oinas-Kukkonen

Working life cooperation:
-

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 spring semester, during period 3. It is recommended to complete the course at the 2nd spring semester of the Master's studies.
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
* 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. The role of power, trust and control in the change process is discussed. The different aspects of change agents are presented and analysed. Students familiarize themselves with 7 organizational theories.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 28 h, individual work 105 h (for self-studying for weekly in-class exams - or optionally a traditional exam), and a review and analysis of selected course materials and writing a case analysis).
Target group:
MSc students
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.
Assessment methods and criteria:

Week exams and weekly case analysis (or traditional exam at end of the course), course assignment (literature review, case analysis).
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Karin Väyrynen

812349A: IT Infrastructure, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Petri Pulli

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work.
Language of instruction:
English
Timing:
The course is held in the spring semester, during period 4. It is recommended to complete the course at the 1st spring semester.
Learning outcomes:
After completing the course, students are able to judge, compare and apply data communications concepts and computing solutions to various situations encountered in industry; identify general concepts and techniques of data communications in different organizational environment; Explain core elements of IT infrastructure, principles underlying layered system architectures and the technology of the Internet; identify the most important server and storage architectures and the main mechanisms for providing high-capacity processing and storage capacity; Understand the principles of service virtualization, and concepts of IP networks and protocols; Explain structure of large-scale organizational IT infrastructure, and role of IT service management as organizational IT infrastructure solution; Understand opportunities for virtual computing service and configure IT infrastructure and security solution for small organization. The course aims to enable effective communication with technical, operational, managerial and service provider communities through improvement in technical knowledge and terminology. The course provides IT consultants with capabilities to make intelligent decisions regarding computing platform and service architectures by considering organizational flexibility.
Contents:
1. Introduction to IT Infrastructure 1.1. System Architecture & System Organizing Structure 1.2. Components of computer-based systems 1.3. Role of IT Infrastructure in a modern organization 2. Architecture, Technologies, Services and Standards in IT Infrastructure 2.1. Operating system 2.2. Networking 2.3. Data Centers 2.4. Securing IT Infrastructure 2.5. Grid computing 2.6. Cloud computing 3. Emerging Technologies and Trends 3.1. Internet of Things (IoT) 3.2. Distributed Ledger and Blockchain Technologies 3.3. Augmented Reality / Virtual Reality 3.4. Wearable Technologies.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 20 h, Student project guidance and seminar 12 h, student project work 71 h and examination 30 h.
Target group:
MSc students
Prerequisites and co-requisites:
Basic knowledge on computer, network and Internet architecture.
Recommended optional programme components:

Recommended or required reading:
Lecture notes, scientific papers and technoloy articles.
Assessment methods and criteria:
Accepted project work and examination.
Grading:
Numerical scale 1-5 or fail.
Person responsible:

Petri Pulli
Working life cooperation:
Two industrial guest lecturers.

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
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 2nd spring semester of the Master's studies.
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;
* improve employees' compliance with the information security procedures through training, campaigning and other means;
* describe certifications related to information security (such as ISO27001); as well as
* describe public-key infrastructure (PKI), Digital signature, & Certification authority (CA).
Contents:
* Business Continuity Management (BCM) and Systems Availability (SA)
* Information Security Life Cycle
* Conduct Information Security (and risk) Analysis;
* Information security standards, regulations, and policies
* Information security investment management
* Insider threats in information security management
* Security Audits (Active Security Assessment)
* Information Security Certification (ISO27001) & 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:
Nataliya Shevchuk

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: 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 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:
Netta Iivari

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 of the Master's studies.
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.
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.

521043S: Internet of Things, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ella Peltonen

Opintokohteen kielet: English

ECTS Credits:
5 ECTS / 135 hours of work
Language of instruction:
English
Timing:
Spring semester during period IV
Learning outcomes:
Upon completion of the course, the student will be able to:
1. explain application areas of IoT and requirements from such application areas for IoT systems.

2. will be able to explain the state-of-the-art IoT solutions, and understand the basic technologies behind them.
3. learn the principles of the novel IoT technologies and know important directions IoT research towards.

Contents:
The basic technologies and novel applications of the Internet of Things, including networking technologies as well as Web of Things. IoT sensor technologies and sensing solutions for smart buildings including smart home, city, office, or campus environments, and wearables and other personal devices such as fabrication. Exercises will include hands-on programming and sensing data analytics tasks.

Mode of delivery:
face-to-face teaching and exercises (both individual and group work)

Learning activities and teaching methods:
20h lectures, 12h exercise sessions, independent studying 95 hours.

Target group:
M.Sc. students of Computer Science and Engineering, M. Sc. students of Ubicomp International master program. The course fits also for Statistics and Math MSc student interested in applying their knowledge into sensing and IoT data.

Prerequisites and co-requisites:
The Bachelor level knowledge of Computer science and engineering study programmes. Good programming skills in a chosen language.

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, complementary reading list, and exercise material will be provided.

Assessment methods and criteria:
Attending lectures and exercise sessions, and returning the weekly exercises online.
Read more about assessment criteria at the University of Oulu webpage.

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

Person responsible:
Ella Peltonen

Working life cooperation:
The course may include the invited guest lectures from industry and other top EU universities.

Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi

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 multidisciplinary field of study that ranges from theory to applications at the interface between engineering, medicine and biology. This course will introduce the subdisciplines within biomedical engineering, including such as systems physiology, bioinstrumentation, bioimaging, biophotonics and biomedical signal analysis. General issues of the subdisciplines will be presented together with selected examples and

clinical applications. A number of lectures will be given by professionals working in health tech companies, University of Oulu and Oulu University Hospital, presenting different 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. Under some circumstances distance learning using online material is possible (please, ask the teacher).

Learning activities and teaching methods:
The course includes online material, lectures and a group project. Lectures 28h and laboratory exercises 4 h and self-study 100h

Target group:
-
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Participation in lectures or using the online material and writing a work report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5, pass, fail
Person responsible:
Teemu Myllylä
Working life cooperation:
Guest lecturers
Other information:
-

521079S: Introduction to Nanotechnology, 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: Finnish

ECTS Credits:
5
Language of instruction:
English
Timing:
4th period
Learning outcomes:
1. The students will acquire the basic principles of nanoscience and technology.

2. The course will also help understanding and rational thinking concerning strategies towards practical synthesis and safe utilization of nanomaterials.
Contents:
Nanotechnology definitions and the nanomaterials around us. Health concerns. Synthesis methods; morphological, structural, electrical, optical and spectroscopic characterization of nanomaterials. Properties on the nanoscale. Integration and device development with nanomaterials. Current and future applications.
Mode of delivery:
Lectures
Learning activities and teaching methods:

Though the course is primarily based on lectures, the communication channel is open in both directions enabling continuous comments, questions and feedback from the students. Critical explanations and think alouds are also applied to motivate thinking and active learning.

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecutre notes and parts of following books Springer Handbook of Nanotechnology, (Ed.) B. Bhushan. Springer Handbook of Nanomaterials, (Ed.) R. Vajtai. Nano-Age: How Nanotechnology Changes Our Future, M. Pagliaro. Applied Nanotechnology: The Conversion of Research Results to Products, J. Ramsden. Introduction to Nanotechnology, C.P. Poole, Jr.,F.J. Owens.

Assessment methods and criteria:

Examination.

Grading:

Numerical grading 1-5.

Person responsible:

Krisztian Kordas

Working life cooperation:

-

Other information:

-

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn, during period 1.

Learning outcomes:

After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.

Contents:

Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra

Recommended optional programme components:

-

Recommended or required reading:

P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

Assessment methods and criteria:

The course can be completed by a final exam.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail
Person responsible:
Keijo Ruotsalainen
Working life cooperation:
-
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 4. It is recommended to complete the course at the end of period 4
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 (12h), seminar (6 h) 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 16 h, Laboratory work 16 h, Exercise 16 h and Self-study the rest (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

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
Spring, period 3.
Learning outcomes:
Upon completion of the course the student
1. understands the fundamentals of image acquisition, representation and modeling
2. can utilize elementary methods of machine vision for image recognition problems
3. can use 2D transformations in model fitting and image registration
4. can explain the basics of 3D imaging and reconstruction

Contents:
1. Introduction, 2. Imaging and image representations, 3. Light and color, 4. Binary image analysis, 5. Texture, 6. Local features, 7. Recognition, 8. Motion, 9. 2D models and transformations, 10. Perceiving 3D from 2D images, 11. 3D transformations and reconstruction.
Mode of delivery:
Face-to-face teaching, homework assignments.
Learning activities and teaching methods:
Lectures (20 h), exercises (16 h) and programming assignments (30 h), self-studying (67 h).
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
521467A Digital Image Processing or an equivalent course, basic Python programming skills.
Recommended optional programme components:
521289S Machine Learning. This course provides complementary knowledge on machine learning methods needed in machine vision.
Recommended or required reading:
Lecture slides and exercise material. The following books are recommended for further information: 1) Shapiro, L. G. & Stockman, G.C.: Computer Vision, Prentice Hall, 2001. 2) Szeliski, R.: Computer Vision: Algorithms and Applications, Springer, 2011. 3) Forsyth, D.A. & Ponce, J.: Computer Vision: A Modern Approach, Prentice Hall, 2002.
Assessment methods and criteria:
The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5. Zero stands for a fail.
Person responsible:
Janne Heikkilä
Working life cooperation:
No.

521096S: Measurement Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521110S	Measuring and Testing Systems	6.0 op
521110S-01	Measuring and Testing Systems, exam	0.0 op
521110S-02	Measuring and Testing Systems, exercise work	0.0 op

ECTS Credits:
5 ECTS credits / 128h
Language of instruction:
Finnish. English, if there are more than 2 foreign students.
Timing:
Guided course is on period 2. The course can be completed independently in during spring semester. Ask responsible person for instructions.
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:
The course can be completed independently during spring semester. Ask instructions from responsible person.
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.

521075S: Microelectronics Packaging Technologies, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Sami Myllymäki

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
Finnish
Timing:
3rd period
Learning outcomes:
1. Upon completing the course student can explain how electronics packaging technology has since invention of transistors to current date, and can estimate how this development is going to continue in future.

2. The student can describe can explain what is meant by microjoining techniques and what are the pros and cons of these.

3. The student can tell what different kind of materials, and why, are used in IC packaging technology.

4. The student can explain what is meant with system level packaging and how the strong miniaturization on IC requires new system level packaging techniques to be developed.

5. He can explain why active and passive components are being, more and more, embedded to be a part of the circuit board.

6. In addition he can explain why and how optoelectronics will be migrate towards circuit board and components on it.
Contents:
Trends of packaging and component technologies. Area array packaging techniques. BGA-components. Micro joining and bonding. Multi-chip-modules: MCM-L, MCM-D and MCM-C modules. Fine line techniques. System level packaging (SOC, SOP). Multilayer substrates and integration of passive components. 3-D packaging. Optoelectronics modules. MEMS components. Electronics applications to nanotechnology.
Mode of delivery:
Face to face teaching
Learning activities and teaching methods:
Lecturing 24 h, practical work 12 h.
Target group:
Primarily major students of electrical engineering.
Prerequisites and co-requisites:
Recommended Introduction to Microfabrication Techniques.
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:
Rao R. Tummala(edit): Fundamentals of microsystems packaging, New York, McGraw-Hill, 2001. R.R. Tummala and M. Swaminathan, Introduction to System-on-Package (SOP), McGraw-Hill, 2008.
Assessment methods and criteria:
The course is completed with the final exam and finished course work.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Sami Myllymäki
Working life cooperation:
No
Other information:
-

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 2020.
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:
-

521045S: Mobile Computing, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Denzil Teixeira Ferreira

Opintokohteen kielet: English

Leikkaavuudet:

521046A Mobile Computing 5.0 op

521147S Mobile and Social Computing 5.0 op

ECTS Credits:
5ECTS / 138 hours of work
Language of instruction:
English
Timing:
Spring, periods 3 and 4
Learning outcomes:
This course focuses on one of the core demands of industry today: deep understanding of mobile interaction, mobile computing constrains and mobile development. After this class, students will possess the:
- ability to design and prototype a mobile user interface taking into account usability aspects of interaction on smaller displays
- ability to explain and leverage the fundamental concepts of context awareness using smartphone hardware, software and human sensors
- ability to understand and implement from scratch a mobile application that leverages both usability and context to create engaging mobile experiences

Contents:
The basic concepts of mobile interface design, implementation, mobile sensor acquisition, context awareness.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
5 ECTS cr = 138h of course work. Lectures (14h), in-class exercises (14h) and practical work (107h) (project, assignments).
Target group:
Computer Science and Engineering students and other students.
Prerequisites and co-requisites:
Recommended to have experience with object-oriented programming (Java, C#).
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 depends on whether the student attends or not the class. For attending students, the assessment is based on 5 laboratory exercises (which the student needs a passing grade). For non-attending students, 5 individual assignments are assigned instead of the laboratory exercises (which the student needs a passing grade). For non-attending students, there is an intermediate exam at the end of period 3 and another at the end of period 4. All students, attending or not, are peer-assessed in a team project during period 4.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:
Denzil Socrates Teixeira Ferreira
Working life cooperation:
-

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti, Matti Latva-aho

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
3-7
Language of instruction:
English

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

Grading:
The course unit utilizes a numerical grading scale 1-5.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Matti Latva-aho, Jari Iinatti
Working life cooperation:
-
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

Opintokohteen kielet: English

ECTS Credits:
5 ECTS / 135 hours of work
Language of instruction:
English
Timing:
Period 2
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), Mohammad Tavakolian (Assistant)
Working life cooperation:
The course includes one or two guest lectures from experts with practical experience.
Other information:
521161S Multi-modal Data Fusion, which is a compulsory study for the Master's students (Specialization Options: Artificial Intelligence, 2017, 2018, 2019 starting), will not be held this year (future info for course not be available). The course can be replaced by an optional course.

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 credits / 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 + 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:
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:
Mehdi Safarpour
Working life cooperation:
No
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 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) 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 (16h), seminar (6h) 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:
-

031051S: Numerical Matrix Analysis, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
Finnish or English.
The course can be completed in English by intermediate exams or by a final exam.
Timing:
Fall semester, period 1
Learning outcomes:

After completing the course the student knows the most efficient and numerically stable methods to solve the basic problems in linear algebra. He/she knows the basic matrix factorizations and their approximations. The student has the capability to solve very large and sparse problems with the iterative solutions methods and understands the significance of preconditioning.

Contents:
Theory of matrix decompositions, SVD-decomposition, LU-decomposition, QR-decomposition, Schur-decomposition, FFT, eigenvalue- and generalized eigenvalue problems, matrix functions, GMRES, MINRES, Preconditioning.

Mode of delivery:
Face-to-face teaching

Learning activities and teaching methods:
Lectures 28 h / Group work 14 h / Self-study 93 h.

Target group:
-

Prerequisites and co-requisites:
Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra and Numerical analysis

Recommended optional programme components:
-

Recommended or required reading:
Material posted on the web-page of the course.

Assessment methods and criteria:
Intermediate exams or 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 stands for a fail.

Person responsible:
Marko Huhtanen

Working life cooperation:
-

Other information:
-

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 2nd 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:
Independent personal and group work about 40 h, weekly meetings and seminars about 30 h, seminar article and presentation about 60 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. (2017): 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

521108S: Optical Measurement Technology Exercise, 5 - 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Anssi Mäkynen

Opintokohteen kielet: Finnish

ECTS Credits:
5 – 10 ECTS credits / 140 - 280 hours of work.
Language of instruction:
Finnish or English.
Timing:
Periods 1 - 4.
Learning outcomes:
The student
1. is able to justify the chosen implementation principle.
2. is able to assess the suitability of the implementation method for different measurement needs.
3. is able to produce solutions for small-scale optical measurement engineering design tasks.
The detailed objectives of the course will vary depending on the assignment.

Contents:
The content and scope of the course will be confirmed on a case-by-case basis.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Includes 140 to 280 hours of independently conducted work depending on the scope of exercise.
Target group:
All students of the University of Oulu can attend the course. Prime target is 4th year students in Electrical Engineering degree program.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-

Assessment methods and criteria:
The course is carried out by completing the assignment.
Grading:
Numerical grading scale 1-5.
Person responsible:
Anssi Mäkynen
Working life cooperation:
No.
Other information:
-

521241A: Optical systems, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Anssi Mäkynen

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS cr
Language of instruction:
Lectures are in Finnish. All written material is also in English. In guided labworks the assistant can English.
Timing:
Period 1.
Learning outcomes:
1. is capable of explaining the basic facts of geometrical and physical optics
2. is able of explaining the operating principles of simple optical components and instruments
3. is able to describe an optical system as a principal point representation
4. is able to trace the most important paraxial rays through the system
5. is able to explain the properties of a laser beam
6. is able to estimate the radiometric properties and resolving power of an ideal optical system
7. is capable of recognizing and explaining the difference between imaging, non-imaging and laseroptics as well as able to conclude from which of these viewpoints he/she should approach a given design task
8. is capable of designing and optimizing simple imaging and non-imaging lens systems as well as optics for laser beam modification using optical design software tools and 3D printing.
Contents:
Basics of geometrical and physical optics, optical components and instruments. Optical design software tools.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 24 exercises 12 h and self-study 100 h.
Target group:
Cource is mandatory for Electrical Engineering students. All students of the University of Oulu can attend the course.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
-
Recommended or required reading:
Material in Optima
Assessment methods and criteria:
Final exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1 - 5
Person responsible:

Anssi Mäkynen
Working life cooperation:
-
Other information:
-

521094S: Optoelectronic Sensors of Future, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Anssi Mäkynen
Opintokohteen kielet: Finnish
Leikkaavuudet:

521238S	Optoelectronic Measurements	4.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Period 3
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:
Anssi Mäkynen
Working life cooperation:
No.

521448S: Physical Design of Digital Integrated Circuits, 5 op

Voimassaolo: 01.08.2018 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Lahti
Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
The course is held on spring semesters, but can in addition be held on autumn semesters on demand.
Learning outcomes:
Upon completion of the course the student
- understands the technologies and the physical design and verification flow of digital integrated circuit
- knows how a digital integrated circuit is implemented using logic synthesis and layout design electronic design automation tools.
Contents:
1. Technologies and libraries
2. Design and verification flow overview
3. Layout-driven, power-optimized logic synthesis process
4. Standard cell layout design, including power-network and clock-tree synthesis
5. Post-layout verification
Mode of delivery:
Blended teaching that consists of lectures, laboratory exercises in computer classes and independent design exercises. Mode of delivery varies between course implementations based on the design tools used.
Learning activities and teaching methods:
1. Lectures 16 hours.
2. Design tool exercises in computer class or own computer 32 h
3. Independent work (design exercise, course report) 87 h
Target group:
Master and doctoral students in electrical and computer engineering
Prerequisites and co-requisites:
521301A Digital techniques 1, 521404A Digital techniques 2 or equivalent skills
Recommended optional programme components:
The course 521406S Digital techniques 3 that covers the logical design of digital integrated circuits is recommended for students specializing in digital circuits and systems design.
Recommended or required reading:
Recommended reading:
Khosrow Golshan: Physical design essentials: an ASIC design implementation perspective (Springer, 2007)
Other reading material will be delivered during the course.

Assessment methods and criteria:
Students must complete the laboratory exercises and write a report that describes the digital integrated circuit deign flow as it was implemented in the laboratory exercises. Grading is based on the report.
Read more about assessment criteria at the University of Oulu web page.
Grading:
The course utilizes a numerical grading scale 1 – 5. In the numerical scale zero stands for a fail.
Person responsible:
Jukka Lahti
Working life cooperation:
The course may include guest lecturers from electronics design automation software companies.
Other information:
-

521025S: Power Electronics, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Määttä
Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
Finnish.
Timing:
Period 3
Learning outcomes:
1. is able to discuss and write on the subject by using the terminology in the field of switching power supplies.

2. can analyze the operation of different switching power supplies in continuous and discontinuous conduction mode and in steady state operation.

3. is able to design various switching power supplies different dc-dc -applications.

4. can calculate loss mechanisms in design and estimate their effect on the efficiency of the switching converter. He or she is able to explain the basics of the ac-modeling of switching.

5. The course provides the basic knowledge on switched-mode power supplies so that the student recognizes the typical terminology and different topologies.
Contents:
Introduction to switched-mode converters, Steady-state analysis in continuous and discontinuous conduction modes, Transformer isolated converters. Power factor.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
The course includes 30 h lectures and 20 h of exercises.
Target group:
Primarily in electrical engineering students. Other University of Oulu students can complete the course
Prerequisites and co-requisites:
Courses Circuit Theory I-II, Electronics Design I-II or equivalent.
Recommended optional programme components:
The course is an independent entity and does not require other studies carried out at the same time.
Recommended or required reading:
R. W. Erickson, D. Maksimovic: Fundamentals of Power Electronics, 2nd ed. Kluwer Academic Publishers, 2004. Chapters 1-3, 5, 6, 7, 13 and chapter 16.
Lecture notes.
Assessment methods and criteria:
The course is passed by means of a final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 0 - 5. In the numerical scale 0 stands for a fail.
Person responsible:
Kari Määttä
Working life cooperation:
No
Other information:
-

521015A: Practical Training, 3 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
1-4
Learning outcomes:
After the practical training the student can describe one possible future job and its working environment from the point of view of his or her studies. The student can identify problems in the work and suggest improvements. The student can find connections between work and studies.The technical goal of the training is to give a student a general insight into the field on which he or she will work after graduation, as well as support and promote theoretical studying. Likewise the training has to acquaint the trainee with the social aspects of industrial production and with industrial safety.
Contents:
Learning about the requirements of working life, responsible contribution to the chosen work community, reporting.
Mode of delivery:
The students find their training jobs themselves. It is recommended to participate University tuition sessions on training, career planning and employment issues, when available.
Learning activities and teaching methods:
Independent work.
Target group:
BSc students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Students submit a training report of the min. 2 month training to the person responsible. More detailed instructions for the training report are available on the WWW pages of the degree program.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Hannu Sorvoja
Working life cooperation:
Yes
Other information:
Practical training is compulsory in the BSc. Tech (Electrical Engineering) degree for students who started in 2010 or earlier. For students starting 2011 or later, Practical Training is optional.

521018A: Practical training, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits
Language of instruction:

Finnish or English
Timing:
This course can be taken in periods I-IV. The recommended time to take this course is during summer of the second year.
Learning outcomes:
Student can apply knowledge and skills learned during university studies to complete work assignments in his/her own field.
Student can evaluate and develop himself/herself as a learner and worker.
Student can plan and evaluate his/her time management and working methods.
Student is capable of working in systematic and goal-oriented manner in group as well as independently.
Student can name important factors that direct the actions of work community and the employer.
Student can name duties where he/she can work after graduating from university.
Contents:
Planning and preparation, introduction to work assignments related to students field of study, carrying out work assignments, documentation of own accomplishments, writing report and reflection.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Student independently finds a place to work to complete the course. To pass the course, minimum of two months of full time work is required. Work can also be carried out in multiple periods. The required elements are a) Making a practice plan for the working period 4 h, b) Documentation of progress during working 20 h, c) Learning while working 108 h, d) Final raport and reflection 8 h
Target group:
Bachelor level students in electrical engineering
Prerequisites and co-requisites:
-
Recommended optional programme components:
The course does not require additional studies carried out at the same time. While carrying out the course working assigments are compared to already completed studies.
Recommended or required reading:
No required material.
Assessment methods and criteria:
Course is carried out by working minimum of two months in a work accepted by study program responsible person. Before starting the actual work the student needs to make a plan for the working period and return it to the responsible person. A weekly report is required from every working week. These reports have to turned in before the working period ends. After the working period is over the student writes a final report and returns it to the responsible person. Signed testimonial from the employer is also required with the final report.
Grading:
The course is graded as ”pass/fail”.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
Hannu Sorvoja
Working life cooperation:
The course is carried out as practical trainingThe course is carried out as practical training.
Other information:
The BSc in electrical engineering degree can include optional practical training. This course is alternative to 521012A Practical Training, 3 ECTS.

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 30h / Individual work 123h. There are sessions each week in FabLab where guidance is available (min total 16 h).
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:
pass/fail
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.
The exercises are in FabLab:
https://www.oulu.fi/fablab/node/32345

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.

521175S: Printed electronics design and construction exercise, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Fabritius

Opintokohteen kielet: Finnish

ECTS Credits:
5 – 10 ECTS credits / 140 - 280 hours of work
Language of instruction:
Finnish or English.
Timing:
Period 1 - 4.
Learning outcomes:
The student The student
1. is able to design the printable sensor structure
2. is able to implement the sensor design and
3. is able to analyse the suitability of fabricated sensors for planned measurement needs.

The detailed objectives of the course will vary depending on the assignment.

Contents:
The content and scope of the course will be confirmed on a case-by-case basis. Primarily 5 ECTS cr.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Includes 140 to 280 hours of independently conducted work depending on the scope of exercise.
Target group:
All students of the University of Oulu can attend the course. Prime target 4th year students in Electrical Engineering degree program.
Prerequisites and co-requisites:
Printed electronics course 521089S is recommended to be passed before starting.
Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
The course is carried out by completing the assignment.
Grading:
Numerical grading scale 1-5.
Person responsible:
Tapio Fabritius
Working life cooperation:
No.

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:
Upon completion of this course, students:

- understand what a Web API is and learn different Web API architectures.
- understand the concept of hypermedia and how it is used to build Web APIs.
- are able to design and implement a Web API following REST architectural style principles using existing web frameworks.
- are able to write unit and functional tests to inspect their APIS.
- are able to document their Web APIs using adequate software tools.
- are able to implement simple software applications that make use of the APIs.

Contents:
RESTful Web API, Hypermedia, RESTful asiakkaat.
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 (521141P) or equivalent Python programming
skills. 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”.

811330A: Project management, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS
Timing:

Learning outcomes:
Upon the successful completion of the course, the student is able to
* split a project into phases and tasks,
* resource and schedule the tasks,
* gather information on the progress of a project and based on it, make project related decisions,
* apply theory on project management in practice,
* recognise risks of software projects and prepare for them,
* work as a project manager, and
* communicate with stakeholders by using both written and spoken language.
Target group:
Master students
Assessment methods and criteria:
Practical work in a real-life SW project as a project manager 130h
Person responsible:
Kari Liukkunen

521225S: RF Components and Measurements, 5 op

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

ECTS Credits:
5 ECTS credits / 132,5 hours of work
Language of instruction:
Finnish. English, if there are at least 3 international students in class.
Timing:
The course is held in the 4th period. It is recommended to complete the course during Master level studies.
Learning outcomes:
1. After completing the course the student has knowledge of the behavior of passive components at RF frequencies, knows the fabrication methods of components and is also able to apply the knowledge to practical applications.

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

3. The student can apply the fundamentals of RF and microwave techniques to measurements, is able to make the measurements of RF components, has knowledge of the operating principles of RF region measurement equipment and is able to compare the usability of d

4. The student knows how to perform typical measurements of RF region magnitudes (power, frequency, impedance and noise).
Contents:
Fundamentals of RF and microwave techniques, components in microwave circuits, measurement instruments, measuring of power, frequency, impedance and noise, time-domain and active circuit measurements.
Mode of delivery:
Face-to-face teaching, independent design exercises and laboratory exercises.
Learning activities and teaching methods:
Lectures 24 h, design execises 20 h, laboatory exercises 20 h, independent work 68,5 h.
Target group:
Masters students on electrical engineering
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronic Components and Materials, Electronic Measurement Techniques, Basics of Radio Engineering.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Handout, Lecture notes. A. Lehto, A. Räisänen: Mikroaaltomittaustekniikka (in Finnish), I. Bahl: Luped Elements for RF and Microwave circuits, R. Ludvig, P.Bretchko: RF circuit Desing: Theory ans Applications, Prentice Hall 2000 and literature announced at the beginning of the lectures.
Assessment methods and criteria:
Final exam, design exercises and laboratory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Merja Teirikangas
Working life cooperation:
No.
Other information:
-

521386S: Radio Channels, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies

Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Pekka Kyösti, Markus Berg
Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 130 hours of work
Language of instruction:
English
Timing:
Autumn, period 2.
Learning outcomes:
After completing the course, student
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 25 h / Self-study 74 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:
Andreas Molisch. "Wireless Communications", 2012. Wireless Communications. Wiley-IEEE Press.
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 / Pekka Kyösti
Working life cooperation:
No
Other information:
-

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: Aarno Pärssinen, Risto Vuohtoniemi
Opintokohteen kielet: Finnish
Leikkaavuudet:

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

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, period 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.
A student can also explain factors, which are limiting the bandwidth of impedance matching networks. Smith chart (admittance/impedance chart).
3. will be able to design a low noise RF amplifier. The amplifier is designed that the noise figure is minimized or the gain is maximized. The impedance matching can also be made for the constant gain.
4. knows single sideband and double sideband noise in mixers. A student will be able to design balanced and double balanced mixer and knows the advantages and the disadvantages of these mixers.
5. will be able to design passive microwave components like a Wilkinson power divider, a directional coupler and hybrids.
6. can explain basic priciples of RF-oscillators. A student can design a cross-coupled oscillator and voltage controlled oscillator.
7. knows concept of noise, non-linearity and dynamic range as used in radio frequency communications.
8. can classify power amplifiers and will be able in the basic case design the matching network for a power amplifier.
Contents:
Noise, non-linearity, impedance matching using lumped components, microstrip matching networks, low noise amplifier (LNA) design, active and passive mixers design, Wilkinson power dividers, directional couplers, hybrids, automatic gain control (AGC), cross-coupled oscillator, voltage controlled oscillators, 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-RF students. 2nd year M.Sc. (Telecom.) and WCE-RAN 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. Parts from B. Razavi: RF Microelectronics, 2nd edition, 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: Risto Vuohtoniemi, Aarno Pärssinen

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 (54 h).
Target group:
1st year M.Sc. and WCE-RF students
Prerequisites and co-requisites:
Radio Engineering I
Recommended optional programme components:
-
Recommended or required reading:

Lecture notes. Parts from B. Razavi: Microelectronics, 2nd edition, 2012. Parts from A. Luzatto, M. Haridim: Wireless Transceiver Design, 2nd edition, 2017.
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:
-

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

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 spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.
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:
The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems
Recommended or required reading:
Lecture slides and specified literature.
Assessment methods and criteria:
Accepted learning diary, active participation
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 / 267 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 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:
Blended 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:
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. 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. Details about the 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:
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 1st and 2nd study year.

816630S: Scientific paper writing, 1 - 3 op

Voimassaolo: 01.08.2008 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Henrik Hedberg
Opintokohteen kielet: English

Person responsible:
Henrik Hedberg

521350S: Seminar in Telecommunication and Radio Engineering, 1 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Matti Isohookana
Opintokohteen kielet: Finnish
Leikkaavuudet:

521362S Electonics and Communications Engineering Seminar 0.0 op

ECTS Credits:
0-1
Language of instruction:
English
Timing:
Fall&Spring, periods 1-4
Learning outcomes:
1. Student can prepare a presentation of predetermined length of her/his thesis

2. Student has experience on presenting her/his topic

3. Student has experience on evaluating other students' presentations

4. Student has a general view of completed diploma thesis
Contents:
The content is determined by the diploma work topics and other current research topics.
Mode of delivery:
Seminar presentations

Learning activities and teaching methods:
Seminar sessions when necessary during the whole year.
Target group:
2nd year M.Sc. (after bachelor degree) and WCE students
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Instructions for preparing a diploma work in the degree program.
Assessment methods and criteria:
Course is mandatory for WCE students and ECE students with communications engineering option who have started their studies before study year 2015-2016. Participation at least in four seminars is required and one of these seminars is reserved for student's own presentation (30 minutes with questions and discussion).

Course is also mandatory for the WCE and ECE student who has started his studies after August 2015. Participation at least in one seminar, which is reserved for student's own presentation (30 minutes with questions and discussion), is required. However, if the student will participate in three other seminars he/she will get one credit unit and he/she can include that in the optional courses of his/her studies.
Presentations are given in English. Seminars are given during the whole year when necessary.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes grading passed.
Person responsible:
Matti Isohookana
Working life cooperation:
No
Other information:
Objective: The aim is to familiarize the students to the diploma work requirements. The students get practice in preparing and giving an oral presentation. At the same time they learn about current research and development projects going on in the university and in the industry.

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Alexey Popov, Aliaksandr Bykau

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English.

Timing:
Period 2.
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:
Aliaksandr Bykau ja Alexey Popov
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: Pekka Sangi

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:
Grading is based on the evaluation of the design exercises, which are done during the course, and exams, which are arranged during the lectures.
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:
Pekka Sangi
Working life cooperation:
None.

521328A: Simulations and Tools for Telecommunications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Johanna Vartiainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521369A	Simulations and Tools for Telecommunications	3.0 op
521369A-01	Simulations and Tools for Telecommunications, exam	0.0 op
521369A-02	Simulations and Tools for Telecomm. exercise	0.0 op

ECTS Credits:
5
Language of instruction:
Finnish
Timing:
Fall, period 2
Learning outcomes:
1. A student recognizes problems and limitations related to simulations.

2. She/he can select a suitable simulation method and knows how to validate the model.

3. Student knows how to generate signals, random numbers and noise.

4. She/he knows how to model fading channels.

5. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results.

6. She/he can explain principles of network level simulations.

7. A student knows basics of one or two fundamental simulation programs
Contents:
Simulation methods, modelling communication systems with simulations, confidence limits of simulation, noise generation and modelling of fading channel. A simple baseband simulation example. Basics of MATLAB and OPNET simulation software (these could vary depending on needs/availability).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 24 h (including program introductions), and the compulsory assignment with a simulation program (40 h).
Target group:

3rd year bachelor's degree students and M.Sc. students
Prerequisites and co-requisites:
Telecommunication Engineering
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Lecture notes. Selected parts (informed in the notes) of Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems, Modeling Methodology and Techniques, 2nd edition. Plenum Press, 2000. Additional reading: William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.
Assessment methods and criteria:
The course is passed with a final examination and the accepted simulation work report. The final grade is based on exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5.
Person responsible:
Johanna Vartiainen
Working life cooperation:
No
Other information:
-

521028S: Small/Medium Power Energy Harvesting and Storage Devices, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Yang Bai

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
English
Timing:
The course is held in the period 1 biannually. The next course will be held in autumn 2019.
Learning outcomes:
1. The students will understand the energy requirements and design principles of self-powered and autonomous electronic systems for various sensing applications.
2. The students will understand different energy harvesting and conversion techniques and thus be able to select appropriate methods according to available energy sources in defined application cases.
3. The students will understand the materials, fabrication processes and characterization methodologies of different energy harvesters and corresponding sensor systems.
4. The students will understand advanced energy storage options used for autonomous systems.
5. The students will be able to design and fabricate their own self-powered electronic devices for autonomous and ubiquitous sensing based on their own selections of application areas.
Contents:
Wireless devices and sensor networks; Solar, kinetic, thermal and electromagnetic wave energy harvesting; Power management circuitry and energy storage; Component and system fabrication and characterization; Hands on learning – private demonstrator manufacturing and testing.
Mode of delivery:
The course will be implemented as face-to-face teaching and experimental practice.
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:
In-depth investigation of novel energy harvesters and integrated self-powered sensor systems.
Recommended or required reading:
Required:
Lecture notes;
Textbook S. Beeby and N. White, Energy Harvesting for Autonomous Systems, Artech House, 2010
Recommended (optional):
Textbook S. Priya and D. J. Inman, Energy Harvesting Technologies, Springer, 2008
Textbook C. R. Bowen, V. Y. Topolov and H. A. Kim, Modern Piezoelectric Energy-Harvesting Materials, Springer, 2016
Textbook J. W. Matiko and S. Beeby, Applications of Energy Harvesting Technologies in Buildings.
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:
Bai Yang
Working life cooperation:
No.

521044A: Social Computing, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr / 135 hours of work
Language of instruction:
English.
Timing:
Autumn semseter, period I.
Learning outcomes:
By the end of the course, students:

- possess the skills for analysing (reverse-engineering) social applications that consist of individuals and computing devices in a variety of contexts.
- can design social software, especially software that deal with crowdsourcing and human-computation
- have advanced understanding of both the positive and negative real-world consequences/aspects of social aspects of computing online
- are able to explain human behaviour with social computing systems by using selected basic theories from such as sociology or psychology

Contents:
Basics of social computing, computer-mediated human communication, designing social software, analysing social computing projects, crowdsourcing
Mode of delivery:
The course consists of lectures, exercises and individual / group-based assignments.
Learning activities and teaching methods:
The course consists of lectures (12h), exercises (16h), assignments and self-study (102h).
Target group:
M.Sc. and B.Sc. students. The course recommended for anyone who wishes to strengthen their expertise on social aspects of computational systems as well as designing for humans.
Prerequisites and co-requisites:
No recommended or required preparations.
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 design exercises that demand some experience with computer programs (not programming per se).

Recommended or required reading:
Required reading will be delivered during the course.

Assessment methods and criteria:
The course completion relies on a number of completed solo-works (such as reflections and evaluation of specific online systems that are graded). The majority of the numerical assessment is project-based. Students have to complete several individual exercises throughout the semester: ideating an application, designing various versions of its prototype, evaluating those prototypes, documenting the final application designs. Passing criteria: all stages of the project-based work must be completed, each receiving more than 50% of the available points.

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

Person responsible:
Associate Professor Simo Hosio

Working life cooperation:
The course contains optional guest lectures.

Other information:
Uses Moodle as the learning environment: https://moodle.oulu.fi/course/view.php?id=2679

813630S: Software Business Development, 5 op

Voimassaolo: 01.08.2011 -

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 spring semester, during period 3. It is recommended to complete the course in the 1st spring semester.

Learning outcomes:
The course provides insights to software business development on a business, company and industry level. After completing the course, the student is able to plan how software business is being developed over the whole life cycle of the business and company; conduct market and business analyses; identify different sources of financing for business operation; evaluate different strategic business options; select a business model adequate for the present and future situation of the company; and write a business plan.

Contents:
The course takes three points of view: company start-up, established business, and software industry. The course introduces the concepts of business idea, business plan, software business models and strategies, and the software value network.

Mode of delivery:
Face-to-face teaching.

Learning activities and teaching methods:
Lectures 24 h, exercises 21 h, course assignments 63 h, (home) exam 25 h. The course assignments will be conducted as group work.

Target group:
MSc students

Prerequisites and co-requisites:
BSc or other equivalent degree and basic knowledge of software business.

Recommended optional programme components:
It is recommended, but not mandatory, to complete the following courses prior to enrolling for the course unit: 811174P Introduction to Software Business, 813316A Business Process Modelling and 813620S Software Business Management.

Recommended or required reading:
Lecture slides and literature announced during the course implementation.
Assessment methods and criteria:
This course unit utilizes continuous assessment. Lectures are for the most part voluntarily, but participation is recommended. The students will write course assignments which will be assessed. In addition, there will be a (home) exam at the end of the course which will be assessed. The assessment of the course unit is based on the learning outcomes of the course unit.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Karin Väyrynen
Working life cooperation:
Usually visiting lecture from industry.

817602S: Software Development in Global Environment, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppänen, Veikko Johannes

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Academic year 2019-2020
Learning outcomes:
After completing the course, the student can define the key success factors of Global Software Design (GSD) and the potential problems in coordination of projects where teams are separated by physical and / or temporal distance; can define and evaluate the collaborative technologies, which in the best way support distributed software development; can choose the methods and tools for distributed software development; can apply the practices of GSD in a student project and use the supporting tools throughout the project life cycle.
Contents:
Some of the topics covered are strategic issues in distributed development (off-shoring, near-shoring, outsourcing, OSS); cost-benefit-risk analysis; the triad of coordination, control and communication; team building (e.g. virtual teams); software process paradigms in the global environment (planned, agile); methods and tools for distributed software development; issues related to allocation of tasks; communication issues that arise due to distance and time zone differences; infrastructure support; geographical dispersion; lack of information communication; coordination complexity; cultural issues; technical issues related to information and artefact sharing; architectural design; and finally knowledge management issues. The lectures and seminars also review current research aspects of the GSD and related case studies from industry. The exercises demonstrate distributed software development as a virtual team with the support of appropriate methods and tools.
Mode of delivery:
Independent work
Learning activities and teaching methods:
An independent assignment agreed with the person responsible for the course, professor Veikko Seppänen (Veikko. Seppanen@oulu.fi).
Target group:
MSc students
Prerequisites and co-requisites:
Basic knowledge of academic writing technique is needed. Basic understanding of software business is an advantage.
Recommended or required reading:
To be announced during the course implementation.
Assessment methods and criteria:
By active participation or alternatively exam, based on the course study materials.
Grading:

Numerical scale 1-5 or fail
Person responsible:
Veikko Seppänen
Other information:
Course does not have any lectures or exercises in academic year 2019-2020. It is still possible to do course, please sent email to Professor Veikko Seppänen veikko.seppanen@oulu.fi

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.
Language of instruction:
English
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.
Mode of delivery:
Face-to-face teaching + Seminars.
Learning activities and teaching methods:
9 Lectures (30 hours), 7 Seminars (30 hours), Individual weekly assignments (43 hours), Group work (30 hours).
Target group:
MSc students
Prerequisites and co-requisites:
BSc or other equivalent degree and basic knowledge of software engineering.
Recommended or required reading:

- 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
- CMMI: Guidelines for Process Integration and Product Improvement. Mary Beth Chrissis, Mike Konrad, Sandy Shrum. Addison-Wesley, ISBN 032-115496-7, 2004.

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:
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

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 recommended to complete the course in the 1st spring semester of the Master's studies.
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:
The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering
Recommended or required reading:

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

Person responsible:
Markku Oivo

817614S: Software Factory Project, 10 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Muhammad Ahmad, Kari Liukkunen, Pasi Kuvaja

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 (4 x 2 h) and two workshops (2 x 8 h), 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). Unique project material provided by the customer of the project and / or material to be collected and studied by the project team.
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:
Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004. - R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005 -Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.
Assessment methods and criteria:
Skills will be reported by a project portfolio. Details about the 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:
Pasi Kuvaja
Working life cooperation:

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 December during 1st study year.

815312A: Software Production and Maintenance, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Mäntylä

Opintokohteen kielet: English

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

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 exercises. Final grade is composed of attendance, assignments and term project.
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Umar Farooq
Working life cooperation:
Usually visiting lecture from industry.

521348S: Statistical Signal Processing 1, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Janne Lehtomäki, 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 semester of the master studies.

Learning outcomes:

Upon completion the student

1. knows the key tools of linear algebra and optimization and can apply them in solving signal processing problems.
2. understands the key concepts in estimation theory such as the classical and Bayesian framework.
3. masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators.
4. can derive an estimator for a given criterion and basic data models.
5. can use the methodology of estimation theory to analyze the performance of estimators
6. understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), matched filtering, estimator-correlator

Contents:

Review of probability, linear algebra, random variables and stochastic processes; SVD (Singular value decomposition), QR decomposition, estimation theory, minimum variance unbiased estimator, Cramer-Rao lower bound, linear models, general minimum variance unbiased estimation, best linear unbiased estimators, maximum likelihood estimation, least squares estimation, Bayesian estimation, linear Bayesian estimation, Wiener filters, statistical decision theory, receiver operating characteristics, hypothesis testing, matched filter, estimator-correlator.

Mode of delivery:

Face-to-face teaching and e-learning tool usage

Learning activities and teaching methods:

Face-to-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 Probability and Mathematical Statistics, 031078P Matrix Algebra, 521330A Telecommunication Engineering.

Recommended optional programme components:

521323S Wireless communications I and 031051S Numerical Matrix Analysis are recommended to be taken in parallel.

Recommended or required reading:

Parts from books:

1. Steven M Kay, "Fundamentals of statistical signal processing, volume I: estimation theory." Prentice Hall 1993.
2. Steven M. Kay, "Fundamentals of statistical signal processing: Detection theory, vol. 2." Prentice Hall 1999.
3. Umberto Spagnolini, Statistical Signal Processing in Engineering 2017.
4. Paolo Prandoni & Martin Vetterli, Martin, “Signal Processing for Communications”, CRC Press 2008.
5. Other literature, lecture notes and material.

Assessment methods and criteria:

Completing the simulation project tasks, and a mid-term exam during the course. The mid-term exams can be retaken by a final exam later. In the final grade of the course, the weight for the examination is 0.7 and that of project report 0.3.

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 (0) stands for a fail.

Person responsible:

Janne Lehtomäki and Markku Juntti

Working life cooperation:

No

Other information:

-

521324S: Statistical 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:

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 typical estimation problems in statistical signal processing.
2. have the skills to apply estimation, detection and other statistical signal processing methods to solve practical problems in communications.
3. can use linear algebra, basics of optimization and statistical signal processing to derive algorithms with statistical models or driven by data.
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 parameter estimation and statistical tools, Monte Carlo methods for estimation, optimal Wiener and Kalman filtering, spectral analysis and estimation, adaptive filtering and algorithms, application examples: equalization in communications engineering, array processing and beamforming, delay estimation and positioning.

Mode of delivery:
Face-to-face teaching and e-learning tool usage

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 Probability and Mathematical Statistics, 031078P Matrix Algebra, 521330A Telecommunication Engineering, 521348S Statistical Signal Processing I. The recommended prerequisite is the completition of 521323S Wireless Communications I, 031025A Introduction to Optimization and 031051S Numerical Matrix Analysis.

Recommended optional programme components:
521317S Wireless communications II is recommended to be taken in parallel.

Recommended or required reading:
Parts from books:

1. P. Prandoni & M. Vetterli, “Signal Processing for Communications”, CRC Press 2008.
2. Umberto Spagnolini, Statistical Signal Processing in Engineering. Wiley 2017.
3. Todd K. Moon & Wynn C. Stirling, Mathematical Methods and Algorithms for Signal Processing. Prentice Hall 2000.
4. Simon Haykin, Adaptive Filter Theory, 3rd ed. or newer, Prentice Hall 1996.
5. Gene H. Golub & Charlers F. Van Loan, Matrix computations, 3rd ed. or newer, Johns Hopkins University Press 1996.
6. Other literature, lecture notes and material.

Assessment methods and criteria:

Completing the simulation project tasks, and a mid-term exam during the course. The mid-term exams can be retaken by a final exam later. In the final grade of the course, the weight for the examination is 0.6 and that of project 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 (0) stands for a fail.
Person responsible:
Markku Juntti and Janne Lehtomäki
Working life cooperation:
No
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:
E-exam
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 information systems design (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 particular, with socio-technical methods (e.g., SSM) 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. The student is also able to assess and give arguments which method is suitable for an ISD project in an organization.
Contents:
Information Systems Strategy, Information Systems Development Life Cycle (SDLC), Information systems success, Soft Systems Methodology (SSM), Socio-Technical Approach, Evolutionary development, Agile methodologies.
Target group:
MSc students
Prerequisites and co-requisites:
Bachelor studies recommended.
Recommended optional programme components:

Assessment methods and criteria:
E-exam
Grading:
Numerical scale 1-5 or fail.
Person responsible:
Pasi Karppinen

521322S: Telecommunication Engineering Project, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Berg, Saarnisaari, Harri Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521387S Telecommunication Engineering Project 4.0 op

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English/Finnish
Timing:
Fall or Spring, periods 1-4
Learning outcomes:
After completing the course student can
1. depending on the work subject, either solve, design, construct, measure, simulate, test or analyze limited telecommunication and radio system and sub-system problems.
2. apply the technical knowledge acquired from advanced sources into practical engineering tasks.
3. document technical and scientific results.
Contents:
Varies depending on the topic.
Mode of delivery:
Independent work.
If you would like to take the course, you can contact the course person responsible.
Learning activities and teaching methods:
The design exercise is done in a group of one or two students depending of work's difficulty. The design exercise can be simulation or implementation work. The work can be defined by the Department of Communications Engineering or by industry. In the later case a proposal must be submitted to the teacher before beginning of the work. Also, student must meet the schedule and deadlines given by a supervisor before starting the work. In preparing the work report document the writing instructions of DCE department's diploma thesis must be followed.
Target group:
1st or 2nd year M.Sc. and WCE students
Prerequisites and co-requisites:
Depending on the subject: advanced courses dealing with telecommunication systems, digital communications, digital signal processing or/and radio engineering.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Varies depending on the topic.
Assessment methods and criteria:
Written work report.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Markus Berg / Harri Saarnisaari
Working life cooperation:
No
Other information:
-

521402S: Telecommunications Circuit Design, 6 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

ECTS Credits:
6 ects / 42 contact hours + design excercise
Language of instruction:
English/Finnish
Timing:
Autumn, 1st period of the last year of studies
Learning outcomes:
After completing the course the student
- knows the most usual schematic structures and dimensioning principles of typical telecommunication circuit blocks
- can sketch the spectral effects of non-linear and time-varying circuit blocks
- can evaluate the performance of the available IC process node
Contents:
The course gives the background needed in the design of RFICs and other analog telecommunication circuit blocks.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
28 hours of lectures, 14 of excercises, and a relatively large design task.
Target group:
Last year MSc students with strong analog design background
Prerequisites and co-requisites:
Strong background in analog transistor level design is required.
Recommended optional programme components:
Needs electronics design 2-3 background
Recommended or required reading:
Handouts
Assessment methods and criteria:
Graded based on the final exam. The design excercise needs to be passed.
Grading:
Numerical scale 0-5. 0 is fail, 5 the best.
Person responsible:
Prof. Timo Rahkonen
Working life cooperation:
The topics are strongly related to the skills needed in the industry
Other information:
The course is the last advanced course in analog design, and requires the basic knowledge of transistor level analog design and IC design.

521098S: Testing Techniques of Electronics and 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

ECTS Credits:
5
Language of instruction:
Finnish. English, if there are more than 2 foreign students.
Timing:
Period 4.
Learning outcomes:

1. After completing the course the student is able to analyze different kinds of testing strategies, and is able to enhance the testability of electronics through the use of design for testability.
2. The student can also compare different testing techniques of analogue and digital electronics, which have been implemented using either embedded testing methods or external automatic testing equipment.
3. Additionally, the student is able to analyze tests made using an automatic test instrument, compare different test interfaces and data busses, and recognizes principles of design of a high-quality printed test circuit board.
4. The Student understands the specific features of printed electronics having an influence on electronics testing and reliability.

Contents:
Overview of different testing methods, constructions of testers, test fixtures, test signal generation and measurement, mixed-signal test buses, DC- and parametric measurements, dynamic tests, AD/DA converter tests, DSP-based tests, data analysis, embedded testing, design for testability, Boundary scan, test applications.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 26h/Exercises 14h and self-studying 100 h.
Target group:
Course is compulsory for the Electrical engineering students in the advanced module of Testing techniques and printed electronics.
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronics Design I, Electronic Measurement Techniques.
Recommended optional programme components:
This course compensates 521098S Testing Techniques of Electronics if the student hasn’t got credits from it.

Recommended or required reading:
M. Burns, G. W. Roberts: An Introduction to Mixed-Signal IC Test and Measurement, Lecture slides. Additional material will be announced at the beginning of the course.
Assessment methods and criteria:
Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Grade is based on exam and grade is on numerical scale 1-5.

Person responsible:
Tapio Fabritius
Working life cooperation:
No.

521006A: The Maturity Test for BachelorŽs Degree, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
0; The maturity test is integrated in the BSc Thesis credits (8 ECTS).
Language of instruction:
Finnish/Swedish/other
Timing:
1-4
Learning outcomes:

After the maturity test, the student has demonstrated that his/her language skills meet the requirements of the work life.
Contents:
The aim of the maturity test is to confirm the student's familiary of the thesis area as well as his/her command of the domestic language of his/her school education.
Mode of delivery:
The maturity test is written in a controlled event, on a topic provided by the thesis supervisor.
Learning activities and teaching methods:
Written essay, approximately 3 pages.
Target group:
-
Prerequisites and co-requisites:
The maturity test can be written after all other components of the BSc thesis are completed.
Recommended optional programme components:
-
Recommended or required reading:
BSc Thesis.
Assessment methods and criteria:
The maturity test is evaluated and approved by the thesis supervisor
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Thesis supervisor.
Working life cooperation:
-
Other information:
-

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

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:
16 h lectures, 16 h 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:
Weekly pre-lecture assignment + exercise submissions, and final exam. Half of the grade will be based on the submissions and half on the 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
Working life cooperation:
-
Other information:
-

521154S: UBISS - International UBI Summer School, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English.
Timing:
Summer semester (June).
Learning outcomes:
Summer school comprises of multiple parallel workshops that each have specific learning outcomes.
Contents:
Each workshop has specific contents.
Mode of delivery:
Face-to-face teaching in workshops.
Learning activities and teaching methods:
Lectures, a project completed as group work, self-study.
Target group:
MSc. and doctoral students.
Prerequisites and co-requisites:
Each workshop may have specific prerequisites.
Recommended optional programme components:
None.
Recommended or required reading:
Each workshop has a specific required reading package.

Assessment methods and criteria:
Final exam (50%), project (50%).
Grading:
The summer school uses a numerical grading scale 1-5.
Person responsible:
Professor Timo Ojala.
Working life cooperation:
None

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: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 133 hours of work
Language of instruction:
English
Timing:
Autumn, periods 1-2.
Learning outcomes:
Upon completing the course the student:
1. understands the history and current state of ubiquitous computing.
2. is able to design, implement, and evaluate a ubiquitous computing system.
3. is able to carry out a research project from initial research problem statement to prototype implementation, empirical evaluation in-the-wild, and reporting in form of a research paper.
Contents:
Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.
Mode of delivery:
Face-to-face
Learning activities and teaching methods:
Lectures 20 h / exercises 20 h / project work 50 h / self-study 43 h. Exercises and project work are completed as a 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:
None.
Recommended or required reading:
Required literature: John Krumm (editor) Ubiquitous Computing Fundamentals, Chapman & Hall, 2010, ISBN 978-1-4200-9360-5, 328 pages; selected scientific publications.
Assessment methods and criteria:
The course is passed with approved exercise reports and an approved project work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course uses numerical scale 1-5.
Person responsible:
Professor Timo Ojala
Working life cooperation:
None.

812671S: User Experience (UX) and Usability Evaluation, 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
Timing:
The course is held in the spring semester, during periods 3 and 4.

Learning outcomes:
Students can: Design and follow through a UX/usability evaluation process; Design test scenarios and tasks; Select participants; Plan and follow through the evaluation in laboratory or in the field; Analyse and report the findings from the evaluations.
Contents:
Basic terms and types of UX and usability testing, usability and UX tests process, usability and UX test tasks and scenarios, test subjects, following through a usability and UX tests, analysing usability and UX test material, reporting the findings from usability and UX 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:
The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems
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:
Pass or fail
Person responsible:
Mikko Rajanen
Working life cooperation:
Students learn how to collaborate with real customers
Other information:

521395S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2019 -
Opiskelumuoto: Advanced Studies
Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti, Timo Kokkonen

Opintokohteen kielet: English

Leikkaavuudet:

521395S-01 Wireless Communications I, Exam 0.0 op
521395S-02 Wireless Communications I, Exercise 0.0 op
521323S Wireless Communications 2 5.0 op
521323S-02 Wireless Communications I, Exercise 0.0 op
521320S Wireless Communications 2 8.0 op
521320S-01 Intermediate exam or final exam, Wireless Communications 2 0.0 op
521320S-02 Exercise work, Wireless Communications 1 0.0 op
521323S-01 Wireless Communications I, Exam 0.0 op

ECTS Credits:
5
Language of instruction:
English
Timing:
Fall, period 1
Learning outcomes:
Student
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 and understand suitable diversity methods for fading channel and related combining methods
4. can understand and explain coding methods for wireless channels
5. recognizes different wideband systems
6. understands the cellular system principle
Contents:
Radio channel models, digital modulation and detection methods, carrier and symbol synchronization, performance of digital modulation in AWGN and fading channel, diversity techniques, coding for wireless channel, multicarrier modulation, spread spectrum, cellular systems.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and exercise (total 40 hours) 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 ECE degree programme)
Prerequisites and co-requisites:
521330A Telecommunication Engineering
Recommended optional programme components:
-
Recommended or required reading:
Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005.
Assessment methods and criteria:
The course is passed with minor exams (only during lecture period) or with final exam; and the accepted design work report. In the final grade of the course, the weight for the examination(s) 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 / Timo Kokkonen
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: Jarkko Kaleva, 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 10 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.

814601S: Work Experience in ICT responsibilities, 5 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Advanced Studies
Laji: Practical training
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tonja Molin-Juustila
Opintokohteen kielet: Finnish

ECTS Credits:
3-5 ECTS credits / 2–4 months of full time work

Language of instruction:
Finnish or English.
Timing:
Timing of this course is free. Recommended to take as a summer course. The course is also suitable for the supported work placement studies. In that case, it is recommended to search for the work placement and apply for the support already at the turn of the year.
Learning outcomes:
After completing the course, the student:
- will master certain part of professional ICT work in enterprises or public organisations
- can analyse and reflect on the work experience with Information Processing Science studies
- can write an informative report on his/her work experience.

Contents:
Working from two to four months in professional ICT responsibilities that require university level studies.

Mode of delivery:
The student is responsible for making the needed arrangements for the internship: search for the work placement, negotiate job contract, prepare the support application when needed, follow the agreed labor agreement, work within the agreed responsibilities as well as study independently the needed professional skills and knowledge. In addition, the student documents his/her internship according to the course requirements.
Learning activities and teaching methods:
Search for the work placement, job contract negotiation, work within the professional ICT responsibilities and reflecting the work experience and learning by reporting; possibly also applying support, planning and weekly reporting the internship experience.
Target group:
MSc students
Prerequisites and co-requisites:
Information Processing Science or related studies, which enable their practical application in the context of professional ICT responsibilities.
Recommended or required reading:
Studies and selected course materials related to the internship in professional ICT responsibilities.
Assessment methods and criteria:
Working in professional ICT responsibilities from two to four months. Work experience can be realized in several periods, which all are processed as independent internship periods. The work experience is proved by delivering a signed letter of reference from the employer(s). The letter of reference contains details of the internship period and the student's primary duties and responsibilities. After the internship period, experiences are reported as soon as possible. An internship report consists of description of realized work and analysis of learning outcomes in relation to the studies taken in Information Processing Science. The studies are proved by delivering an up-to-date transcript of records. Proposals to develop Information Processing Science studies are included in the report as well. Based on the internship period, student will gain 3-5 ECTS credits (2 months = 3, 3 months = 4, 4 months = 5). In addition to above, student may also document his/her personal plan and learning goals for the internship period as well as report weekly implementation status of those plans and goals. In this case, 5 ECTS credits will be gained already from 2 months' internship period. For applying the financial support, this documentation is mandatory.

Grading:
Pass/fail
Person responsible:
Tonja Molin-Juustila
Working life cooperation:
Working on professional ICT responsibilities.

Other information:
Documenting guidelines and templates are available in the course materials. Before the internship starts, the support application must be recorded in the university systems with the copy of the internship agreement. The letter of reference from the employer(s) will be recorded together with the credits.

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, Jani Peräntie
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 Electronics and Communications 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 in autumn 2019.