Opasraportti

Department of electrical and information engineering (2010 - 2011)

• ***Degree programmes in the department of Electrical and Information Engineering***

The department has three degree programmes. Electrical Engineering and Information Engineering (EIE) programmes consist of (nominal) 3 year BSc and 2 year MSc level. A graduated BSc can directly apply to MSc studies. The third programme is an international 2 year MSc program Wireless Communication Engineering (WCE), that is taught entirely in English.

The BSc degree gives the student the basics of the chosen area, capability to scientific work, and prepares him to MSc studies. MSc studies contain more advanced courses, and prepare the student to work in expert and developer, as well as qualifies the student for PhD studies. Both degrees aim in to give train the student in team work and engineering communication, also in international duties. However, the degree programmes are highly structured and technically oriented, with relatively little "soft" content, like languages.

Generally, the size of the courses in the EIE degree programmes is typically 5 ects (i.e., ca. 12 course per year). A majority of the courses contain also an individually performed design exercise, and also intermediate exams in lecture courses are often used to keep the student constantly working. The exams of all courses of EIE can be taken in English, but the majority of courses are taught in Finnish. BSc level course will continue be held in Finnish, but more MSc courses will gradually be taught in English.

University level education is based on scientific research, and the department of Electrical and Information Engineering has several strong research groups, with ca. 200 researchers. This gives good possibilities to continue to PhD studies, too.

•Degree programme of Electrical Engineering

The students of Electrical Engineering MSc programme can choose their option within the field and specialization. Studies consist mainly of advanced studies within the specific area. There are four options in the Degree Programme of Electrical Engineering:

Telecommunication

Embedded systems

Electronics

Microsystem engineering and applied electronics

•Degree programme of Information Engineering

The students of Information Engineering MSc programme can choose their option within the field and specialization. Studies consist mainly of advanced studies within the specific area. There are five options to choose from:

Intelligent systems

Information networks and mobile applications

Embedded systems and software

Signal processing

Information networks

•MSc programme of Wireless Communication Engineering

WCE is a 2 year MSc programme taught entirely in English. The structure of the programme and the corresponding learning outcomes are listed on http://www.ee.oulu.fi/En/Admissions/Masters .

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

477607S: Advanced Control and Systems Engineering, 5 op
521016A: Advanced Practical Training, 3 op
805334A: Analysis of categorical data, 9 op
521380S: Antennas, 4 op
521358S: Application Specific Signal Processors, 4 op
080910A: Applied Diagnostic Radiology, 4 op
Compulsory
080910A-02: Applied Diagnostic Radiology, Home exam, 0 op
080910A-01: Applied Diagnostic Radiology, Seminar, 0 op
766320A: Applied Electromagnetism, 6 op
521495S: Artificial Intelligence, 5 op
555280P: Basic Course of Project Management, 2 op
555281A: Basic Course of Quality Management, 5 op
761101P: Basic Mechanics, 4 op
806109P: Basic Methods in Statistics I, 9 op
761102P: Basic Thermodynamics, 2 op
806110P: Basic methods in statistics II, 10 op
521384A: Basics in Radio Engineering, 5 op
811380A: Basics of Databases, 7 op
521315A: Basics of Information Theory, 4 op
750340A: Basics of bioinformatics, 3 op
521126S: Biomedical Measurements, 5 op
521273S: Biosignal Processing, 5 op
721704P: Business Logistics, 5 op
031010P: Calculus I, 5 op
031011P: Calculus II, 6 op
521302A: Circuit Theory 1, 5 op
521306A: Circuit Theory 2, 4 op
521343S: Coding Methods, 4 op
521374S: Communication Networks 2, 6,5 op
521360S: Communication Signal Processing II, 4 op
521340S: Communications Networks I, 5 op
031018P: Complex Analysis, 4 op
521332S: Computer Aided Circuit Design, 4 op
521267A: Computer Engineering, 4 op
521493S: Computer Graphics, 7 op
521261A: Computer Networks I, 5 op
521262S: Computer Networks II, 6 op
521498S: Computer Organization and Design, 5 op
721419P: Consumer Behavior, 5 op
470462A2: Control and Systems Engineering, 5 op

521485S: DSP-laboratory Work, 3,5 op
031017P: Differential Equations, 4 op
521337A: Digital Filters, 5 op
521467S: Digital Image Processing, 5 op
721650P: Digital Products, 5 op
521413A: Digital Techniques 1, 4 op
521404A: Digital Techniques 2, 5 op
521445S: Digital Techniques 3, 6 op
521478S: Digital Video Processing, 4 op
521266S: Distributed Systems, 6 op
721671A: E-commerce and Business Networks, 5 op
521115S: EMC Design, 5 op
721653P: Ec Systems, Implementation and Strategy, 5 op
721210P: Economics for Business, 5 op
721672S: Economics of Network Industries, 6 op
521109A: Electrical Measurement Principles, 5 op
761103P: Electricity and Magnetism, 4 op
521103S: Electroceramics and Intelligent Materials, 4 op
721426P: Electronic Commerce, 5 op
521208A: Electronic Components, 2,5 op
521430A: Electronic Measurement Techniques, 6 op
521436S: Electronic Research Exercise, 3,5 op
521405A: Electronic System Design, 5 op
521223S: Electronic and Optoelectronic Materials, 5 op
521432A: Electronics Design I, 5 op
521443S: Electronics Design II, 5 op
521435S: Electronics Design III, 6 op
521441S: Electronics Design and Construction Exercise, 6,5 op
521141P: Elementary Programming, 5 op
521275A: Embedded Software Project, 8 op
521423S: Embedded System Project, 5 op
521268A: Embedded Systems, 4,5 op
521142A: Embedded Systems Programming, 5 op
521331A: Filters, 4 op
477505S: Fuzzy-neuromethods in Process Automation, 4 op
721342S: Game Theory, 6 op
521263S: Genetic Algorithms, 5 op
521264S: Human-Computer Interaction Techniques, 5 op
721415A: Industrial Sales Management, 5 op
521032A: Information Engineering Study, 3 - 8 op
521499A: Information Networks Service Techniques, 5 op
521031A: Information Networks Study, 3 - 8 op
521496S: Information Networks System Design, 5 op
030005P: Information Skills, 1 op
031047S: Introduction Course to the Boundaryelement Method, 6,5 op
801346A: Introduction to Cryptography, 4 op
521104P: Introduction to Material Physics, 5 op
521218A: Introduction to Microelectronics and Micromechanics, 4 op
031025A: Introduction to Optimization, 5 op
080901A: Introduction to Technology in Clinical Medicine, 5 op
- *Compulsory*
  - 080901A-04: Introduction to Technology in Clinical Medicine, Exam, 0 op
  - 080901A-03: Introduction to Technology in Clinical Medicine, Written assignment, 0 op
  - 080901A-02: Introduction to Technology in Clinical Medicine, Lectures and demonstrations, 0 op
  - 080901A-01: Introduction to Technology in Clinical Medicine, Initial exam, 0 op

521319A: Introduction to Telecommunication Engineering, 2,5 op
521481P: Introduction to the Use of Workstation, 1 op
761121P: Laboratory Exercises in Physics 1, 3 op
521378A: Laboratory Exercises in Telecommunication Engineering, 4,5 op
521433A: Laboratory Exercises on Analogue Electronics, 3 op
812641S: Location and Context Based Services, 5 op
721673A: M-Commerce, 5 op
521466S: Machine Vision, 5 op
811328A: Managing a software product, 5 op

721421A: Marketing of a High Tech Firm, 5 op
031028S: Mathematical Signal Processing, 6 op
031023P: Mathematical Structures for Computer Science, 5 op
031019P: Matrix Algebra, 3,5 op
800653S: Matrix Theory, 10 op
521110S: Measuring and Testing Systems, 6 op
764369A: Medical Equipments, 3 op
521216S: Microelectronics Packaging Technology and Reliability, 7 op
521224S: Microelectronics and Micromechanics, 6 op
521203S: Micromodules, 5 op
521228S: Microsensors, 4 op
521113S: Mixed-signal Testing, 5 op
815349A: Mobile Internet Service Architecture, 7 op
811359A: Mobile Systems Programming, 6 op
521333A: Mobile Telecommunication Systems, 5 op
521318S: Modern Topics in Telecommunications and Radio Engineering, 3 - 7 op
521488S: Multimedia Systems, 6 op
721462S: Network Theory, 6 op
031022P: Numerical Analysis, 5 op
521453A: Operating Systems, 5 op
521238S: Optoelectronic Measurements, 4 op
521450S: Optoelectronics, 4 op
815301A: Parallel programming, 5 op
521497S: Pattern Recognition and Neural Networks, 5 op
812642S: Personalisation, profiling and segmentation for mobile, 5 op
521025S: Power Electronics, 5 op
521015A: Practical Training, 3 op
521431A: Principles of Electronics Design, 5 op
721409P: Principles of Marketing, 5 op
521205A: Principles of Semiconductor Devices, 4,5 op
031072S: Principles of the Boundary Element Method, Homework Exercise, 2 op
521217S: Printed Electronics, 4 op
031021P: Probability and Mathematical Statistics, 5 op
721412P: Product and Market Strategies, 5 op
521024A: Programmable Electronics, 5 op
521143A: Programming, 7,5 op
555282A: Project Management, 4 op
721533A: Project Management, 5 op
521225S: RF Components and Measurements, 5 op
521381S: Radio Communication Channels, 4,5 op
521335S: Radio Engineering 1, 6 op
521375S: Radio Engineering II, 5 op
031024A: Random Signals, 5 op
812340A: Real Time Software Design, 6 op
521260S: Representing Structured Information, 5 op
555348S: Research Project in Technology Management, 5 op
465075A: Research Techniques for Materials, 3,5 op
521489S: Research Work on Information Processing, 8 op
521201S: Research methods of Thin Films for Electronics, 3,5 op
901008P: Second Official Language (Swedish), 2 op
555347S: Seminar in Technology Management, 5 op
521350S: Seminar in Telecommunication and Radio Engineering, 1 op
521124S: Sensors and Measuring Techniques, 5 op
521486S: Signal Processing Systems, 4 op
521365S: Simulations and Tools for Telecommunications, 3,5 op
521457A: Software Engineering, 5 op
521479S: Software Project, 7 op
813323A: Software Quality and Quality Techniques, 3 op
813322A: Software Testing, 3 op
521410S: Special Course in Electronic Design, 4 - 7 op
521108S: Special Course in Optical Measurements, 5 - 10 op
802632S: Special course for teachers of mathematics, 10 op
802633S: Statistical Pattern Recognition, 10 op
521484S: Statistical Signal Processing, 5 op

721519P: Strategic Management, 5 op
811388A: Symbian Programming, 4 op
900060A: Technical Communication, 2 op
903010P: Technical German 1, 6 op
903012P: Technical German 3, 6 op
521440S: Technical Optics, 4 op
521359A: Telecommunication Engineering 1, 2,5 op
521361A: Telecommunication Engineering II, 3 op
521366S: Telecommunication Engineering Project, 3,5 op
521368S: Telecommunications Signal Processing 1, 5,5 op
521265A: Telecommunications Software, 5 op
521167S: Testing Techniques of Electronics, 4 op
031026A: Variational Methods, 5 op
764627S: Virtual measurement environments, 5 op
761104P: Wave Motion, 3 op
031045S: Wavelet Transform in Numerical Analysis, 8 op
811345A: Web-information Systems Design, 5 op
521316A: Wireless Communications 1, 4 op
521320S: Wireless Communications 2, 8 op
521317S: Wireless Communications 3, 8 op
521114S: Wireless Measurements, 4 op
521219S: X-ray Methods, 4,5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

477607S: Advanced Control and Systems Engineering, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Ikonen, Mika Enso-Veitikka
Opintokohteen kielet: Finnish
Leikkaavuudet:

470444S Advanced Control Methods 6.0 op

ECTS Credits:
5,0 cr
Language of instruction:
Finnish, it is possible to complete the course in English.
Timing:
Implementation in 4th-5th periods.
Learning outcomes:
To introduce advanced tools for control engineering as predictive control, adaptive control, multivariable control and neuro-fuzzy systems, which are commonly used applications in non-linear process modelling, control, plant optimisation, monitoring and scheduling.
Learning outcomes *:* After completing the course the student can model processes based on real-time measurements, build models for non-linear processes, and design control systems as optimization problems based on process models.

Contents:
Identifying processes using linear and non-linear models: recursive least squares methods, Kalman filtering, neural networks. 2. Model-based control: predictive control, multivariable control, adaptive control.
Learning activities and teaching methods:
Lectures and exercises. Examination and/or project work
Recommended or required reading:
Lecture handout; Ikonen, E. & Najim, K.: Advanced Process Identification and Control, Marcel Dekker Inc., New York 2002. 310 pp.
Person responsible:
Professor Enso Ikonen

521016A: Advanced Practical Training, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

Leikkaavuudet:

521026S	Advanced practical training	5.0 op

Learning outcomes:
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 organising, administration and management of a company and its production.
The student has to observe vigilantly everything connected to working life and to industrial operation in his or her training job and has to develop his professional skill. During the training, the student can make contacts to the industrial establishments which have significance from the point of view of both the choice of the diploma work and a final transition to the working life. Practising abroad is recommended because of, among others, improvement of the language skill and of gaining international experience.
Learning outcomes: After advanced practical training the student can describe one possible future job, or an other 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.
Learning activities and teaching methods:
The students acquire their training job themselves.
Assessment methods and criteria:
For master stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. A more exact compilation instruction of the training report is on the WWW pages of the department and on the notice board.

805334A: Analysis of categorical data, 9 op

Voimassaolo: - 28.02.2011

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Agresti, Alan , , 1990
Christensen, Ronald , , 1990
McCullagh, Peter , , 1989
McCulloch, Charles E. , , 2001

Opintokohteen kielet: Finnish

ECTS Credits:
9 cr
Learning outcomes:
A student who has succesfully completed the course is supposed to
- be familiar with generalized linear models and to be able to use them when studying discrete data
- be able to model the behaviour of ordinal dependent variables
- be able to make use of so-called mixed models while studying discrete or ordinal data

Contents:
The course deals with the analysis of contingency tables and with models for qualitative and ordinal dependent variables. Models for truncated dependent variables are also briefly touched. A majority of these models can be interpreted as generalised linear models (GLIM). This is why the essentials of the GLIM-theory and the corresponding phraseology is presented. So-called generalised mixed linear models (including random effects) and the estimation of their parameters by the GEE and the ML methods are also discussed. The course can be taken either as a graduate course or as an undergraduate course. It consists of 52 hours of lectures and 36 hours of excercises in the computer lab.
Person responsible:
Markku Rahiala

521380S: Antennas, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karhu Seppo

Opintokohteen kielet: English

Leikkaavuudet:

521388S Antennas 5.0 op

Language of instruction:
English.
Timing:
Periods 4-5.
Learning outcomes:
After having passed the course the student knows antenna terminology, understands the role of antennas as a part of different radio systems and is familiar with the theories explaining the electromagnetic radiation of usual antenna types and antenna arrays. In addition, the student masters the preliminary design of various antenna types and arrays, as well as, knows the feasibility of electromagnetic simulators in the antenna design.
Learning outcomes: After completing the course the student can apply antenna terminology and calculate the antenna characteristics of different kind of radio systems. He/she can apply electromagnetic theory to calculate the properties of the fields radiated by wire antennas, microstrip antennas and antenna arrays. The student is also able to design wire antennas, microstrip antennas and antenna arrays for different radio systems. In addition, the student can use electromagnetic simulators to analyze and design antennas.
Contents:
Introduction to different antenna types. Antenna parameters. Antennas as a part of a radio system. Radiation of an antenna from the Maxwell's equations. Typical linear wire antennas: infinitesimal dipole, small dipole, finite length dipole, half-wavelength dipole. Antennas near the conducting plane. Loop antennas. Microstrip antennas. Antenna arrays.
Learning activities and teaching methods:

Lectures, exercises and the compulsory antenna design work with an electromagnetic simulation program. 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.
Recommended optional programme components:
Basics of Radio Engineering.
Recommended or required reading:
C. A. Balanis: Antenna Theory, Analysis and Design (Third Edition). John Wiley & Sons, 2005. Chapters 1-6 and 14.

521358S: Application Specific Signal Processors, 4 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Boutellier, Jani Joosefi
Opintokohteen kielet: Finnish

Language of instruction:
English, if one or more international students are present
Timing:
Period 4-5.
Learning outcomes:
After completing the course the student can distinguish the main types of signal processors and design a couple of transport triggered architecture processors. The student is able to assemble a signal processor out of basic entities and match the processor performance and the application requirements. The student applies the TTA codesign environment and Altera's FPGA tools to synthesize a system.
Contents:
Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.
Learning activities and teaching methods:
Lectures 10h (participation mandatory). Independent work 98h
Target group:
This is an optional advanced-level course. It is inteded for masters-level students and post-graduate students, especially to those that are specializing into signal processing
Recommended optional programme components:
521267A Computer engineering, 521337A digital filters, programming skills
Recommended or required reading:
Handouts.
Assessment methods and criteria:
Participation in mandatory classes and approved project work.
Grading:
5 - 1 / failed
Person responsible:
Jani Boutellier.

080910A: Applied Diagnostic Radiology, 4 op

Voimassaolo: - 31.07.2016
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Institute of Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Koivula, Kalle Antero
Opintokohteen kielet: Finnish

ECTS Credits:
4 credits
Language of instruction:
Finnish
Timing:
Master studies, autumn-spring
Learning outcomes:
After this course student knows the theoretical basics, usability and restrictions of different medical imaging techniques. The student knows how an image of good quality is obtained and what is essential when interpreting the images.
Contents:
Course gives insight to radiological work (conventional X-rays, computed tomography, ultrasound examinations, magnetic resonance imaging and radiological operations). Seminars include radiological examinations from the technical point of view combining technical and medical knowledge.
Learning activities and teaching methods:
Lectures 20 hrs. Seminars and demonstrations 20 hrs. Selected lectures from the course 080602A (see the ECTS guide for the Faculty of Medicine). Final exam.
Recommended or required reading:
S Soimakallio (ed), L Kivisaari, H Manninen, E Svedström, O Tervonen. Radiologia, WSOY, 2005.
Assessment methods and criteria:
Seminar presentation and final exam are graded 1–5 or fail. Seminar grade is weighted as 2/3 and final exam grade as 1/3 in the final grade.
Grading:
1-5 or fail.
Person responsible:
Doc Antero Koivula
Other information:
This course is a part of specialization Medical Engineering. For more information, please contact Dr Pasi Pulkkinen.

Compulsory

080910A-02: Applied Diagnostic Radiology, Home exam, 0 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Institute of Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Koivula, Kalle Antero
Opintokohteen kielet: Finnish

ECTS Credits:

4 credits

Language of instruction:

Finnish

Timing:

Master studies, autumn-spring

Learning outcomes:

After this course student knows the theoretical basics, usability and restrictions of different medical imaging techniques. The student knows how an image of good quality is obtained and what is essential when interpreting the images.

Contents:

Course gives insight to radiological work (conventional X-rays, computed tomography, ultrasound examinations, magnetic resonance imaging and radiological operations). Seminars include radiological examinations from the technical point of view combining technical and medical knowledge.

Learning activities and teaching methods:

Lectures 20 hrs. Seminars and demonstrations 20 hrs. Selected lectures from the course 080602A (see the ECTS guide for the Faculty of Medicine). Final exam.

Recommended or required reading:

S Soimakallio (ed), L Kivisaari, H Manninen, E Svedström, O Tervonen. Radiologia, WSOY, 2005.

Assessment methods and criteria:

Seminar presentation and final exam are graded 1–5 or fail. Seminar grade is weighted as 2/3 and final exam grade as 1/3 in the final grade.

Grading:

1-5 or fail.

Person responsible:

Doc Antero Koivula

Other information:

This course is a part of specialization Medical Engineering. For more information, please contact Dr Pasi Pulkkinen.

080910A-01: Applied Diagnostic Radiology, Seminar, 0 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Institute of Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Koivula, Kalle Antero

Opintokohteen kielet: Finnish

ECTS Credits:

4 credits

Language of instruction:

Finnish

Timing:

Master studies, autumn-spring

Learning outcomes:

After this course student knows the theoretical basics, usability and restrictions of different medical imaging techniques. The student knows how an image of good quality is obtained and what is essential when interpreting the images.

Contents:

Course gives insight to radiological work (conventional X-rays, computed tomography, ultrasound examinations, magnetic resonance imaging and radiological operations). Seminars include radiological examinations from the technical point of view combining technical and medical knowledge.

Learning activities and teaching methods:

Lectures 20 hrs. Seminars and demonstrations 20 hrs. Selected lectures from the course 080602A (see the ECTS guide for the Faculty of Medicine). Final exam.

Recommended or required reading:

S Soimakallio (ed), L Kivisaari, H Manninen, E Svedström, O Tervonen. Radiologia, WSOY, 2005.

Assessment methods and criteria:

Seminar presentation and final exam are graded 1–5 or fail. Seminar grade is weighted as 2/3 and final exam grade as 1/3 in the final grade.

Grading:

1-5 or fail.

Person responsible:

Doc Antero Koivula

Other information:

This course is a part of specialization Medical Engineering. For more information, please contact Dr Pasi Pulkkinen.

766320A: Applied Electromagnetism, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766325A	Electromagnetism (TTK)	4.0 op
761398A	Theory of Electricity	6.0 op

ECTS Credits:
6 credits
Timing:
Second autumn
Learning outcomes:
The student is familiar with the mathematics needed in field theory. He understands the experimental foundation of Maxwell's equations and the structure of the field theory based on these equations. He can apply the theory to electrostatics, magnetostatics, induction phenomena and electromagnetic radiation.
Contents:
This lecture course consists of electromagnetic field theory and its applications. The course contains three parts: a) lectures, problem classes of field theory and four mini exams and one end exam b) home problems c) project with a report. Each part must be passed at an acceptable level. The marks of the whole course are given by a weighted average of the marks of parts a), b) and c) with weights 50 %, 25 % and 25 %, respectively.
a) Lectures of field theory and problem classes
The field theory starts with Maxwell’s equations and their experimental justification. They are then used in deriving the electrostatics, stationary currents, magnetostatics, theory of dynamic electromagnetic fields and the propagation of electromagnetic waves in space. This theory makes the foundation of all electrical technology, but it is essential especially in understanding the working of antennas, transfer lines and wave guides. The problems given to students are brief and consist of simple cases which can be solved using the theory.
b) Home problems
These problems are more extensive than those on problem classes and solving them requires more profound reasoning. Each person will receive 6 problems to be solved.
c) Project
The project works are meant to act as concrete examples of electromagnetic phenomena. No detailed instructions are given, but the task is described in a loose way. The project group has to invent the experimental arrangement by themselves using the available tools. The group will also write a project report.
Learning activities and teaching methods:
Lectures 36 h, exercises 24 h, four mini examinations and one end examination or one final examination. Home problems. Project.
Target group:
Students in electrical engineering.
Recommended optional programme components:
Courses 761103P, 031011P
Recommended or required reading:
Textbooks by Ismo Lindell ja Ari Sihvola (Sähkömagneettinen kenttäteoria 1 ja 2) can be used. Lecture material on web pages in Finnish.
Grading:
Each part must be passed.
Person responsible:
Tuomo Nygrén
Other information:
https://wiki.oulu.fi/display/766320A/

521495S: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2005 - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Pietikäinen, Matti
Opintokohteen kielet: English

Learning outcomes:
The course makes an introduction to basic principles and methods of artificial intelligence.
Learning outcomes: After passing the course the student identifies those problems which can be solved with artificial intelligence methods. The student knows the basic principles of intelligent agents, and how to apply most commonly used search, logic inference and planning methods to solve artificial intelligence problems. The student can also apply some uncertainty based inference methods and simple learning methods based on machine's observations. In addition, the student is able to implement most common search methods with a programming language.

Contents:
1. Introduction , 2. Intelligent agents , 3. Solving problems by searching , 4. Informed search and exploration, 5. Constraint satisfaction problems , 6. Games (adversarial search), 7. Logical agents , 8. First-order logic, 9. Inference in first-order logic, 10. Planning, 11. Uncertainty, 12. Bayesian networks, 13. Learning from observations.
Learning activities and teaching methods:
Lectures, programming exercise, and examination.
Recommended optional programme components:
Knowledge of some programming language.
Recommended or required reading:
Russell, S., Norvig, P.: Artificial Intelligence, A Modern Approach, Second Edition, Prentice-Hall, 2003. Syrjänen, M.: Tietämystekniikan peruskurssin luentomoniste (in Finnish). Original lecture slides at: http://aima.eecs.berkeley.edu/slides-pdf/

555280P: Basic Course of Project Management, 2 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Industrial Engineering and Management
Arvostelu: 1 - 5, pass, fail
Opettajat: Jaakko Kujala
Opintokohteen kielet: Finnish
Leikkaavuudet:

555288A	Project Management	5.0 op
555285A	Project management	5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:
Finnish
Learning outcomes:
The objective of the course is to familiarise the student with the basics and the basic methods of project management.
Learning outcomes: Upon completion the student can explain the essential concepts related to project management. He can present the main features of a project plan and can use different methods of partitioning a project. The student can also schedule a project and estimate its costs. The student can explain the terms related to Earned value method and can apply the method on simple tasks. Upon completion the student recognizes the essential tasks of project risk management.

Contents:
Defining project management, project planning, organising and scope management, schedule management, cost management, earned value calculation and project risk management.
Learning activities and teaching methods:
Lectures and exercise book. The final grade is derived from the course exam.

555281A: Basic Course of Quality Management, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Jaakko Kujala, Osmo Kauppila

Opintokohteen kielet: Finnish

Leikkaavuudet:

555286A Process and quality management 5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:
Finnish
Learning outcomes:
The objective of the course is to familiarise the student on managing production processes from a point of statistical process control.
Learning outcomes **:** Upon completion the student can explain the essential concepts of quality management and recognizes the significance of quality in different working environments. The student gains basic level skills for applying the methods of statistical process control. The student is able to solve problems of production process by using quality management problem solving methods.
Contents:
The significance of quality to a company, quality in open and closed systems, quality costs, quality tools and methods of statistical process control and the use of them in practical problem solving, basics of total quality management.
Learning activities and teaching methods:
Lectures and exercise are integrated. A group study is made during the course. The final grade is determined by the group study and a final exam.
Recommended or required reading:
Lecture materials, lecture handout and exercise book

761101P: Basic Mechanics, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761118P Mechanics 1 5.0 op

761118P-01 Mechanics 1, lectures and exam 0.0 op

761118P-02 Mechanics 1, lab. exercises 0.0 op

761111P-01 Basic mechanics, lectures and exam 0.0 op

761111P-02 Basic mechanics, lab. exercises 0.0 op

761111P Basic mechanics 5.0 op

761101P2 Basic Mechanics 4.0 op

ECTS Credits:
4 credits
Language of instruction:
The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.
Timing:
Autumn
Learning outcomes:
The student masters the basic concepts of mechanics and is able to apply those when solving the problems related to mechanics.
Contents:
We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, also the modern physics.
Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton's laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.
Learning activities and teaching methods:
Lectures 32 h, 8 exercises (16 h), four mini examinations and end examination or final examination.
Target group:
Secondary subject students.
Recommended optional programme components:
Knowledge of vector calculus and basics of differential and integral calculus would be desirable.
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12th edition, 2008, chapters 1-14. Also 11th and 10th editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Person responsible:
Anita Aikio
Other information:
https://wiki.oulu.fi/display/761101P/

806109P: Basic Methods in Statistics I, 9 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen oppimateriaali:
Grönroos, Matti (2) , , 2003
Heikkilä, Tarja , , 1998
Helenius, Hans , , 1989
Ranta, Esa (2) , , 1991
Wild, Christopher J. , , 2000

Opintokohteen kielet: Finnish

Leikkaavuudet:

806119P	A Second Course in Statistics	5.0 op
806116P	Statistics for Economic Sciences	5.0 op
806117P	Analysis of continuous response variable	5.0 op
ay806109P	Basic Methods in Statistics I (OPEN UNI)	9.0 op

ECTS Credits:
9 cr
Learning outcomes:
On successful completion of this course, the student will be able to
- use basic methods of collecting and describing data
- apply methods of statistical inference in some simple situations
- interpret listing of some statistical software

Contents:
Principles of collecting data and describing data with suitable tables, graphs and numerical measures are treated. The basic idea of estimation and statistical tests will be presented as well as some of the most common used confidence intervals and statistical tests. One aim is also to give basic knowledge from some statistical software.
Person responsible:
Marjatta Mankinen (economics) and Jari Päkkilä (others)

761102P: Basic Thermodynamics, 2 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766348A	Thermophysics	7.0 op
766328A	Thermophysics	6.0 op

ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
Every Fall term
Learning outcomes:
The student will learn to recognize and understand ordinary thermodynamic phenomena taking place around us as well as to take them into account and utilize them, for instance, in designing devices and buildings.
Contents:
We cover the basics of temperature, heat and thermal properties of matter both in macroscopic and microscopic levels. Topics in detail: Temperature, thermometers, heat, thermal properties of matter (e.g. thermal expansion, specific heat, phase changes), equations of state, the laws of thermodynamics, heat engines (e.g. internal-combustion engine), refrigerators, the Carnot cycle, entropy.
Learning activities and teaching methods:
Lectures 16 h, 4 exercises (8 h), 2 intermediate examinations (in Fall) or final examination.
Target group:
For students with physics as a minor subject.
Recommended or required reading:
Young and Freedman; University Physics, Addison Wesley (Edition 10, Chapters 15-18, or Editions 11-12, Chapters 17-20). Similar material can also be found in H. Benson: University physics, Wiley & Sons, New York (Chapters 18-21).
Lecture notes: Basic thermodynamics (in Finnish) by K. Mursula.
Person responsible:
Ville-Veikko Telkki
Other information:
https://wiki.oulu.fi/display/761102P/

806110P: Basic methods in statistics II, 10 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:
Armitage, P. , , 2002
Grönroos, Matti (2) , , 2003
Ranta, Esa (2) , , 1991

Opintokohteen kielet: Finnish

ECTS Credits:
10 cr
Learning outcomes:
On successful completion of this course, the student will be able to
- analyze continuous and categorical response in the most common experimental and observational studies
- critically evaluate chosen model
- use some statistical software
Contents:
Skills for performing statistical analyses and inferences on the basis of data obtained in common experimental and observational studies are expanded and deepened. Topics included are e.g. (1) principles of collection, description, and modelling of, and inference on statistical data; (2) basic methods of analysing continuous outcome variables, like comparison of two groups, one-way and two-way analysis of variance, regression analysis, residuals and model diagnostics, nonparametric methods, treatment of correlated and lifetime (censored) observations; (3) and basic methods of analysing binary, categorical and count data.
Person responsible:
Marjatta Mankinen

521384A: Basics in Radio Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karhu Seppo

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Periods 1-2.
Learning outcomes:
The aim is to give elementary knowledge about and to introduce some basic scientific tools needed in radio engineering.

Learning outcomes: After completing the course the student can define what radio engineering is and list its separate areas. He/she is also able to describe different terms and applications of radio engineering. Using Maxwell's equations the student can solve the propagation of radio waves in a homogenic medium, the reflection and transmission at an interface of two lossless media, the power and energy of the electromagnetic fields, as well as, the radio wave propagaton in common transmission lines and waveguides. In addition, he/she is able to apply these solutions to typical problems in radio engineering. The student can utilize the methods based on the Smith chart for the impedance matching of microwave circuits and antennas. He/she can describe the operation of passive transmission line and waveguide devices, resonators and filters, as well as, the operation of the circuits based on the semiconductor devices. In addition, he/she is able to calculate their characteristics with the microwave circuit theory. The student is capable to describe the antenna terms, to classify antenna types and antenna arrays, as well as, to calculate the electromagnetic fields radiated by them. He/she can classify and describe the most significant radio wave propagation mechanisms occurring over the radio links on the Earth's surface, through the troposphere and via the ionosphere. The student is able to summarize the structure of a radio system and to calculate the properties of its blocks. In addition, he/she can design a free-space radio link using the link budget. The student can identify the biological effects and safety standards of radio waves and can apply them to himself or herself and to other people.
Contents:
Introduction to radio waves and radio engineering. Fundamentals of electromagnetic fields. Transmission lines and waveguides. Impedance matching. Microwave circuit theory. Passive transmission line and waveguide devices. Resonators and filters. Circuits based on semiconductor devices. Antennas. Propagation of radio waves. Radio system. Applications of radio engineering. Biological effects and safety standards.
Learning activities and teaching methods:
Lectures and exercises. Exam.
Recommended optional programme components:
Elementary knowledge of the electromagnetic theory.
Recommended or required reading:

In Finnish: Antti Räisänen & Arto Lehto: Radiotekniikan perusteet. Otatieto, 2007. In English: Antti V. Räisänen & Arto Lehto: Radio Engineering for Wireless Communication and Sensor Applications, Artech House, 2003. Additional reading in Finnish: Jyrki Louhi & Arto Lehto: Radiotekniikan harjoituksia. Otatieto, 1995.

811380A: Basics of Databases, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

811318A	Introduction to Data Management	9.0 op
811318A-02	Introduction to data management, exam	0.0 op
811318A-01	Introduction to data management, exercise work	0.0 op

ECTS Credits:
4 ECTS
Timing:
2nd year, periods 2+3
Learning outcomes:
Objective: The course does relational databases, conceptual modelling of data-bases, as well as XML and object databases.
Learning Outcomes: After finishing the course the student understands data-bases - especially relational, XML and object-oriented databases. Moreover, student can model a database.
Contents:
Conceptual modelling (ER- and EER-diagrams); Relational model (theory, databases, query techniques and normalisation); XML-databases; object-oriented databases; transactions.
Learning activities and teaching methods:
Lectures (in Finnish), compulsory exercises and assignments (English available).

Target group:
2nd year
Recommended optional programme components:
Object oriented analysis and design -course or knowledge about object oriented class model.
Recommended or required reading:
Silberschatz, Korth & Sudarshan: Database system concepts

Assessment methods and criteria:
A way to pass will be informed in course web pages.

Grading:
1-5
Person responsible:
Juha Iisakka

521315A: Basics of Information Theory, 4 op

Voimassaolo: 14.11.2005 - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: Finnish

Language of instruction:
In English.
Timing:
Period 1-2.
Learning outcomes:
To learn the information theory as a discipline and its most important applications in information technology in general and in communications engineering in particular.

Learning outcomes: Upon completing the required coursework, the student is able to use the basic methodology of information theory to calculate the capacity bounds of communication and data compression systems. The student can

estimate the realisability of given design tasks before

the

execution of the detailed design. What is more, the student can

independently search for information and knowledge related to

communication engineering, system design and signal processing.

Contents:
Basic concepts, data compression, basics of source coding, channel capacity, capacity of a Gaussian channel, maximum entropy method, rate distortion theory, introduction to network information theory.
Learning activities and teaching methods:
Lectures and self-calculated exercises. The course is passed with final examination.
Recommended optional programme components:
Random signals, Telecommunication Engineering II.
Recommended or required reading:
Parts from Thomas M. Cover & Joy A. Thomas, Elements of Information Theory, 2nd ed. John Wiley & Sons, 1991 ISBN: 0-471-06259-6. Lecture notes.

750340A: Basics of bioinformatics, 3 op

Voimassaolo: - 31.07.2016
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Biology
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruokonen, Minna Johanna
Opintokohteen oppimateriaali:
Mount, David W. , , 2001
Opintokohteen kielet: English
Leikkaavuudet:

757314A	Basics of bioinformatics	5.0 op

ECTS Credits:
3 cr.

Language of instruction:
Finnish / (English).
Timing:
B.Sc. studies, 2 nd spring.
Learning outcomes:
After the course the student knows and is able to use the basic methods for handling the nucleotide and protein sequences. The aim is that the student learns how to use the databases, understands the background and principles of the analytic methods, is able to take up a critical attitude towards the used methods and gets a good background for applying new methods that are developed continuously.
Contents:
Searching of material from the databases, inferring the function of a gene and structure of a protein based on sequence data, comparing the sequences and evaluating the differences between them as well as examining the evolution history of the genes.
Learning activities and teaching methods:
12 h lectures, 2 h seminar, 20 h exercises, independent work.
Target group:
BT: compulsory, recommended for all biologists. Suitable also for biochemists.
Recommended optional programme components:
Course Concepts of genetics (753124P) compulsory, also Molecular evolution (753327A) is recommended.
Recommended or required reading:
Mount, D.W. 2000: Bioinformatics, sequence and genome analysis. Cold Spring Harbor Laboratory Press, 564 p.
Assessment methods and criteria:
Reports, seminar presentation.
Grading:
1-5 / Fail
Person responsible:
Dr. Minna Ruokonen.

521126S: Biomedical Measurements, 5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Myllylä, Risto Antero

Opintokohteen kielet: Finnish

Language of instruction:
Lectures are in Finnish. Calculation exercises are in Finnish but same material is available in English.

Timing:
Period 4-5.
Learning outcomes:
The objective of the course is to give an overall presentation of modern medical equipment and their special requirements. The emphasis is on technical and functional presentation. The goal is to provide the student sufficient knowledge to study hospital engineering.
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, medical imaging methods and instruments, ear measurements, heart pacing and defibrillators, physical therapy devices, intensive care and operating room devices and electrical safety aspects.

Learning activities and teaching methods:
Lectures and exercises. The course is passed by a final exam.
Recommended or required reading:
J. G. Webster: Medical Instrumentation, Application And Design. John Wiley & Sons, 1998; lecture notes (in Finnish); exercise notes (also in English)

521273S: Biosignal Processing, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 2-3.
Learning outcomes:
The course provides knowledge of most common biomedical signals and signal processing methods that can be used for computerized biomedical signal analysis.

Learning outcomes: After passing the course, the student can explain the importance of artifact filtering, time- and frequency-domains, and nonstationarity for biomedical signal analysis and select a proper solution for most common application situations. In addition, (s)he can explain the central feature detection methods to analyze the contents of biosignals.

Contents:
Biomedical signals. Digital filtering. Time- and frequency-domain analysis, Nonstationarity of biomedical signals. Feature detection and classification. Diagnostic decision.
Learning activities and teaching methods:
Lectures 10 hours + Laboratory exercises 20-30 hours + Written exam

Recommended optional programme components:
The basic engineering math courses, digital filtering, programming skills
Recommended or required reading:
The course is based on the book "Biomedical Signal Analysis, A Case-Study Approach", R.M Rangayyan. 516 pages. +Lecture transparencies
+ Task assignment specific material.

721704P: Business Logistics, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Juga

Opintokohteen kielet: English

Leikkaavuudet:

ay721704P	Business Logistics (OPEN UNI)	5.0 op
721704A	Business Logistics	5.0 op

ECTS Credits:
5 ects.

Language of instruction:
English.

Timing:
Period B.

Learning outcomes:
The student understands how logistics contributes to business competitiveness and knows the central planning principles of logistics activities and their mutual relationships.

Contents:
Course topics include logistics trade-offs, logistics service level, transport and inventory management, logistics performance measurement, basic production planning and order scheduling, just-in-time logistics, and green logistics. The development of the logistics discipline and current logistics issues will also be discussed.
Learning activities and teaching methods:
Lectures (30 h), including basic calculations and exercises in classes.
Recommended or required reading:
Jonsson, P. (2008), Logistics and Supply Chain Management, McGraw-Hill, and supplementary study material in OPTIMA.

Check availability from here.
Assessment methods and criteria:
Exam (course book, lectures, basic calculation problems).
Grading:
1-5.

Person responsible:
Professor of logistics.

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031010P	Calculus I (OPEN UNI)	5.0 op

Language of instruction:
Finnish
Timing:
Period 1-3
Learning outcomes:
The course gives the basics of vector algebra, analytic geometry, elementary functions and differential and integral calculus of real valued functions of one variable.
Learning outcomes **:** After completing the course the student identifies concepts of vector algebra and can use vector algebra for solving problems of analytic geometry. The student can also explain basic characteristics of elementary functions and is able to analyse the limit and the continuity of real valued functions of one variable. Furthermore, the student can solve problems associated with differential and integral calculus of real valued functions of one variable.
Contents:
Vector algebra and analytic geometry. Limit, continuity, differential and integral calculus and applications of real valued functions of one variable. Complex numbers.

Learning activities and teaching methods:
Term course. Lectures 5 h/week. Two examinations or a final examination.
Recommended or required reading:
Grossmann, S.I.: Calculus of One Variable; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations (partly); Adams, R.A.: A Complete Course Calculus (partly).

031011P: Calculus II, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

031075P	Calculus II	5.0 op
ay031011P	Calculus II (OPEN UNI)	6.0 op

Language of instruction:
Finnish
Timing:
Period 4-6
Learning outcomes:
The course gives the basics of theory of series and differential and integral calculus of real and vector valued functions of several variables.
Learning outcomes **:** After completing the course the student is able to examine the convergence of series and power series of real terms and estimate the truncation error. Furthermore, the student can explain the use of power series e.g. in calculating limits and approximations for definite integrals and is able to solve problems related to differential and integral calculus of real and vector valued functions of several variables.
Contents:
Sequences, series and power series of real terms. Differential and integral calculus of real and vector valued functions of several variables.
Learning activities and teaching methods:
Term course. Lectures 5 h/week. Two examinations or a final examination.
Recommended optional programme components:
Calculus I.
Recommended or required reading:
Kreyszig, E.: Advanced Engineering Mathematics; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations.

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Language of instruction:
The course and exercises are held in Finnish.
Timing:
Period 5-6.
Learning outcomes:

In this course the student learns to analyse simple DC, AC, and transient circuits. The course gives necessary basic knowledge for all analogue electronics courses (Basics of Electronic Design, Electronics Design I - III, Analog Filters).
Learning Outcomes: After completing the course the student can write and solve a system of equations describing the behaviour of electric circuits, use complex phasor arithmetics to solve the response of circuits driven by sinusoidal signals, solve time responses of circuits, simplify circuit by employing equivalent circuits and series and parallel combinations, and run simple circuit simulations and understands the differences and limitations of different types of analyses.
Contents:
Electric quantities, circuit laws, systematic writing and solving of circuit equations using nodal and mesh analysis, time and frequency response, phasor calculation. Basics of circuit simulation.
Learning activities and teaching methods:
6 hours lectures and exercises per week. Basic circuit simulation exercises. The course is passed by a final exam and the simulation exercises (contact the lecturer for exam in English).
Recommended optional programme components:
Matrix Algebra, Differential Equations.
Recommended or required reading:
Handouts. The same topics are covered in Nilsson, Riedel: Electric Circuits (6th ed., Prentice-Hall 1996), chapters 1-11.

521306A: Circuit Theory 2, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521303A Circuit Theory 2 5.0 op

Language of instruction:
The course and exercises are held in Finnish.
Timing:
Period 1-3.
Learning outcomes:
This course gives basic knowledge about the analysis and modelling of electrical circuits. After passing this course the student is capable of analyzing frequency responses of circuits implemented using lumped circuit elements.
Learning outcomes: After completing the course the student can use Laplace transform for solving transient and steady-state responses, can derive the transfer function of a continuous-time system, solve its poles and zeros, and understand their meaning, can draw the pole-zero map and Bode plots of a given transfer function, can construct and use a 2-port parameter presentation of a circuit, and understands the principles of circuit synthesis and limitations of linear circuit analysis.

Contents:
Use of Laplace transformation in circuit analysis. Properties of network functions, concept of poles and zeros. Pole-zero plot, Bode amplitude and phase plots. Behavioral modeling of electric circuits. One and two-port parameter presentations. Basics of network synthesis.
Learning activities and teaching methods:
This course includes 4 hours of lectures and exercises per week. The course is passed by a final exam.
Recommended optional programme components:
Circuit Theory I, Calculus I - II, Differential Equations.
Recommended or required reading:
Handouts. Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), chapters 12-18.

521343S: Coding Methods, 4 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Timo Kokkonen
Opintokohteen kielet: Finnish

Language of instruction:
In Finnish every second year (in uneven years) and in English in every other year (in even years)
Timing:
Period 4-5.
Learning outcomes:
The objective of the course is to teach basic information of information theory and source encoding, and the basics of error-detecting and error-correcting codes that are needed in the design of digital communication systems.

Learning outcomes: Upon completing the required coursework, the student can solve simple problems dealing with information theory and source encoding. He or she is able to explain operating principles of block codes, cyclic codes and convolutional codes. The student can form a coder and decoder for common binary block codes, and is capable of using tables of the codes and shift register when solving problems. He or she can represent operating idea of convolutional encoder as a state machine, the student is able to apply Viterbi algorithm to decoding of convolutional codes, and is capable of specifying principles of turbo coding and coded modulation. Moreover, the student can evaluate error probability of codes and knows practical solutions of codes by name.

Contents:
The basics of information theory, discrete-valued channel models, source encoding methods, block codes, cyclic codes, burst error correcting codes, error correcting capability of block codes, convolutional codes, Viterbi algorithm, concatenated codes, and introduction to turbo coding and to coded modulation.

Learning activities and teaching methods:
Lectures and exercises in total 6 hours in a week during periods 4-5. The course is given in Finnish every second year (in uneven years) and in English in every other year (in even years). The course is passed with weekly exams (only during lecture periods) or with final exam.

Recommended optional programme components:
Basics of Digital Communications. Also recommended: Wireless Communications II.

Recommended or required reading:
S. Benedetto and E. Biglieri: Principles of Digital Transmission with Wireless Applications, 1999, chapters 1, 3, 10, and partly chapters 11 and 12.

521374S: Communication Networks 2, 6,5 op

Voimassaolo: - 31.08.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Savo Glisic
Opintokohteen kielet: Finnish

Language of instruction:
In English.
Timing:
Period 4-6.
Learning outcomes:
The aim is to help the student to understand the basic principles of networking by providing a balance between the description of existing networks and the development of analytical tools. The descriptive material is used to illustrate the underlying concepts, and the analytical material is used to generate a deeper and more precise understanding of the concepts. The course presents the basic principles of queueing theory giving mathematical tools to apply the theory to practical communication systems.
Learning outcomes: Upon completing the required coursework, the student is able to construct simple theoretical queueing theory models and analyze the simulation results of these models. The student achieves skills to explain simple Markovian birth-death process and apply that model in queueing systems. The course gives skills for the student to describe functionalities of a communication network with game theory. The student knows the decomposition methods of network utility function and is capable of using that knowledge for network optimization.
Contents:
Introduction to concepts in queuing theory, birth-death process, queueing systems and their measures of effectiveness, Little's result, blocking in queueing systems, open and closed (Jackson) queueing networks, advanced routing in data networks, multiple access techniques, network information theory, cognitive networks.
Learning activities and teaching methods:
Two hours of lectures in a week and exercises, The course is passed with final examination and accepted design exercise. The course is lectured in English.
Recommended optional programme components:
Communication Networks I, Stochastic Processes
Recommended or required reading:
Parts from: S. Glisic & B.Lorenzo: Wireless Networks:4G Technologies (2 nd ed.), 2009; S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technologies (2 nd ed.), 2007.

521360S: Communication Signal Processing II, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521325S Communication Signal Processing 5.0 op

Language of instruction:
In English.
Timing:
Period 5-6.
Learning outcomes:
Digital communication knowledge is deepened by applying the statistical signal processing techniques to the design of receiver baseband algorithms. The main goal is to learn the principles which are used to optimise the receiver synchronisation and channel estimation methods based on detection and estimation theory.
Learning outcomes: After completing the course the student recognizes the blocks of all-digital receiver and can explain the basis for them. She/he can derive synchronization algorithms for timing, phase and frequency and for joint estimation. He can derive the performance of the algorithms and comparison methods of them. Student can utilize proper interpolation methods for timing estimation. In addition, she/he can utilize and develope algorithms for fading channels.

Contents:
Synthesis and performance of synchronisation algorithms in AWGN channels, frequency estimation, interpolation in synchronisation, synchronisation and channel estimation in fading channels.
Learning activities and teaching methods:

Lectures and exercises in total 6 hours in two weeks during periods 5-6. The course is given in English. A design exercise by Matlab software. The course is passed with final examination and accepted design exercise. Grade is based on exam. Course will be given every second year in uneven year.

Recommended optional programme components:

Statistical Signal Processing, Wireless Communications II. Recommended: Communication Signal Processing I.

Recommended or required reading:

H. Meyr, M. Moeneclaey & S. A. Fechtel, Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998. (Partly).

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic

Opintokohteen kielet: English

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

The aim is to present the fundamentals of the structure of digital data transmission systems. Operation adapted according to the telephone network also considered. Technical implementation and application of the common data and local networks are discussed.

Learning outcomes: Upon completing the required coursework, the student is able to list the functionalities of different layers of OSI and TCP/IP protocol models. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE IEEE802.11 systems. The student is able to describe the basic protocol model of the UMTS radio interface and radio access network. The student will achieve skills to describe the main principles of mobility control, network security, crosslayer optimization and routing in ad hoc networks. The course also gives the student the ability to explain the essential features of sensor networks.

Contents:

Communications architecture and protocols, adaptive network and transportation layers, mobility management, network security, network management, ad hoc and sensor networks, cross-layer optimization, examples of wireless communication networks.

Learning activities and teaching methods:

Two hours of lectures in a week. The course is passed with final examination and accepted design exercise. The course is lectured in English.

Recommended or required reading:

Parts from: S. Glisic & B.Lorenzo: Wireless Networks:4G Technologies (2 nd ed.), 2009; S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technologies (2 nd ed.), 2007.

031018P: Complex Analysis, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: Finnish

Leikkaavuudet:

031077P	Complex analysis	5.0 op

Language of instruction:
Finnish
Timing:
Period 1-2
Learning outcomes:
The objective of the course is to supply the student with basic understanding of the use of complex numbers and complex functions in various applications of technics, especially in signal processing. Learning outcomes **:** Upon completing the required coursework, the student is able to apply complex numbers and functions to modeling, solving and analysing of problems arising in technics, especially in signal processing. The student also knows how to use mapping properties and differential and integral calculus of complex functions in applications of technics .
Contents:
Complex numbers, complex exponential function and discrete linear system, mapping properties of complex functions, differential calculus, conformal mapping, integral calculus, Cauchy formula, residue, residue calculus, Möbius transformation, applications to signal processing.
Learning activities and teaching methods:
Term course. Lectures 4 h/week. Two intermediate exams or a final examination.
Recommended optional programme components:
Calculus I.
Recommended or required reading:
Lecture notes and exercise materials. Kreyszig, E.: Advanced Engineering Mathematics; Spiegel **:** Complex Variables; Lang: Complex Analysis.

521332S: Computer Aided Circuit Design, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Aikio, Janne Petteri

Opintokohteen kielet: Finnish

Leikkaavuudet:

521305S Computer Aided Circuit Design 5.0 op

Language of instruction:
The course and exercises are held in Finnish.
Timing:
Periods 4-6.
Learning outcomes:
This course explains the operation, limitations and application areas of various types of front-end and back-end CAD tools used for analog and mixed signal design.
Contents:
Circuit simulators. Solving network equations. Principles of AC, DC, transient analyses and steady-state simulation methods. Simulation of noise and distortion. Worst-case and statistical analysis and optimization. Physical design and design verification.
Learning activities and teaching methods:
Lectures 2 hours / week. Simulation exercises and final exam.
Recommended optional programme components:
Knowledge in circuit theory, basic circuit simulations, and analog design.
Recommended or required reading:
Handouts. K. Kundert: Designer's guide to SPICE and Spectre. Kluwer Academics.

521267A: Computer Engineering, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Janne Haverinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

810122P Computer Architecture 5.0 op

Learning outcomes:
The aim of the course is to provide basic understanding to the operation of a digital computer, and to provide basic knowledge for programming using a symbolic programming language.
Learning objectives: After passing the course, student can explain the basic operation principle of a computer, the phases of an instruction execution, and an interrupt mechanism. The student can explain the basic organization of a computer including CPU, ALU, memory, I/O device, bus, and a register. The student can describe some basic operations of a computer using a register transfer language, and explain the role of instruction format as a part of the control logic. The student can perform conversions between number systems such as decimal, binary and hexadecimal systems. The student can use and interpret the basic data representations used in a digital computer such as integers, fixed point numbers, floating point numbers, and ASCII symbols. The student can explain the arithmetic operations performed using two's complement, the basic principles of a RISC architecture, and the connection of these principles to the performance of the computer. The student can explain a typical memory organization and terms like address space, cache memory, and virtual memory. The student can explain the principles of asynchronous communication, and the operation of the assembler. The student can create small programs using an assembly language.
Contents:
Computer organization and architecture, the operation principle of a computer, register transfer language, data types, interrupt, I/O devices, and memory organization. Assembly language and the operation of an assembler.
Learning activities and teaching methods:
Lectures, programming exercise, and exam.
Recommended optional programme components:
Digital Techniques I
Recommended or required reading:
Mano M., Computer System Architecture. Prentice Hall, Englewood Cliffs, New Jersey 1993; Patterson D., Hennessy J., Computer Organization and Design. Morgan Kauffman, San Fracisco, CA, 2005.

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S Computer Graphics 5.0 op

Language of instruction:
In English.
Learning outcomes:
The objective of the course is to supply the student with basic understanding of computer graphics, algorithms and applications.

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

The history and evolution of computer graphics; 2D graphics including: line drawing, polygon filling, clipping, and transformations, and 3D computer graphics algorithms including viewing transformations, hierarchical modeling, color, lighting and texture mapping; image processing, animation and virtual reality; graphics API (OpenGL) and Virtual Reality Modeling Language (VRML) for implementation.
Learning activities and teaching methods:
The course consists of lectures and several design exercises. The final grade is based on the combined points from exercises and final exam.
Recommended optional programme components:
computer engineering, programming skills using C++
Recommended or required reading:
Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
Edward Angel: Interactive Computer Graphics, 4th, Addison-Wesley 2006
Lecture notes (in English);
Materials in the internet (e.g. OpenGL redbook).

521261A: Computer Networks I, 5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish. Materials are in English.
Timing:
Period 5-6.
Learning outcomes:

The course gives a comprehensive description of the fundamentals of

computer networks, using the public Internet and its protocols

and applications as examples

Learning outcomes:

Upon completing the course the student is able to explain the

structure of the public Internet and the TCP/IP protocol stack,

solve

simple computer networking problems, and design and implement a

small computer networking application

Contents:

Internet's architecture, most important access networks, TCP/IP

protocol stack, the most important Internet applications, Internet

security.

Learning activities and teaching methods:

Lectures, exercises, and practical work.

Recommended or required reading:

James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down

Approach (5th Edition), Addison-Wesley, 2009.

Lecture slides and exercise materials.

Assessment methods and criteria:

The course is passed with a final exam or with a set of

intermediate exams, together with an approved practical work.

521262S: Computer Networks II, 6 op

Voimassaolo: 01.08.2007 - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Ojala, Timo Kullervo
Opintokohteen kielet: English

Language of instruction:
In English.
Timing:
Period 3-4.
Learning outcomes:

The course focuses on advanced issues on computer networking and

the Internet.

Learning outcomes:

Upon completing the course the student is able to explain the recent developments in the Internet, solve complicated computer networking problems, and design and implement a computer networking application.

Contents:

Recent developments in Internet architecture, access networks, and Internet protocol stack, multimedia and quality of service, session management, mobility management.

Learning activities and teaching methods:

Lectures, exercises, and practical work. The course is passed with a final exam or with a set of intermediate exams, together with an approved practical work. The implementation is fully English.

Recommended optional programme components:

Recommended courses include Computer Networks I, Operating Systems,

Basics of Digital Communications, Telecommunications Software

and Communication Networks I.

Recommended or required reading:

James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down

Approach (5th Edition), Addison-Wesley, 2009.

Assorted Internet standards.

Lecture slides, exercises.

521498S: Computer Organization and Design, 5 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Learning outcomes:
Learning outcomes: Upon completing the required coursework, the student is able to explain the relationships between the software and hardware of computer systems. The student is able to explain how hardware design decisions affect the performance of the software, and the performance of the software can be increased.
Contents:
Instruction set and arithmetic, translating and executing programs, assessing and understanding performance, processor's datapath and control, enhancing performance with pipelining, exploiting memory hierarchy, peripherals.
Learning activities and teaching methods:
Lectures and exam.
Recommended optional programme components:
Computer Engineering
Recommended or required reading:
Patterson D., Hennessy J., Computer Organization and Design. Morgan Kauffman, San Fracisco, CA, 2005.

721419P: Consumer Behavior, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Sinisalo, Jaakko Lauri Juhani

Opintokohteen oppimateriaali:
Assael, Henry , , 1995
Solomon, Michael R. , , 2004

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay721419P	Consumer Behavior (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ects.

Language of instruction:
Finnish.

Timing:
Period D.

Learning outcomes:
After having passed this course, students will have an overall picture of the consumer decision making process and an understanding of the factors affecting consumer decision making. In addition, students are able to combine these factors both in theory and in practice.

Contents:
Consumer decision making; the individual consumer, environmental influences to consumer decision making, marketing strategies connected with individual and group behaviour.

Learning activities and teaching methods:
24 h lectures, assignment and independent reading of the textbooks.
Recommended or required reading:

Assael, H.: Consumer Behavior & Marketing Action, 4th ed. 1992 (or newer), OR Solomon, M.R.: Consumer Behavior. Buying, having, being, 5th ed. (or newer) and material provided by lecturer.

Check availability from here.
Assessment methods and criteria:
Lecture and literature examination and written assignment.

Grading:
1-5.

Person responsible:
Assistant of Marketing Jaakko Sinisalo.

470462A2: Control and Systems Engineering, 5 op

Voimassaolo: - 31.05.2015
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Harri Aaltonen, Seppo Honkanen
Opintokohteen kielet: Finnish

Learning outcomes:
To give the student knowledge about the mathematical and practical methods used in control system design.
Learning outcomes *:* After completing the course the students can apply mathematical and graphical methods for the dynamics of the process characterisation and control design. The student can independently: form a linear dynamic process model and design the PID controller and analyse the behaviour of the closed-loop system.
Contents:
Systems and control. Models of processes. Stability. Design and tuning of feedback control. Controllers and control algorithms. Controllability and observability. Transient and Steady-State Response Analyses. Frequency-Response Analyses. Tuning the controller using root locus. Compensators.
Learning activities and teaching methods:
Lectures and exercises. Examination.
Recommended or required reading:
Dorf, R.: Modern Control System. 11th ed. Prentice-Hall 2008, 1018 pp.; Ogata, K., Modern Control Engineering. 4th ed. Prentice-Hall 2002. 964 pp.
Additional literature *:* DiStefano, J.: Feedback and Control Systems. 2nd ed. Prentice-Hall 1990, 512 pp.; Ylen; J-P.: Säätötekniikan harjoitustehtäviä. Hakapaino Oy 1994. 252 pp.
Person responsible:
Assistant Seppo Honkanen

521485S: DSP-laboratory Work, 3,5 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Miguel Bordallo Lopez
Opintokohteen kielet: English

Language of instruction:
In English.

Timing:
Period 2-6.
Learning outcomes:
The course concentrates on implementing basic algorithms and functions of digital signal processing using common modern programmable DSP processors.
Learning outcomes: After the course the student is able to use integrated design environments of digital signal processors for implementing and testing algorithms based on floating and fixed point representation.
Contents:
Sampling, quantization noise, signal generation, decimation and interpolation, FIR and IIR filter implementations, FFT and adaptive filter implementations.
Learning activities and teaching methods:
The course is based on a starting lecture and exercises that are done using development boards of modern 32-bit digital signal processors, and the respective software development tools. The course is passed by accepted and documented exercises
Recommended optional programme components:
Digital filters, computer engineering, programming skills.

031017P: Differential Equations, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Hamina, Martti Aulis

Opintokohteen kielet: Finnish

Leikkaavuudet:

800320A	Differential equations	5.0 op
031076P	Differential Equations	5.0 op

Language of instruction:
Finnish
Timing:
Period 4-6
Learning outcomes:
The students learn the concepts concerning differential equations and get the ability to read associated literature. The students will achieve adequate mathematical skills for treating differential equations. They can identify simple analytically solvable differential equations and they can solve these by using various methods.
Learning outcomes: The students can apply differential equations as a mathematical model. They can identify and solve various differential equations and they have knowledge on basic solvability of differential equations. The student can use the Laplace transform as a solution method.
Contents:
Principles of mathematical modelling. Ordinary differential equations of first and higher order. Laplace transform with applications to differential equations.
Learning activities and teaching methods:
Lectures 3h/week. Two intermediate exams or one final exam.
Recommended optional programme components:
Calculus I.
Recommended or required reading:
Lecture notes in Finnish. Kreyszig. E., Advanced Engineering Mathematics

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannuksela, Jari Samuli

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A Digital Filters (OPEN UNI) 5.0 op

Language of instruction:
In Finnish.
Timing:
Period 5-6.
Learning outcomes:
The objective of the course is to supply the student with basic understanding of digital signal processing and applications.
Learning outcomes: Upon completing the required coursework, the student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods. He is also able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the filters. Moreover, the student is able to explain the impacts of finite word length in filter design. After the course the student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:
1. Introduction, 2. Discrete transforms, 3. Correlation and convolution, 4. Digital filter design, 5. FIR filter design, 6. IIR filter design, 7. Finite word length effects, 8. Multi-rate signal processing, 9. Adaptive filtering.

Learning activities and teaching methods:
The course is based on lectures and design exercises. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.

Recommended optional programme components:
Signals and systems, complex analysis.
Recommended or required reading:
Lecture notes and exercise materials. Material is in Finnish. Some material is in English.
Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

521467S: Digital Image Processing, 5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Pietikäinen, Matti

Opintokohteen kielet: English

Learning outcomes:
To make an introduction to digital image processing and image analysis.
Learning outcomes: After passing the course the student knows the theoretical foundations and most important application areas of digital image processing and image analysis. The student is able to apply spatial domain, frequency domain and wavelet-based image processing methods introduced in the course to solve practical problems in image enhancement, restoration, compression, segmentation and recognition.

Contents:

1. Digital image fundamentals, 2. Image enhancement, 3. Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression, 7. Morphological image processing, 8. Image segmentation, 9. Representation and description, 10. Basic principles of pattern recognition.
Learning activities and teaching methods:
Lectures, exercises, examination. Interactive image processing in Matlab environment is introduced in the programming exercise.
Recommended optional programme components:
Basic studies of mathematics
Recommended or required reading:
Gonzalez R.C., Woods R.E.: Digital image processing, Second edition, Addison-Wesley, 2002. Lecture notes (in Finnish), exercise material.

721650P: Digital Products, 5 op

Voimassaolo: - 31.07.2010
Opiskelumuoto: Basic Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521413A: Digital Techniques 1, 4 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannu Heusala
Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 5-6.
Learning outcomes:
After having completed the coursest student are expected to understand functional principles, implementation options, and logic design principles of the most usual digital equipmet.
Learning outcomes: After the course, students are able to ably binary number system and Boolean algebra in the form of switching algebra to the design and functional analyze of simple digital circuits. In addition, they are also able to use in their designs graphical symbols specified in the dependency notation standard (SFS4612 ja IEEE /ANSI Std.91-1991) and different descriptions of function and structure of state machines. Based on this knowledge, students are able to implement and analyze digital devices consisting of ordinary simple digital components, especially FPGA circuits. After having assimilated the basic knowledge of digital technique, students are able to understand also the function and structure of micro controllers and micro processors.

Contents:
Boolean algebra, number notations, analyze and synthesis of combinatorial circuits, flip-flops, principles of state machine behavior, CPLD- and FPGA-circuits, physical characteristics of CMOS technology.
Learning activities and teaching methods:
Kurssissa tutustutaan luennoilla ja harjoituksissa konkreettisten esimerkkien kautta nykyaikaisten digitaalisteknisten laitteiden toimintaan ja rakenteeseen. Kurssiin sisältyy luennot ja laskuharjoitukset. Opintojakso suoritetaan loppukokeella. Kurssiin liittyy Ohjelmoitava elektroniikka -kurssi, jolle osallistuminen edellyttää Digitaalitekniikka I -kurssin sisällön hallintaa.
Recommended or required reading:
Brown, S., Vranesic, Z. Fundamentals of Digital Logic with VHDL Design, McGraw Hill, 2005

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Heusala

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-2.
Learning outcomes:
The goal of the cource is to familiarize students to the professional design flow, design methodology and implementaion options of digital integrated circuits.
Osaamistavoitteet: After the cource students are able to design high level architectures of digital systems and blocks of the system implemented by special hardware (ASIC and FPGA). Students are able to ably design methodologies and tools. Design verification and implementation analysis are emphasised. Students can simulate and model (VHDL modelling and VHDL simulation) digital systems and critically revalue the design also from the implementation’s point of view.
Contents:
1. Implementation technologies of digital circuits, 2. Description levels of digital systems, 3. VHDL modelling of digital circuits and systems, 4. System level specification and design, 5. Design of ASICs and FPGAs, 6. High level VHDL synthesis, 7. RTL-VHDL synthesis, 8. Planning of production test of digital ASICs.

521445S: Digital Techniques 3, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 3-4.
Learning outcomes:
The goal of the cource is to familiarize students to the professional design flow, design methodology and implementaion options of digital integrated circuits.
Learning outcomes **:** After the cource students are able to design high level architectures of digital systems and blocks of the system implemented by special hardware (ASIC and FPGA). Students are able to ably design methodologies and tools. Design verification and implementation analysis are emphasised. Students can simulate and model (VHDL modelling and VHDL simulation) digital systems and critically revalue the design also from the implementation's point of view.
Contents:
1. Implementation technologies of digital circuits, 2. Description levels of digital systems, 3. VHDL modelling of digital circuits and systems, 4. System level specification and design, 5. Design of ASICs and FPGAs, 6. High level VHDL synthesis, 7. RTL-VHDL synthesis, 8. Planning of production test of digital ASICs.

521478S: Digital Video Processing, 4 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Periods 2-3.
Learning outcomes:
In this course students become familiar with basics of video processing and communications. The main emphasis is in video representation and coding.
Learning outcomes: After completing the course the student is able to explain the basic formats and representations of digital video signals. He can analyze the frequency properties of video signals as well as the effects of sampling of multi-dimensional signals, and he can specify digital filters for video sampling rate conversions. He is able to model video content by using simple two- and three-dimensional models, and apply certain well-known methods for video motion estimation. The student can explain the essential parts of the techniques used in video coding and the most important properties of common video coding standards. He can also describe the general principles of scalable video coding and error resilient video coding.

Contents:
1. Video formation, 2. Fourier analysis of video signals, 3. Sampling of multi-dimensional signals, 4. Video sampling rate conversion, 5. Video modeling, 6. Motion estimation, 7. Foundations of video coding, 8. Waveform-based coding, 9. Scalable video coding, 10. Video compression standards, 11. Error control in video communications.
Learning activities and teaching methods:
Lectures, exercises and Matlab design exercise. The course is passed with final exam and accepted Matlab exercise
Recommended optional programme components:
Digital Image Processing, Digital Filters.
Recommended or required reading:
Y. Wang, J. Ostermann, Y. Zhang: Video processing and communications, Prentice-Hall, 2002, chapters 1-6, 8, 9, 11,13,14. P. Symes: Digital Video Compression, McGraw-Hill, 2004, chapters 9-12. Lecture notes and exercise material .

521266S: Distributed Systems, 6 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Leikkaavuudet:

521290S Distributed Systems 5.0 op

Language of instruction:
In English.
Timing:
Period 5-6.
Learning outcomes:

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The course provides the key principles of distributed systems and
the major design paradigms used in implementing distributed
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systems.

Learning outcomes:

Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the

major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and

implement a small distributed system

Contents:

Architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security,

distributed object-based systems, distributed file systems, distributed object-based systems, distributed coordination-based systems

Learning activities and teaching methods:

Lectures, exercises and practical work.

The course is passed with a final exam or with a set of intermediate exams, together with an approved practical work.

Recommended optional programme components:

Computer networks, Operating systems, Software Engineering.

Recommended or required reading:

Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems - Principles and Paradigms, Second Edition, Prentice Hall, 2007.

Lecture slides and exercises.

721671A: E-commerce and Business Networks, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Salo, Jari Tapani
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521115S: EMC Design, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Häkkinen
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

Language of instruction:
Finnish. In English if there are more than 2 foreign students in the class.
Timing:
Period 6.
Learning outcomes:
The special requirements and limitations of EMC design provide directives for the equipment's interference emission and for their ability to operate as intended in environments/circumstances under interference. This has a great effect on electrical and mechanical design. The course introduces the EMC requirements for electrical equipment as well as methods to achieve them. Learning outcomes: After completing the course the student is able to name common EMC standards, and is able to use EMC testing equipment and methods. The student can explain the noise coupling mechanisms, and is able to use good design practices related to analogue and digital electronics design, grounding, cabling, filtering and shielding.
Contents:
EMC standards for emission and susceptibility, interference coupling, circuit design and grounding, connections, filtering and shielding. EMC testing laboratories, EMC tests and their background.
Learning activities and teaching methods:
Lectures, exercises and laboratory exercises. Final exam.
Recommended optional programme components:
Electronics Design I, Digital Techniques I, Electronic Measurement Techniques, Measuring and Testing Systems, RF Components and Measurements.
Recommended or required reading:
Tim Williams: EMC for Product Designers, 4th edition, Oxford: Newnes, 2007. T. Williams, K. Armstrong: EMC for Systems and Installations. E. L. Bronaugh, W. S. Lambdin: A Handbook Series on Electromagnetic Interference and Compatibility, vol. 6, Electromagnetic Interference Test Methodology and Procedures.

721653P: Ec Systems, Implementation and Strategy, 5 op

Voimassaolo: - 31.07.2010
Opiskelumuoto: Basic Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail

Opettajat: Kesti, Manne Kalervo
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

721210P: Economics for Business, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Tommi Inkilä
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay721210P Economics for Business (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ects.
Language of instruction:
Finnish.
Timing:
Period A.
Learning outcomes:
After completing the course, the student understands how firms, consumers and government interact in markets and how, from a business perspective, the economy as a whole operates. In addition, the student understands the principles of economic way of thinking, e.g. the principles whereby resources are allocated, income distribution is determined, how firms arrive at production decision and how consumers make their consumption choices. The course covers all of the major principles of economics, but its focus is on applying these economic principles to the real world of business.
Contents:
Market mechanism: price formation, importance of prices in directing the economic resources, role of consumers, firms and public authority in market economy.
Learning activities and teaching methods:
36 hours of lectures and individual reading of the literature.
Recommended or required reading:
Begg, D. & Ward, D.: Economics for Business 3. ed., McGraw-Hill Education (2009) and other material given in class.

Check availability from here.
Assessment methods and criteria:
Exam
Grading:
1-5.
Person responsible:
Lecturer in Economics

721672S: Economics of Network Industries, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Timo Koivumäki
Opintokohteen kielet: Finnish

ECTS Credits:
6 ects.

Language of instruction:
Finnish.

Timing:
Period D.

Learning outcomes:
Upon completion of the course, students can understand the effects of the special characteristics (complementarity, consumption externalities, switching costs and lock in and economies of scale in production) on the market dynamics of network industries.
Contents:
We take a game theoretic approach to study dynamics of company structure, strategic decision-making and market development in network industries. We also focus on the effects of social interaction on consumers' choices.

Learning activities and teaching methods:
Lectures/ independent reading of the textbooks.

Recommended or required reading:
Shy (2001): Economics of Network Industries.

Check availability from here.
Assessment methods and criteria:
Exam.

Grading:
1-5.

Person responsible:
Research Professor of Mobile Business Applications Timo Koivumäki.

521109A: Electrical Measurement Principles, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Language of instruction:
Lectures are in Finnish. Laboratory exercises can be done in English.
Timing:
Periods 4-6.
Learning outcomes:
The goal of this course is to give the theoretical and practical basis on electrical measuring techniques and to give basic knowledge to later studies. The course will also provide knowledge to use of general electrical measurement equipment.
Learning outcomes: Upon completion of the course, students are be able to measure basic measurements with a ammeter, voltmeter and oscilloscope. They can 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 safety regulations.
Learning activities and teaching methods:
Lectures and laboratory exercises. One or two exams and passed lab exercises.
Recommended optional programme components:
Calculus I and II, Physics S.
Recommended or required reading:

A.D. Helfrich, W.D. Cooper: Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1990., material from Optima.

761103P: Electricity and Magnetism, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P Electromagnetism 1 5.0 op
761119P-01 Electromagnetism 1, lectures and exam 0.0 op
761119P-02 Electromagnetism 1, lab. exercises 0.0 op
761113P-01 Electricity and magnetism, lectures and exam 0.0 op
761113P-02 Electricity and magnetism, lab. exercises 0.0 op
761113P Electricity and magnetism 5.0 op
766319A Electromagnetism 7.0 op

ECTS Credits:
4 credits
Language of instruction:
The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.
Timing:
Spring
Learning outcomes:
The student masters the basic concepts of electricity and magnetism and is able to apply those when solving the problems related to electromagnetism.
Contents:
Electromagnetic interaction is one of the four fundamental interactions in physics and many phenomena like light, radio waves, electric current, magnetism and formation of solid matter are based on electromagnetism. The current technological development is largely based on applications of electromagnetism in energy production and transfer, telecommunications and information technology.
Contents in brief: Coulomb's law. Electric field and potential. Gauss's law. Capacitors and dielectrics. Electric current, resistors, electromotive force and DC circuits. Magnetic field, motion of a charged particle in electric and magnetic fields, and applications. Ampère's law and Biot-Savart law. Electromagnetic induction and Faraday's law. Inductance and inductors. R-L-C circuits, alternating current and AC circuits.
Learning activities and teaching methods:
Lectures 32 h, 6 exercises (12 h), four mini examinations and end examination or final examination.
Target group:
Secondary subject students.
Recommended optional programme components:
Knowledge of vector calculus and basics of differential and integral calculus are needed.
Recommended or required reading:
Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12th edition, 2008, chapters 21-31. Also 11th and 10th editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Person responsible:
Anita Aikio
Other information:
https://wiki.oulu.fi/display/761103P/

521103S: Electroceramics and Intelligent Materials, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Antti Uusimäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521073S Electroceramics and Intelligent Materials 5.0 op

Learning outcomes:
The course introduces the student to properties and application areas of functional ceramics that are used in electronics. Besides traditional passive components the application area consists of energy sources based in fuel cells, chemical sensors based in ceramics, high-temperature superconductors, piezoelectric precision actuators, ferroelectric memories, pyroelectric infrared detectors, electro-optical light quides and switches and magnetic microwave and antenna components.
Learning outcomes: Upon completing the course, the student is able to estimate the properties and usability of functional ceramics in different component applications of electronics and can perform theoretical calculatory structural dimensioning for them. The student is able to compare and choose applicable processing methods for the production of abovementioned functional structures. In addition the student is able to interpret new research results of the field and recognizes their application areas.
Contents:
Microstructures and special features of ceramic materials, dielectric-, polarization and electrical conductivity properties and the influence of lattice defects on these properties, fabrication and processing of ceramics, ceramic conductors and insulators, piezoelectric and ferroelectric materials, pyroelectric and electro-optical materials, magnetic materials.
Learning activities and teaching methods:
2 hours of lectures and 2 hours of exercises every week. The course is passed with a final exam

721426P: Electronic Commerce, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Salo, Jari Tapani

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

521208A: Electronic Components, 2,5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 5-6
Learning outcomes:

The course provides basic concepts of electronic components and technologies in their fabrication and assembling to electronic circuits.
Learning outcomes: Student is able to compare and choose the right passive component for electronics design to suit the requirements of application and environment. Student can also identify various active components. Student can classify different circuit board techniques and is able to choose proper coupling techniques. Student also recognizes parasitic phenomenon on component and device level. In addition student can justify the need of reliability and testing of electro nics.

Contents:
Passive electronic components (resistors, capacitors and wound components) together with their structures and properties. Basics of the active components (semiconductors, integrated circuits and sensors) Interconnection technologies and circuit fabrication (PCBs and hybrid circuits). Parasitic electric and electromagnetic effects and distributed parameters in high frequency circuits. The concept of reliability.
Learning activities and teaching methods:
Lectures. The course is passed by a final exam.
Recommended optional programme components:
Prerequisites: Electricity and Magnetism
Recommended or required reading:
Lecture notes. S.J. Sangwine: Electronic Components and Technology. Van Nostrand Reinhold (UK), 1987.

521430A: Electronic Measurement Techniques, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Eija Forsberg, Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521092A	Electronic Measurement Techniques	5.0 op
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

Language of instruction:
Lectures are in Finnish. Calculation exercises are in Finnish but same material is available in English. Laboratory exercises can be done in English.
Timing:
Periods 1-3.
Learning outcomes:
The goal of the course is to deepen the knowledge of the field of electronic measurement techniques, to become familiar with censoring principles, measurements of amplifier and filter properties, interference problems and common connector and digital interface solutions and the principles of the processing of measurement results.
Learning outcomes: Upon completion of the course, students can plan and implement complicated measurements with oscilloscopes and basic measurements with spectrum analyzers and light detectors. Students can measure common sources of noise and interference and can name means to control them. Students can name methods to realize electrical quantities.
Contents:
Calibration, measurement amplifiers, spectrum analysers and correlation measurements, noise and interference, grounding, CMR and processing of measurement results

Learning activities and teaching methods:
Lectures and laboratory exercises. One or two exams and passed lab exercises.
Recommended optional programme components:
Electrical Measurement Principles, Analogue Electronics I, Digital Techniques I.

Recommended or required reading:
Ask the lecturer.

521436S: Electronic Research Exercise, 3,5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Kostamovaara

Opintokohteen kielet: Finnish

Leikkaavuudet:

521308S Electronic Research Exercise 5.0 op

Language of instruction:
In Finnish and in English.
Timing:
Period 1-6.
Learning outcomes:
To familiarize the student with independent research work in a field of electronics circuit, device and system development and to give a deeper knowledge in a certain sector of electronics.
Learning outcomes: On completion of the study module students should be able to carry out small-scale electronic circuit or instrument design assignments using appropriate methods and report on the results both orally and in writing.

Learning activities and teaching methods:
The course contains an exercise, in which the student gets a deeper insight in a selected sector of electronics supervising by a researcher in Electronics Laboratory and writes afterwards a short research report. The word "familiarize" means in practice that the student acquires information from publications, for example. The research work may contain real electronic circuit design, simulations and experiments. The Exercise does not contain direct construction of a device like in the course "Electronics Design and Construction Exercise". The research topics belong to the research projects of Electronics Laboratory. This course prepares the student for his diploma work. The student can carry out this course at 3rd year and it is recommended for those students who are interested in research. The grade is given according to the statement of the supervisor and documentation of the work.
Recommended optional programme components:
Depends on the topic of the research work. Minimum prerequisites: Analogue Electronics II, Digital Techniques II. Works requiring design of an integrated circuit: Analogue Electronics II, Digital Techniques III and Computer Aided Circuit Design.

521405A: Electronic System Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Periods 1-2.
Learning outcomes:
The main goal of the course is to introduce methods and techniques needed in designing larger electronic entities such as equipment and systems.
Learning outcomes: On completion of the study module a student is able to explain all the phases of a development project of an electronic device. He or she is able to explain how to protect results obtained during the development process and on the other hand the student is able to explain the restrictions caused by standards and patents of other companies. The student is able to choose the optimum method of the choices

presented in the course in the field of power supply, thermal design, grounding, and routing of the high speed signals. The student is able to calculate problems, caused by electrical disturbances, crosstalk and nonidealities of electrical components. After passing the course the student can calculate reliability of an electrical device or system.

Contents:
Electronic product design process, patents, test design, and EMC/LVD standards, Characteristics of ASIC technology and design, Characteristics of highspeed digital design. Reliability engineering. Documentation design
Learning activities and teaching methods:
The course includes 3 h of lectures and 2 h of exercises per week. The course will be passed by means of a final exam.
Recommended optional programme components:
Circuit Theory I-II, Analogue Electronics I-II, Digital Techniques I-II, Filter Theory, Computer engineering, Embedded Systems.
Recommended or required reading:
Handout. Ward & Angus: Electronic Product Design, m Hall&Hall&McCall: Highspeed Digital Design, Montrose: EMC and the Printed Circuit Board, Ott: Noise Reduction Techniques.

521223S: Electronic and Optoelectronic Materials, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-3.
Learning outcomes:
Opintojaksossa perehdytään elektroniikassa ja optoelektroniikassa käytettäviin funktionaalisiin materiaaleihin. Tarkoituksena on antaa yleiskäsitys näiden materiaalien pääominaisuuksista ja ilmiöistä, joihin nämä ominaisuudet perustuvat, sekä niiden käytöstä elektroniikassa.
Osaamistavoitteet: Opintojakson suoritettuaan opiskelija osaa selittää perusteet eristeiden käyttäytymisestä tasa- ja vaihtokentässä, magneettisten materiaalien ominaisuuksista sekä magnetismiin liittyvistä käsitteistä, sähkökeraamien ominaisuuksista ja sovelluksista sekä valoa lähettävien ja moduloivien laitteiden materiaaleista. Opiskelija osaa myös arvioida eri materiaalien käytettävyyttä ja soveltuvuutta elektroniikan ja optoelektroniikan laitteisiin.

Contents:
The course treats materials used in electronic circuits, optoelectronics and transducers. Magnetic materials (soft and hard, information storage). Piezo-, pyro- and ferroelectric materials and their applications. Displays and their materials (liquid crystals). Materials for optoelectronic devices.
Learning activities and teaching methods:
Lectures, exercises and design exercises. The course is passed by a final exam and exercises.
Recommended optional programme components:
Introduction to Material Physics
Recommended or required reading:
N. Braithwaite and G. Weaver, Electronic Materials, The Open University, Butterworths, London, 1990. Lecture notes.

521432A: Electronics Design I, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kilpelä, Ari Juhani

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 4-5.
Learning outcomes:
To give the student the basic information about analogue electronics design. The course is continuation to Principles of Electronics Design.
Learning outcomes: On completion of the study module students should be able to recount the principles governing the design of multistage amplifiers, analyse and set the frequency response of a transistor amplifier and make use of feedback to improve the properties of an amplifier in the desired manner. They should also be able to analyse the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability. Students should similarly be able to describe the principles governing the design of power amplifiers, to make widespread use of operational amplifiers for realizing electronic structural blocks and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers. They should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and resonance amplifiers and to recount the basic principles governing the functions and properties of emitter-coupled logic.
Contents:
Frequency response of transistor amplifier, differential amplifier, feedback, stability and nonidealities of feedback amplifier, comparator, output stages and power amplifiers, application of operational amplifier, oscillators, tuned amplifiers and ECLlogic. Implementation: Lectures and exercises. This course is required when participating in Laboratory Exercises on Analogue Electronics. Final exam.
Recommended optional programme components:
Circuit Theory II, Principles of Electronics Design, Principles of Semiconductor Devices.
Recommended or required reading:
Handout. Sedra, Smith: Microelectronic Circuits (4th edition), Chapters 2, 6-12. OR Hambley: Electronics (2nd edition), chapter 2; chapters 7 - 12 to most part.

521443S: Electronics Design II, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tarmo Ruotsalainen

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish (In English if needed).
Timing:
Period 1-2.
Learning outcomes:
The goal is to reinforce and further develop the student's understanding of concepts of analogue circuit blocks and their application and use in the design of electronic equipment. The course also gives basic skills for the design of integrated building blocks. Noise and modeling of noise in electrical circuits, and the structures and properties of DA/AD converters are covered.
Learning outcomes: On completion of the study module students should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies, analyse and design integrated structural blocks based on these components, such as operational amplifiers, comparators and sampling circuits, and estimate and minimize the effects of noise on these. They should also be able to explain the terminology connected with DA and AD conversion and converters and to analyse and outline their main structural principles and evaluate their characteristics.
Contents:
Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.

Learning activities and teaching methods:
Lectures, exercises and a small design work. Final exam.
Recommended optional programme components:
Electronics Design I.
Recommended or required reading:
Lecture notes, D. A. Johns & K. Martin: Analog integrated circuit design, Wiley & Sons 1997, chapters 1, 3, 4, 5, 7, chapter 8 partially, 11, 12 and 13. OR P. E. Allen &D. R. Holberg: CMOS Analog Circuit Design, Oxford University Press 2002, chapters 1, 3, 4, 5, 6, 8 and 10.

521435S: Electronics Design III, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tarmo Ruotsalainen

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 3-4.
Learning outcomes:
This course continues themes of Electronics Design II with the goal of extending the understanding and skills of the student in the area of integrated circuits and systems (mainly mixed-mode) in CMOS technology. The emphasis is in highperformance and high-level system building blocks (sampling, filtering, AD/DA conversion, phase/frequency domain signal processing). The analogue/digital boundary with oversampling and __ related conversion techniques is one of the main topics here. All topics covered in this course are highly relevant to modern state-ofthe-art electronics. One of the goals is also to advance the students skills in self learning and ability to follow the development of the technology field.
Learning outcomes: On completion of the study module students should be able to detail the advantages of differential signal processing in IC realizations and to analyse and design differential amplifiers and other structural blocks for implementation in an IC environment. They should be able to explain how an SC technology functions and to apply such a technology to sampling and filtering. 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 and to apply it for realizing integrated DA and AD converters. They should be able to account for the functioning, use and structure of a phase-locked loop, 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, __-techniques in general and particularly in AD /DA converters, operations with frequency/phase domain signals, design of IC layout.
Learning activities and teaching methods:
Lectures, exercises and an extended laboratory exercise. In the laboratory exercise CAD tools used in IC design and a complete IC design flow become familiar. Lectures and exercises are on periods 3 and 4 and the laboratory exercise on periods 5 and 6. The course may include seminar-type study. The course will be passed by means of a final exam and a passed laboratory exercise.
Recommended or required reading:
Lecture notes: D. A. Johns & K. Martin: Analog integrated circuit design, Wiley & Sons 1997 chapter 6, chapter 8 partially, 9, 10, 14, 15 and 2. 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.
Prerequisites: Filter theory, Electronics Design II, Principles of Microelectronics and Micromechanics (recommended).

521441S: Electronics Design and Construction Exercise, 6,5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521300S Electronics Design and Construction Exercise 6.0 op

Language of instruction:
Finnish.
Timing:
Period 1-6.
Learning outcomes:
To familiarize the student with independent electrical circuit and system design and with the methods and tools used in the design process. The course prepares the student for the diploma work in the area of circuits and system design.
Learning outcomes **:** On completion of the study module a student is able to carry out all the stages needed to develop an electronic circuit or device starting from independent creation and design work to realization, testing and technical documentation. He or she is able to use independently without any help professional methods, software packages, measurement devices and tools.

Contents:
Design and construction of an electronic device or a part of a device according to the given specification. The task can be part of an industrial research or a product design project. Experienced designers are used as instructors. The task can be carried out by one person or by a team of two persons. The mark will be decided on the basis of the statement of the instructor and the report provided by the student. Starting from spring 2003 an alternative for normal design/contruction work is to take part in a special course, in which a mixed mode analog IC is designed. This design task is executed under supervision in the workstation class and the whole IC design flow and the IC design software are studied. It is possible that the number of the students taking part in the IC design course may be limited on the basis of successful progress in electronics studies.
Recommended optional programme components:
Analogue Electronics I-II, Digital Techniques I-II, Electronic System Design, Filter Theory, Digital Filters, Computer Engineering, Embedded Systems

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521141P Elementary Programming (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:
Finnish.
Timing:
Period 1-3.
Learning outcomes:
Learning outcomes: Upon completing the required coursework, the student is able to recognize the basic programming concepts and structures. Moreover, the student is able to implement small programs.
Contents:

History of programming, basic concepts of programming, basic structures of programming languages, solving problems by programming
Learning activities and teaching methods:
Lectures, many programming exercises
Recommended or required reading:
Will be announced later

521275A: Embedded Software Project, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Learning outcomes:
To familiarize students with modern embedded system development with modern methods and tools.
Learning Outcomes: Embedded software project is the final course in the Bachelor's degree. The skills to pass this course have been acquired in precious courses. During the course, students work in groups to implement a program into an embedded system and write a Bachelor's thesis on the work. The subject of the program is not necessarily covered in previous courses.
After completing the course work, students have demonstrated that they can employ their skills in acquiring information to find a feasible solution to a given problem while still addressing the constraints imposed by a given embedded system. The student has shown that they are capable of designing and then implementing the non-trivial solution as a program to the given embedded system. Furthermore, they have demonstrated that they are capable of writing good-quality scientific text, including a literature survey, theory, technical documentation, testing documentation and other necessary chapters to form an acceptable Bachelor's thesis.

Contents:
Development tools, practical application programme for an embedded system.
Learning activities and teaching methods:
Pair project with monitoring meetings and a compulsory exercise.

Recommended optional programme components:
Software Engineering, Embedded Systems, Operating Systems.
Recommended or required reading:
Data periodicals, handouts, handbooks.

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Learning outcomes:

The objective of this course is to familiarize students to modern embedded system development process with hands on approach.
Learning outcomes: Upon completing the required coursework, the student is able to do an embedded system development process from a requirement specification to a prototype. Based on the requirement specification the student can create a system level design, select components, design a printed circuit board and manufacture it, assemble the board, and design, implement, test and debug software for the system, and finally achieve a result that fulfills the given requirements.
Contents:
Creating a simple prototype level device, based on the Atmel AVR microcontroller. Demonstration of the prototype. Applicable components and tools: avr-gcc, Eagle/Orcad, AVR Studio, JTAG-ICE.
Learning activities and teaching methods:
The course is a project that is made with groups of three students. The proceeding of the project is monitored by meetings with assistants.
Recommended optional programme components:
Digital Techniques I, Computer Engineering, Embedded Systems. Also recommended Embedded Software Project, Principles of Electronics Design.
Recommended or required reading:
Assignment, component datasheets, manuals, www-pages.

521268A: Embedded Systems, 4,5 op

Voimassaolo: 01.08.2005 - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Janne Haverinen

Opintokohteen oppimateriaali:
Berger, Arnold S. , , 2002
Opintokohteen kielet: English

Learning outcomes:
The aim of the course is to provide the basic knowledge about the design and implementation of embedded systems. The course will introduce the design life cycle of the embedded systems, and a basic tool set for embedded systems development. The course also provides the basic knowledge about the hardware programming with an Atmel AVR series microcontroller.
Learning objectives: After passing the course a student can explain the life cycle of the embedded system, the characteristic features related to embedded systems development, and the risks involved. In addition, the student can explain the roles of the client and the system developer during the requirements specification, and the role of the iteration phase as a part of the requirements specification phase. The student can explain the factors affecting to SW/HW partitioning process, and the concept of SW/HW dualism. The student can fairly analyze the factors affecting to the selection of the processor and the operating system. The student can recognize the basic development tools used and their possible advantages and disadvantages. The student can compare various testing approaches. The student can explain how a design error affects to the final cost of the system in different phases of the development. The student can do some basic I/O programming using C programming language.
Contents:
The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing, I/O programming.

Learning activities and teaching methods:
Lectures, laboratory exercise, and exam.
Recommended optional programme components:
Computer Engineering, Programming Exercise, Introduction to C Programming, Digital Techniques I.
Recommended or required reading:
Berger, Arnold S. (2002) Embedded Systems Design: An introduction to Processes, Tools, & Techniques, CMP Books, USA. ISBN:1578200733.

521142A: Embedded Systems Programming, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Language of instruction:
Finnish.
Timing:
Period 4-6.
Learning outcomes:
Learning outcomes: Upon completing the required coursework, the student is able to implement small C programs both in PC environment and for embedded systems with memory-mapped I/O. Moreover, the student is able to recognize how embedded systems programming differs from programming general-purpose computers.
Contents:
Basics of C, bitwise operations, memory management, memory-mapped I/O devices, hardware registers, interrupts
Learning activities and teaching methods:
Lectures, many programming exercises
Recommended optional programme components:
Elementary programming
Recommended or required reading:
Will be announced later

521331A: Filters, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521304A Filters 5.0 op

Language of instruction:
The course and exercises are held in Finnish
Timing:
Period 3-4.
Learning outcomes:
Learning Outcomes: After completing the course the student can construct a needed pole-zero map for a given frequency response, can perform frequency and impedance scaling, can choose an appropriate prototype filter and solve the required order of the filter. Further, he can synthesize simple passive and active filters, and understands the principles for optimising the dynamic range of active filters, and understands the basic limitations of various filter implementation technologies.
Contents:
Prototype filters (Butterworth, Chebychev, Bessel etc.), frequency transforms and impedance conversions. Implementations using lumped and distributed circuits. Active filters. Sensitivity analysis and optimizing the dynamic range of filter stages.
Learning activities and teaching methods:
Lectures and exercises together 5 hours per week. Design exercise and final exam.
Recommended optional programme components:
Knowledge in circuit theory and analog design.
Recommended or required reading:

Handouts. van Valkenburg: Analog Filter Design, chapters 1-14, 18, 20 Holt-Saunders 1982, OR Schauman, van Valkenburg: Design of Analog Filters, chapters 1-13, Oxford University Press 2001.

477505S: Fuzzy-neuromethods in Process Automation, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Esko Juuso

Opintokohteen kielet: Finnish

Leikkaavuudet:

477525S	Computational intelligence in automation	5.0 op
470438S	Fuzzy Sets and Neural Networks in Process Automation	3.5 op

ECTS Credits:
4,0 cr
Language of instruction:
Finnish and English
Timing:
Implementation in 5th period.
Learning outcomes:
The objective of the course is to provide advanced understanding on the methodologies and applications of intelligent systems, especially in process automation.
Learning outcomes **:** After the course the student is capable of explaining the concepts of intelligent systems and operation principles of fuzzy set systems, neural networks, neuro-fuzzy systems and genetic algorithms. The student has skills to construct and tune fuzzy models in Matlab-Simulink environment and to explain the operation of these models. The student is able to explain in an integrating way the principle concepts of neural computing and construct neural network models in Matlab-Simulink environment. The student recognizes the key problems of the data-driven modelling and is able to choose suitable solutions which ensure generalization. The student is able to explain the operation principles of genetic algorithms and to use them in optimization. Moreover, the student is able to describe alternative solutions for dynamic models, hyper plane methods and hybrid solutions. The student can explain the key concepts of cellular automata and evolutionary computation. After the course the student is able to search other relevant programming tools.
Contents:
Modelling, modular and equation based simulation, dynamic simulation, intelligent methods in simulation, simulation in automation, event handling in continuous simulation, simulation of production processes, distributed simulation, integration with other systems, simulation languages and programming tools.
Learning activities and teaching methods:
The course consists of lectures, several exercises, a case study, two seminars and a final report. The case study covers several topics applied in a chosen problem. Each seminar presentation concentrates on a single topic. The final grade is based on the combined points from exercises, case study, seminar and the final report. Final exam is an alternative for the final report. Reports and exams can be done also in English.

Recommended or required reading:
Lecture notes and exercise materials. Material is in Finnish and in English.
Person responsible:
University teacher Esko Juuso

721342S: Game Theory, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Marja-Liisa Halko
Opintokohteen kielet: English

ECTS Credits:
6 ects.
Language of instruction:
Finnish.
Timing:
To be announced later.
Learning outcomes:
The aim of this course is both to familiarize students with the principles of game theory and shortly introduce some results of the behavioral game theory.
Contents:
Basic concepts of game theory, Games of perfect information (normal and extensive form games, Nash equilibrium, mixed strategy equilibrium), Games of imperfect information (Bayesian games).
Learning activities and teaching methods:
To be announced later.
Recommended optional programme components:
Microeconomic analysis recommended.
Recommended or required reading:
M. Osborne. An Introduction to Game Theory. Oxford University Press 2003.

Check availability from here.
Assessment methods and criteria:
To be announced later.
Grading:
1-5.
Person responsible:
D.Soc.Sc. (Econ.) Marja-Liisa Halko.

521263S: Genetic Algorithms, 5 op

Voimassaolo: 01.08.2005 - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Jarmo Alander
Opintokohteen kielet: Finnish

521264S: Human-Computer Interaction Techniques, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:
Learning outcomes: A student is able to explain user-computer interaction principles types, mechanisms on the area of smartphones and interoperable smart environments, and the student is able to apply the methods in a creative and innovative way to the selected application areas. After the course the student is able evaluate critically the applicability of interaction techniques and provide solutions to interaction technique design challenges.
Contents:

D esign processes and guidelines to develop professional quality user interfaces. Techniques for physical selection interaction. Techniques for context aware interaction with multitude of context types. Techniques and principles for multimodal interaction (for example interaction based on mixture of modalities; gesture, graphics, audio, context and touch). Mechanisms for context-based interaction adaptivity.
Learning activities and teaching methods:
Lectures, Seminar presentations , Mandatory design excersice.
Recommended optional programme components:
Required skills: Programming skills, intelligent systems
Recommended or required reading:
Lecture material. Selected scientific publications.
Assessment methods and criteria:
To pass the course accepted written exam and accepted design excersice are required.

721415A: Industrial Sales Management, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Johnston Wesley
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ects.

Language of instruction:
English.

Timing:
Period A.

Learning outcomes:
After the course, the students know the principles of international industrial sales management on the basis of a relationship approach and understand the sales force environment. Furthermore, students are able to plan sales and recruit, motivate, evaluate and supervise the sales force.

Contents:
The selling process, industrial sales management, planning for sales, developing sales force.

Learning activities and teaching methods:
24 h lectures, (and a computer simulation conducted in teams).

Recommended or required reading:
Hite, R.E. & Johnston, W. J.: Managing Salespeople. A Relationship Approach. 1998; Collection of articles and cases.

Check availability from here.
Assessment methods and criteria:
A computer simulation conducted in teams, and a literature examination.

Grading:
1-5.

Person responsible:
Professor (Docent) in Industrial Marketing and Sales Wesley Johnston.

521032A: Information Engineering Study, 3 - 8 op

Voimassaolo: 01.08.2008 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:
Finnish/English
Learning outcomes:
In this course the student learns basic research skills by writing a thesis that fulfills the principles scientific reporting. Another objective is to provide deeper knowledge on the given subject area.
Learning outcomes: After the course the student has rudimentary skills for doing a literature study and using it to write a short thesis that fulfills the principles of scientific writing. He can explain the most essential related methods, and he can utilize the terminology of the given subject in written and oral communications. The student is able to tell about good research practices and use them when working in research oriented tasks.
Contents:
The student makes himself familiar with the problems, concepts and methods of the subject area using scientific literature. He may also implement the selected methods and produce own experimental data. The material obtained is then analyzed and represented as a written thesis that follows the guidelines of the diploma thesis when applicable. Special attention is paid to coverage, consistency and clarity of the presentation.
Learning activities and teaching methods:
The subject is selected together with the supervisor. The course includes self-studying and meetings with the supervisor. The thesis can be made also in groups of two students provided that the individual part each student is sufficient and the roles have been clearly specified in the thesis submitted for review. Completing the course requires that the thesis has been accepted.
Recommended optional programme components:
Basic mathematics and related intermediate courses.
Recommended or required reading:
The material is determined based on the subject.

521499A: Information Networks Service Techniques, 5 op

Voimassaolo: 01.08.2007 - 31.12.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ylianttila

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 4-5.
Learning outcomes:
Course aims at providing insight into the structure, services, techniques and networks of modern information networks, and involved strategic decisions. Course provide introduction in applying the converged service techniques and understanding the related theoretic models.
Learning objectives: Student can explain the essential concepts and fundamentals of the information networks structures. Student can explain related theoretic models and classify different service technologies. Student can recognize the role of networked technologies in the implementation of various information network services.

Contents:
Network theory, traffic theory, game theory, information network services, service platforms, service architectures, network effects, service adoption, network strategies, peer-to-peer network techniques.

Learning activities and teaching methods:
Lectures and group work. Grade is determined by a final exam. Group work can provide additional points to exam. Course materials are available at OPTIMA. Further information: http://www.ee.oulu.fi/research/tklab/courses/521499A/

Recommended optional programme components:
recommended courses include Introduction to Telecommunication Engineering (521319A), Software Engineering (521457A), Operating Systems (521453A) and Eletronic commerce (721426A).

Recommended or required reading:
S. Mueller, APIs and Protocols for Convergent Network Services, McGraw-Hill 2002, kappaleet 1,2,7-14. Additional reading **:** T. Ahonen, m-Profits: Making Money from 3G Services, Wiley 2002.

521031A: Information Networks Study, 3 - 8 op

Voimassaolo: 01.08.2008 - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ylianttila

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-6.
Learning outcomes:
The aim of the course is to provide skills for the student to do research on information networks study area by writing a report according to the principles of scientific writing. In addition students get deepened understanding of the studied topic.
Learning objectives: Student can produce a scientific report in a required format and language specifications. Student can use scientific method in research and can organize the written study in a systematic and clear way.

Contents:
Students familiarises with the problems, concepts and methods based on literature study and research publications. Student can do research on computer science or utilizing multidisciplinary approach. Methodology is selected based on the topic. Results are analyzed and presented as written study, where the layout and format follows the guidelines given for diploma theses. Emphasis is given into extensiveness, organization, consistency and substance of the presented information.

Learning activities and teaching methods:
Topic of the study is agreed with the supervisor. Work is done independently with some counselling with the supervisor. Study can be done in groups of two persons, but the independent work part of each must be big enough for each and the division of work must be clear when the report is returned. Approved report is required for passing the course.

Recommended optional programme components:
Basic studies of the Information Networks study program, and relevant subject studies for the topic.
Recommended or required reading:
Based on the topic.

521496S: Information Networks System Design, 5 op

Voimassaolo: 01.08.2005 - 31.12.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-6.
Learning outcomes:
The aim of the course is to provide students advanced knowledge on the design criteria, implementation and testing of the systems hardware level architecture.
Learning objectives: Student can produce design and requirement specification and other related project documentation. Student can implement system integration and other required hardware or software components based on the architecture specification, and also functional testing.

Contents:
Information networks systems design and implementation work, include the following three aspects:

1. Architecture specification design and requirement specification for the implemented system
2. Implementation the hardware and software components based on the architecture specification, to achieve system integration goals
3. Functional testing of the systems and project reporting

Learning activities and teaching methods:
Course is done as independent design work within 1-3 member groups, for topic of novel systems areas. Work involves design and implementation of whole or part of information network system by case studying a service example. Further information: http://www.ee.oulu.fi/research/tklab/courses/521496S/

Recommended optional programme components:
courses included in the B.Sc level for software and electronics courses.

Recommended or required reading:
Depending on the topic, including standards specifications and software/hardware API documentations

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Faculty of Technology

Arvostelu: 1 - 5, pass, fail

Opettajat: Koivuniemi, Mirja-Liisa, Sassali, Jani Henrik

Opintokohteen kielet: Finnish

Leikkaavuudet:

030004P Introduction to Information Retrieval 0.0 op

ECTS Credits:
1 credit.
Language of instruction:
Finnish/English
Timing:
2nd or 3rd year.
Learning outcomes:
Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.
Contents:
Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.
Learning activities and teaching methods:
The course involves training sessions (8h), web-based learning materials, exercises in the Optima learning environment and a final assignment on a topic of the student's own choice.
Recommended or required reading:
Web-based learning material from Toolbox of Reseach (https://wiki.oulu.fi/display/tor/1.1+Finding+scientific+information)
Assessment methods and criteria:
Passing the course requires participation in the training sessions and successful completion of the course assignments.
Grading:
pass/fail
Person responsible:
Science and Technology Library Tellus, tellustieto (at) oulu.fi
Other information:
http://www.kirjasto.oulu.fi/index.php?id=738

031047S: Introduction Course to the Boundaryelement Method, 6,5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Hamina, Martti Aulis

Opintokohteen kielet: Finnish

Leikkaavuudet:

031083S Principles of the boundary element method 7.0 op

Language of instruction:
Finnish
Timing:
Period 1-2
Learning outcomes:
The student is given a description of the mathematical machinery which is necessar
for implementation of the boundary element method. Both theoretical and practical aspects are included.
Learning Outcomes **:** The students will be able to program a solution algorithm by using the Boundary Element Method. They understand the underlying principles of basic numerical methods (FDM, FEM, BEM) used for approximate solution of the boundary value problem of the potential equation.
Contents:
Connections between differential and integral equations. The variational form and minimum characterization of a boundary value problem. Formulation of a potential problem as a boundary integral equation. The numerical solution of a boundary integral equation. Spline interpolation. Numerical integration. Funkcional analytical background. The Lax-Milgram theorem. Comparison between the method of finite differences, finite elements and boundary elements. Convergence.
Learning activities and teaching methods:
Lectures and classroom exercices.
Recommended optional programme components:
Calculus I and II, matrix algebra, differential equations, numerical methods.

Recommended or required reading:
Lecture notes in Finnish. Chen G., Zhou J.: Boundary Element Methods. Hackbush W.: Integralgleichungen. Brebbia C.A, Dominguez J.: Boundary Elements. An Introductory Course.

801346A: Introduction to Cryptography, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802336A Introduction to Cryptography 5.0 op

ECTS Credits:
4 cr
Learning outcomes:
After completeing the course, student
- knows the principles of sime traditianl symmetric key methods
- knows how public key methods (RSA, discrete logarithm, knapsack) work
- is familiar with the possibility to use and apply number theory in cryptography
Contents:
The course considers some traditianl symmetric key methods (affine system, matrix cryptography) and three public key methods, namely RSA, discrete logarithm and knapsack.
Person responsible:
Keijo Väänänen

521104P: Introduction to Material Physics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-2.
Learning outcomes:
The students are introduced to the physical principles of electronic and atomic phenomena existing in electronic materials and components. The connections to the general principles of solid state physics are emphasized in the consideration of the phenomena.
Learning outcomes: After completing the course, student is able to explain the basic concepts related to materials physics. The student can outline the crystal structure of the solids and the crystalline binding and is able to explain the principles of the theory used in describing the different kinds of waves traveling in solids. Moreover, he or she can explain the principles of statistical mechanism and use them to explore thermal properties of the solid. The student can also outline the free electron model of metals and the formation of the energy band structure of the crystals and their significance to the electrical properties of materials. He or she is able to explain the basic phenomena related to semiconductors and is able to calculate the charge carrier distributions in them.

Contents:
Crystal structures and cohesion. Waves and defects in crystals. Basic principles of quantum mechanics and thermal properties (statistics). Free electron model of metals, energy bands and Brillouin zones in crystals. Basic phenomena of semiconductors.
Learning activities and teaching methods:

Lectures and exercises.
Recommended optional programme components:
Basic physics and mathematics
Recommended or required reading:
H.M. Rosenberg: The Solid State, Clarendon Press, Oxford, 1988. B. Streetman: Solid State Electronic Devices, Prentice Hall, New Jersey, 1995.

521218A: Introduction to Microelectronics and Micromechanics, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Antti Uusimäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521070A Introduction to Microfabrication Techniques 5.0 op

Language of instruction:
In Finnish.
Timing:
Peroid 4-6.
Learning outcomes:
The student is introduced to the fabrication methods of integrated circuits (IC) and structures of micromechanics. Learning outcomes **:** After completing the course the student has an extensive knowledge of different fabrication methods of microelectronics and micromechanics. The student knows the required properties of semiconducting materials, the processing of the source material and basic principles of the semiconductor wafer fabrication. The student is able to apply her/his knowledge of the fabrication of semiconductor components. The student has also an understanding of the micromechanics processing methods and thick-film circuit design and fabrication.

Contents:
Integrated circuits: materials, methods, components and circuit technologies. Thick film hybrid techniques. Fabrication of micromechanical structures. Application examples
Learning activities and teaching methods:
Lectures and demonstration including design work. Final exam.
Recommended or required reading:
Lecture notes. D.V. Morgan, K. Board: An Introduction to Semiconductor Microtechnology, John Wiley & Sons, New York 1990/1995.
Assessment methods and criteria:
Final exam, design exercise and demonstration.

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

Language of instruction:
Finnish. English for the students in the International Master program.
Timing:
Period 1-3
Learning outcomes:
The objective of the course is to provide the mathematical foundations of the optimization methods, to analyze their basic theoretical properties and demonstrate their performances on examples.

Learning outcomes **:** The student learns to solve convex optimization problems with the basic optimization algorithms. He/She is able to form the necessary and sufficient conditions for the optimization problem and is able to form the corresponding dual problem.
Contents:
Linear optimization. Simplex-algorithm. KKT-conditions. Dual problem. Gradient algorithms. Conjugate gradient algorithm. Barrier- and penalty function methods. Implementation: Lectures 3h/week, Exercises 2h/week. Two intermediate exams or one final exam.
Recommended optional programme components:
Calculus 1, Calculus 2, Matrix algebra.
Recommended or required reading:
- K. Ruotsalainen, Optimoinnin perusteet (lecture notes in finnish)
- P. Ciarlet; Introductionto numerical linear algebra and optimization
- M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

080901A: Introduction to Technology in Clinical Medicine, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Institute of Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
2nd year, autumn-spring
Learning outcomes:
After this course student is familiar with the different applications of medical technology and engineering that are used in different clinical areas.
Contents:
Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented.
Learning activities and teaching methods:
Initial exam. Lectures 35 hrs, demonstrations 30 hrs, written work. Final exam.
Assessment methods and criteria:
Initial exam and written work. Taking part in the lectures and demos. Written final exam.
Grading:
1-5 or fail
Person responsible:
Professor Timo Jämsä

Compulsory

080901A-04: Introduction to Technology in Clinical Medicine, Exam, 0 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Institute of Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

2nd year, autumn-spring

Learning outcomes:

After this course student is familiar with the different applications of medical technology and engineering that are used in different clinical areas.

Contents:

Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented.

Learning activities and teaching methods:

Initial exam. Lectures 35 hrs, demonstrations 30 hrs, written work. Final exam.

Assessment methods and criteria:

Initial exam and written work. Taking part in the lectures and demos. Written final exam.

Grading:

1-5 or fail

Person responsible:

Professor Timo Jämsä

080901A-03: Introduction to Technology in Clinical Medicine, Written assignment, 0 op

Voimassaolo: 01.08.2010 -
Opiskelumuoto: Intermediate Studies
Laji: Partial credit
Vastuuyksikkö: Institute of Health Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

2nd year, autumn-spring

Learning outcomes:

After this course student is familiar with the different applications of medical technology and engineering that are used in different clinical areas.

Contents:

Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented.

Learning activities and teaching methods:

Initial exam. Lectures 35 hrs, demonstrations 30 hrs, written work. Final exam.

Assessment methods and criteria:

Initial exam and written work. Taking part in the lectures and demos. Written final exam.

Grading:

1-5 or fail

Person responsible:

Professor Timo Jämsä

080901A-02: Introduction to Technology in Clinical Medicine, Lectures and demonstrations, 0 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Institute of Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

2nd year, autumn-spring

Learning outcomes:

After this course student is familiar with the different applications of medical technology and engineering that are used in different clinical areas.

Contents:

Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented.

Learning activities and teaching methods:

Initial exam. Lectures 35 hrs, demonstrations 30 hrs, written work. Final exam.

Assessment methods and criteria:

Initial exam and written work. Taking part in the lectures and demos. Written final exam.

Grading:

1-5 or fail

Person responsible:

Professor Timo Jämsä

080901A-01: Introduction to Technology in Clinical Medicine, Initial exam, 0 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Vastuuyksikkö: Institute of Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

2nd year, autumn-spring

Learning outcomes:

After this course student is familiar with the different applications of medical technology and engineering that are used in different clinical areas.

Contents:

Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented.

Learning activities and teaching methods:

Initial exam. Lectures 35 hrs, demonstrations 30 hrs, written work. Final exam.

Assessment methods and criteria:

Initial exam and written work. Taking part in the lectures and demos. Written final exam.

Grading:

1-5 or fail

Person responsible:

Professor Timo Jämsä

521319A: Introduction to Telecommunication Engineering, 2,5 op

Voimassaolo: 01.08.2006 - 31.07.2012
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 2-3.
Learning outcomes:
The course gives an overview to wireless communication systems, basic concept, key technologies and future trends as well as an overview to teaching and research given by Telecommunication laboratory
Learning outcomes: Upon completing the required coursework, the student is able to use the basic concepts of different areas of data communication systems to describe the functionality of a communication system. The student recognizes the different parts of a digital communication system and is capable of answering simple questions related to the system.

Contents:
History of telecommunications, wireless transmission techniques, radio engineering, communication networks and communication signal processing, basics of communication theory.
Learning activities and teaching methods:
Two to four hours of lectures per week. Written final exam.
Recommended or required reading:
Lecture notes.

521481P: Introduction to the Use of Workstation, 1 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Toni Hakanen
Opintokohteen kielet: English

Language of instruction:
Finnish and English
Learning outcomes:
Give the student basic skills in using Unix-based workstations. After the course the student has a user account in the electrical engineering workstation network.
Osaamistavoitteet: After passing the course, the student can explain the directory structure of a Unix-based system and is able to use a workstation from the command line interface. The student finds help

for new commands from the manual pages, can modify file access rights and finds files from the directory tree.

Contents:
Using Unix-based workstations from the command line interface, moving around in the directory tree, manual pages. Creating, moving, searching and deleting files. File permissions. Establishing connections to remote servers.
Learning activities and teaching methods:
Lab exercises. Preliminary assignments.
Recommended or required reading:
Hand-out.

761121P: Laboratory Exercises in Physics 1, 3 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761115P	Laboratory Exercises in Physics 1	5.0 op
761118P-01	Mechanics 1, lectures and exam	0.0 op
761115P-02	Laboratory Exercises in Physics 1, laboratory exercises	0.0 op
761115P-01	Laboratory Exercises in Physics 1, lecture and exam	0.0 op
761114P-01	Wave motion and optics, lectures and exam	0.0 op
761113P-01	Electricity and magnetism, lectures and exam	0.0 op

ECTS Credits:
3 credits
Language of instruction:
The lectures and the instruction material will be in Finnish. The laboratory experiments will be made in groups guided either in Finnish or in English.
Timing:
Autumn, spring.
Learning outcomes:
Main aim is to learn to make safe physical measurements, use different measurement tools, read different scales, handle the data, calculate the error estimations and make a sensible report of the measurements. After this course the student is able to make laboratory experiments and reports independently.
Contents:
The skill to make laboratory measurements is important for physicists. This is an introductory course how to make physical measurements and how to treat the measured data. Laboratory works are made in groups. The laboratory security is an essential part also in physics. Different measurements are made with different instruments. As a result the most probable value is determined as well as its errors. Five different works will be made during the course in groups of up to 8 students. The skills obtained during this course can be applied in the other laboratory courses Laboratory exercises in physics 2 and 3.
Learning activities and teaching methods:
Lectures 12 h, exercises 20 h (5 x 4 h). Written reports of the experiments and a written examination.
Target group:
Compulsory.
Recommended optional programme components:
Upper secondary school physics and mathematics.
Recommended or required reading:
English material is given from laboratory.
Person responsible:
Kari Kaila
Other information:
https://wiki.oulu.fi/display/761121P/
Registration for the course and exams will be found by using the code 761121P-01

521378A: Laboratory Exercises in Telecommunication Engineering, 4,5 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha-Pekka Mäkelä
Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 4-6.
Learning outcomes:
The course introduces the student to different measurements and measurement documentation in the field of communication systems. The measurements give information about communication system components, operational principles and performance. A range of common communications system measurement instruments are studied and used in the laboratory exercises.
Learning outcomes: Upon completing the required coursework, the student is able to use a spectrum analyzer for basic radio frequency measurements. The student can operate a vector signal analyzer and analyze the obtained results. The course gives skills to measure and analyze basic properties of a radio frequency amplifier and other components used in radio systems. In addition, the student is also capable for building a simple digital communication link and measuring its performance using spectrum and vector signal analyzers.

Contents:
Radio interface and spectrum. Measurements of radio system components. Performance measurements of communication systems. Implementation: Laboratory exercises. Exercises include both measurements and documentation. The grade is given according to the written reports.
Recommended optional programme components:
Telecommunication Engineering I, Telecommunication Engineering II , Basics of Radio Engineering, Radio Communication Channels, Communication Networks I, Wireless Communications I
Recommended or required reading:
Laboratory exercise manual(s).

521433A: Laboratory Exercises on Analogue Electronics, 3 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Määttä
Opintokohteen kielet: Finnish
Leikkaavuudet:

521307A	Laboratory Exercises on Analogue Electronics	5.0 op

Language of instruction:
Finnish, English.
Timing:
Period 1-6
Learning outcomes:
Design exercises are used to deepen the understanding of the material presented in Principles of Electronics Design and Analogue Electronics I. Implementation: Independent design exercise, which is checked by CADsimulations and experimentally. Simulations are carried out in PSpice environment
Learning outcomes: On completion of the study module students should be able to design basic electronic structural blocks and verify their functioning in a CAD simulation environment. They should be able independently to realize and test a small-scale design object employing the analogue technique.

Recommended optional programme components:
Both Principles of Electronics Design and Analogue Electronics I must have been accepted.

812641S: Location and Context Based Services, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Information Processing Science
Arvostelu: 1 - 5, pass, fail
Opettajat: Jouni Markkula
Opintokohteen kielet: English

ECTS Credits:
5 ECTS
Timing:
4th year, period 2
Learning outcomes:
Objective: The course aims at demonstrating how location and context-aware mobile services work and how they are built.
Learning Outcomes: After the course the student will understand what tech-nologies and architectures can be used to build location and context awareness in software applications. The student will understand the potential and challenges presented by mobile platforms and smart environments. Furthermore, the student will remember a variety of services that utilize context-awareness and under-stands how they work.
Contents:
1. Geographic information systems
2. Context-aware computing
3. Pervasiveness and mobility
4. Technological considerations
5. Ethical and commercial issues
6. Applications
Learning activities and teaching methods:
Lectures, demonstrations.
Target group:
4th year
Recommended optional programme components:
: Internet and Computer Networks, Mobile Internet Service Architecture.
Recommended or required reading:
Material listed in the course web page.

Assessment methods and criteria:
Seminar assignment.
Grading:
1-5

721673A: M-Commerce, 5 op

Voimassaolo: - 31.07.2010
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Miikka Blomster
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Heikkilä, Janne Tapani
Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Periods 5-6.
Learning outcomes:
To make an introduction to computer vision.
Learning outcomes: Upon completion of the course, the student can utilize common machine vision methods for various image analysis problems. He is able to carry out region segmentation and pattern recognition using color, texture and shape descriptors computed from images. He can use motion information in image analysis and model matching in image registration and object recognition. The student can explain the basics of geometric computer vision and is able to calibrate cameras as well as to obtain 3D coordinate measurements from the scene using for example stereo imaging. After the course the student has the rudimentary skills to use the Matlab environment and its tools for implementing machine vision methods and analyzing the results.

Contents:
1. Introduction, 2. Imaging and image representation, 3. Binary image analysis, 4. Pattern recognition concepts, 5. Color and shading, 6. Texture, 7. Contentbased image retrieval, 8. Motion from 2D image sequences, 9. Image segmentation, 10. Matching in 2D, 11. Perceiving 3D from 2D images, 12. 3D models and matching.
Learning activities and teaching methods:
Lectures, exercises, examination. Laboratory excercises using Matlab environment.
Recommended optional programme components:
Digital image processing
Recommended or required reading:
Shapiro L.G., Stockham G.C.: Computer vision, Prentice Hall, 2001. Lecture notes, exercise material. All course material is in English.

811328A: Managing a software product, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Information Processing Science
Arvostelu: 1 - 5, pass, fail
Opettajat: Henrik Hedberg
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

721421A: Marketing of a High Tech Firm, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ects.

Language of instruction:
English.

Timing:
Period B.

Learning outcomes:
After having completed this course, students will have an improved understanding of the typical features of high technology firms, their offerings, markets and internationalization. Students will learn to describe and analyze the current state of these issues in high tech firms. Students will also develop their abilities to analyse and report empirical data and to work in a multicultural team.
Contents:
Based on the theoretical view provided in the introductory lectures and literature, students will write an analytical report of the current state of chosen issues (e.g. internationalization, product development, partnering) in case firms through the examination of companies, their offerings and the markets in which they operate.
Learning activities and teaching methods:
6-10 h lectures, company presentations and needed amount of case-sessions and presentations (depending on the number of participating groups). The case firms consist of high tech firms located in the Oulu region. The students are divided into multicultural teams of 4-5 persons and each team is introduced to a specific research topic. The groups make an analytical written report on the case firms and present it to other students in the case-sessions.
Recommended or required reading:
Mohr, J et al., (2005) Marketing of High-Technology Products and Innovations (or older), articles, lecture material and other material named by the lecturer.

Check availability from here.
Assessment methods and criteria:
Group work (60 % of grade is based on written report, 30 % on presentation and 10 % on activity).
Grading:
1-5.

Person responsible:
Doctoral Student Elina Pernu.

031028S: Mathematical Signal Processing, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

031079S	Mathematical Signal Processing	5.0 op

Language of instruction:
Finnish
Timing:
Period 5-6
Learning outcomes:
The aim of the course is to provide the student with frequency analysis of multidimensional and multichannel signals and of processing signals in discrete/analog LTI (linear time invariant) and LSI (linear shift invariant) systems. Also mathematical basics of wavelet analysis and image processing are given.
Learning outcomes **:** After completing the course the student understands the mathematical basics of two dimensional Fourier analysis and of two dimensional LSI systems, and is able to apply the obtained knowledge in image processing. Also the student understand the mathematical basics of wavelets and of multichannel signals and LTI systems, and knows how to apply them in signal processing.
Contents:

Two dimensional Fourier analysis of signals and its applications to image processing, analysis of two dimensional LSI systems, multichannel signals and LTI systems, wavelets in signal processing, mathematics of image processing.

Learning activities and teaching methods:
Term course. Lectures 4 h/week. A final exam.

Recommended optional programme components:
Complex Analysis, Signals and Systems, Random Signals.

Recommended or required reading:
Lecture notes; Marple:Digital Spectral Analysis with Applications

031023P: Mathematical Structures for Computer Science, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031023P	Mathematical Structures for Computer Science (OPEN UNI)	5.0 op

Language of instruction:
Finnish

Timing:
Period 1-2

Learning outcomes:
The course gives the elementary theory of logic, predicate logic and multi-valued logic as well as basic theory of set theory and number theory. The automata theory and the theory of formal languages is introduced.
Learning outcomes **:** After completing the course the student is able to apply result of logic to _nd the truth value of logical statement. He can express sentences of natural language by symbols of logic. He can use arithmetic operations on different number bases. The student is able to apply formal methods of discrete mathematics to model simple information processing problems.

Contents:
Elementary logic. Mathematical induction. Boolean algebra and set theory. Theory of automata and formal languages. Some graph theory.

Learning activities and teaching methods:
course. Lectures 4 h/week. Two examinations or a _nal examination.

Recommended or required reading:
Rosen K.H.: Discrete Mathematics and Its Applications. Gersting J.L.: Mathematical Structures for Computer Science.

031019P: Matrix Algebra, 3,5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

031078P	Matrix Algebra	5.0 op

Language of instruction:
Finnish

Timing:
Period 1-3

Learning outcomes:
The course gives the elementary theory of linear equations, matrices and vector spaces. The eigenvalues and eigenvectors with applications are introduced.
Learning outcomes **:** After completing the course the student is able to apply arithmetic operations of matrices. He can solve system of linear equations by matrix methods and can apply iterative methods to _nd the solution of the system of linear equations. The student is able to recognise the vector space and can relate the consepts of linear transform and matrix. He can analyse matrices by the parameters, vectors and vector spaces of matrices. The student is able to diagonalize matrices and apply diagonalization to the simple applications.
Contents:
Vectors and matrices. Systems of linaer equations. Vector spaces and linear transformations. The rank, nullity, row space and the column space of a matrix. The determinant of a matrix. Eigenvalues and eigenvectors of a matrix. The diagonalization with applications. The iterative methods of solving linear system of equations. The theorems of Gershgorin and Cayley- Hamilton.
Learning activities and teaching methods:
Term course. Lectures 4 h/week. Two examinations or final examination.
Recommended or required reading:
Grossman, S.I. : Elementary Linear Algebra.

800653S: Matrix Theory, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Lancaster, Peter , , 1985

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521110S: Measuring and Testing Systems, 6 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521096S Measurement Systems 5.0 op

Language of instruction:
Finnish. In English if there are more than 2 foreign students in the class.
Timing:
Period 4.
Learning outcomes:
The goal of this course is to teach measurement and testing systems generally. Constructions, connections, software, data acquisition as well as widely used interfaces are included in this course. Also methods to analyze measured signals especially to take care of eliminating disturbances are considered.
Learning outcomes: After completing the course the student is able to explain the principles of measuring and testing systems, and is able to compare the properties and performance of different communication techniques used in measurement systems. The student is able to design an application

which controls a measurement system and stores the measurement data. Additionally, the student is able to realize essential multisensor systems and large systems which utilize data networks, and can give examples of practical measurement systems found in the industry and in medicine.
Contents:
Basics of measurement and testing systems, data transmission in measurement systems, software and data acquisition, design of measurement system, examples of measurement systems in industry and medicine, wide measurement systems using data networks, test system applications.
Learning activities and teaching methods:
Lectures and laboratory exercises. Final exam and passed laboratory exercises.
Recommended optional programme components:
Electronic Measurement Techniques .
Recommended or required reading:
Handout. Lab-View material

764369A: Medical Equipments, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Other information:
https://wiki.oulu.fi/display/764369A/

521216S: Microelectronics Packaging Technology and Reliability, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Periods 1-3.
Learning outcomes:
The students are introduced to the packaging and interconnection technologies and to the reliability and testing of electronics packaging technology.
Learning outcomes: Upon completing the course the student can explain what is meant by microjoining techniques and what are the pros and cons of these. The student can tell what different kind of materials, and why, are used in IC packaging technology. He can describe the module techniques and the basics for wafer level packaging. He can explain how the electronic packaging technologies have been developed, since the invention of the transistor, up to date and how this development will continue in the future. In addition, the student can explain, study and predict the failure mechanism’s of an electronic device. He can apply environmental testing and statistical methods to predict the reliability.
Contents:
Trends of packaging technologies. Microjoining from IC to substrate: flip-chip, wirebond and TAB techniques. Metal, ceramic and plastic package structure and manufacturing. Multi-chip-modules (MCM). Chip scale packages (CPS) and wafer level packaging (WLP). Failure mechanisms of electronic components and packaging methods and analyzing these. Methods of environmental testing, screening and quality control.
Learning activities and teaching methods:
Lectures and literature review. The course is passed by a final exam and an accepted literature review.
Recommended optional programme components:
Introduction to Microelectronics and Micromechanics.
Recommended or required reading:

Lecture notes. Parts form books: Rao R. Tummala: Fundamentals of Microsystems Packaging, Rao R. Tummala, Eugene J. Pymaszewski, Alan G. Klopfenstein: Microelectronics Packaging Handbook II, William D. Brown (toim.): Advanced Electronic Packaging, With Emphasis on Multichip Modules, IEEE, Inc., New York 1999, luvut 11 ja 16, Patrick D.T. O'Connor: Practical Reliability Engineering, John Wiley&Sons, 2002, luvut 8 ja 9 ja Ken Gilleo: Area Array Packaging Handbook: Manufacturing and Assembly, McGraw-Hill 2002.

521224S: Microelectronics and Micromechanics, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Krisztian Kordas

Opintokohteen kielet: English

Leikkaavuudet:

521074S Microelectronics and Micromechanics 5.0 op

Learning outcomes:
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:
Fabrication stages of VLSI semiconductors. Simulation of semiconductor processes. VLSI semiconductor techniques. GaAs devices and circuits, the new features of hybrid techniques and the trends of microelectronics. Materials and fabrication methods of micromechanics. Design and implementation of micromechanical structures. Actuators for small movements, micro valves, pumps and motors, switches, micro-optics, applications in medical engineering, autonomic microsystems, microrobotics, nanotechniques. Implementation: Lectures and exercises. Final exam.
Recommended optional programme components:
Introduction to Microelectronics and Micromechanics.
Recommended or required reading:
Will be informed during lectures

521203S: Micromodules, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 4-6.
Learning outcomes:
The student get acquainted to system level packaging technologies and applications and how these will be developed in the future.

Learning outcomes **:** Upon completing the course 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. He can explain why active and passive components are being, more and more, embedded to be a part of the circuit board. The student can tell what is the meaning of SOB, MCM, SOC, SIP and SOP and how the system level packaging technology will be developed during the next 10 – 20 years. In addition he can explain why and how optoelectronics will be migrate towards circuit board and components on it, and can explain the packaging methods of MEMS components. Upon completing the course the student can make small-scale literature reviews.

Contents:

System level packaging technologies: SOC, SIP and SOP. Multilayer printed circuit boards and embedding components. Optoelectronics and MEMS component packaging

Learning activities and teaching methods:

L ectures and a literature review. The course is passed by a final exam and an accepted literature review. The course rank is a weighted average (2 and 1) from exam and literature review .

Recommended optional programme components:

Principles of Microelectronics and Micromechanics, Microelectronics Packaging Technology and Reliability.

Recommended or required reading:

R.R.Tummala and M. Swaminathan, Introduction to System-on-Package (SOP), McGraw-Hill, New York, 2008.

521228S: Microsensors, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521072S Microsensors 5.0 op

Language of instruction:

In Finnish.

Timing:

Period 1-3.

Learning outcomes:

The course provides knowledge of electrical and optical microsensors, their structure, operation principles, and use in various applications. Course also introduces to design and fabrication of main sensor types for different forms of energy.

Learning outcomes: 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 processing circuitry. 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. Students can explain the basic structures, physical operation principles, and fabrication processes of main sensor types for different forms of energy.

Contents:

Principles of sensing and sensor physics . Energy conversion forms and sensor signals. Processing of sensor signals. Microsensor fabrication by three different microtechnology; monolitchic (silicon technology), thin-film technology, and thick film technology. Advanced fabrication methods. Main types of thermal, radiation, mechanical, magnetic, and (bio)chemical sensors. Sensor performance. Smart sensors and microsensor array devices.

Learning activities and teaching methods:

Lectures 2 hours/week and calculation exercises 1 hour/week.

Recommended or required reading:

Julian W. Gardner, Microsensors, Principles and Applications, John Wiley&Sons, 1994.

521113S: Mixed-signal Testing, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

Language of instruction:
Finnish. In English if there are more than 2 foreign students in the class.
Timing:
Period 5.
Learning outcomes:
The goal of the course is to deepen the knowledge of life cycle testing of mixed-signal devices. Learning outcomes: After completing the course the student is able to use production testing techniques from the life-cycle testing and re-usability points of view. The student can compare different testing techniques of analogue, digital and RF-electronics, which have been implemented using either embedded testing methods or external automatic testing equipment. Additionally, the student is able to use DSP-based testing and remote testing, and compare different test interfaces and data busses.
Contents:
Design for testability, DC- and parametric measurements, dynamic tests, constructions of testers, test signal generation and measurement, mixed-signal test buses, converter tests, data analysis, diagnostics, DSP-based tests, embedded testing.
Learning activities and teaching methods:
Lectures and exercises. Final Exam.
Recommended optional programme components:
Electronics Design I, Testing Techniques of Electronics.
Recommended or required reading:
M. Burns, G.W. Roberts: An Introduction to Mixed-Signal IC Test and Measurement.

815349A: Mobile Internet Service Architecture, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:
6 ECTS
Timing:
4th year, periods 1+2

Learning outcomes:
Objective: The course is an introduction to the general architecture of mobile In-ternet and its core enablers and services. MISA course delivers a comprehensive knowledge base for mobile service understanding, creation and management.
Learning Outcomes: After completion of the course, the student understands architectural framework of Internet and mobile network service provision layers, interfaces and service primitives. Student is able to extend/modify existing mobile services as well as design and implement simple mobile services based on available primitives and bearer service capabilities.
Contents:
The topics included are: principles, service software architecture, service enablers, All-IP vision, IPv6, mobile IP, Quality of Service, SIP, mobile VPN, wireless access, application layer technologies, service development tools, commercial and open-source platforms. Lectures review also the current and emerging technologies and their deployment. The exercises demonstrate exam-ples of different maturity technologies and their implementations.
Learning activities and teaching methods:
: lectures (36 h) exercise (90 h) exam (30). Part of the lectures is online digital presentations. Exercises include 10 hours laboratory demonstrations and 50 hours student project. Laboratories are compulsory 3 out of 5, and they

are scheduled with 2 hours / lab and 1 lab / week. The student project groups are organized into teams of students (2-3 students per team). For student project reporting recommended language is English but Finnish can be used as well.
Target group:
4th year
Recommended or required reading:
Nokia: Mobile Internet Technical Architecture Vol 1-3, IT Press. ISBN 951-826-671-9. (partially).Camarillo, Gonzalo, and Miguel-Angel Garcia-Martin: The 3G IP multimedia subsystem (IMS): merging the Internet and the cellular worlds. John Wiley & Sons, 2004. ISBN 0-470-87156-3. 406 p. (partially). Lecture notes.
Assessment methods and criteria:
1) Compulsory attendance for exercise classes (3 out of 5), 2) Completion of the assigned project work (80 hours), 3) Passing the exam.
Grading:
1-5
Person responsible:
Petri Pulli

811359A: Mobile Systems Programming, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

815308A	Embedded Software Development Environments	4.0 op

Ei opintojaksokuvauksia.

521333A: Mobile Telecommunication Systems, 5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic

Opintokohteen kielet: Finnish

Language of instruction:
In English.
Timing:
Period 4-6.
Learning outcomes:
To get the basic understanding of mobile communication systems dimensioning and performance. To learn some of the current and developing mobile communication system standards and to prepare students to understand the structure, functionality and dimensioning of these systems.
Learning outcomes: Upon completing the required coursework, the student is able to determine the values of the main parameters of WCDMA physical layer and power control. The student can also determine 3G channel model and derive the CDMA cellular network capacity. In addition, the student can determine the main component used in the CDMA network planning. The course gives skills to describe mobility management, adaptive recourse control and dynamic recourse allocation in CDMA networks.

Contents:

Concept and structure of mobile communications system. Basics of CDMA radio network planning and capacity, channel modeling, distributed transmission power control, mobility management, adaptive recourse control, cooperative transmission, transmission diversity, dynamic recourse allocation. Examples of digital mobile telecommunication systems in practice.
Learning activities and teaching methods:
Two hours of lectures in a week and exercises. The course is passed with final examination and accepted laboratory exercise. The course is lectured in English.
Recommended optional programme components:
Telecommunication Engineering II
Recommended or required reading:
Parts of the following: S. Glisic: Wireless Networks:4G Technologies; S. Glisic: Adaptive WCDMA: Theory and Practice, S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technoloques (2 nd ed.), 2007

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

Language of instruction:
In English.
Timing:
In periods 1-6.
Learning outcomes:
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.
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.
Recommended or required reading:
Will be defined in the beginning of the course.

521488S: Multimedia Systems, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ylianttila

Opintokohteen kielet: English

Language of instruction:
In Finnish.
Timing:
Period 2-3.
Learning outcomes:
The aim of the course is to provide advanced knowledge of multimedia technologies, and applying them in designing and implementing a multimedia system.
Learning objectives: Student can determine specifics of different multimedia elements and can explain basic techniques for presentation of multimedia. Student can describe novel multimedia communication techniques and

recognize different functional domains, and how to apply them in the design and implementation of novel multimedia applications and services.

Contents:
key concepts, multimedia elements: image, voice, video, and animation techniques; resource management, real-time multimedia, quality of service, synchronization, multimedia communication techniques, multimedia databases, reference models, standardization, applications, watermarking, design and implementation of multimedia system.

Learning activities and teaching methods:
Lectures and course exercise related to multimedia systems (emphasis either on implementation, research or design). Course is passed with final examination and accepted course exercise. In addition group exam for additional points to exam. Course materials and group work instructions are available at OPTIMA.
Further information: http://www.ee.oulu.fi/research/tklab/courses/521488S/

Recommended optional programme components:
recommended courses include basic courses in computer science and mathematics, Operating systems (521453A), Digital Image Processing (521467S), Computer networks (521476S), Software Engineering (521457A) and Knowledge Engineering (521468S).
.

Recommended or required reading:
Multimedia Communications: Applications, Networks, Protocols and Standards. F. Halsall, Addison-Wesley 2001, chapters 1-5. Lecture slides provide appendices and show the focus areas in more detail.
Supportive reading **:** Multimedia: Computing, Communications and Applications. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995, chapters 1-6, 9.1.-9.4, 10.1, 11,12 and 15. Open Distributed Processing and Multimedia. G. Blair and J. Stefani, Addison-Wesley 1998, chapters 2-4 and 8. Principles of Multimedia Database Systems. V. Subrahmanian, Morgan Kaufman 1998, chapters 1,5, 9 and 15. Multimedia: Computing, Communications and Application. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995. Chapters 1-6, 9.1.-9.3, 10.1, 11-13, 15, 17.

721462S: Network Theory, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Satu Nätti
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
6 ects.

Language of instruction:
Finnish.

Timing:
Period C.

Learning outcomes:
Upon completion of the course, students have deepened their theoretical understanding of business networks. They understand, why the different kinds of networks are important in business life and how we are able to coordinate them considering strategic goals of the company. They can critically apply different theories and conceptions to their business environment, they understand the underlying logic of different types of strategic nets, learning and knowledge transfer within the network likewise sources of conflict and conflict resolution strategies. Learning the kind of frameworks will aid students to evaluate the relevance of such theories and using them in their Master's Thesis.

Contents:
Lectures and related material include the following themes:
1) Principles of network thinking and basic concepts;
2) networks and strategic thinking;
3) Different kind of strategic nets, their management mechanisms and capabilities needed (from subcontractor networks to development and innovation networks;
4) Learning and knowledge in the network context; and
5) sources of conflict in networks, conflict resolution.

Learning activities and teaching methods:
In order to participate the course, a pre-exam should be passed (from book Håkansson, H. & Snehota, I eds: Developing Relationships in Business Networks, 1995). Detailed information on the pre-exam will be given during the period B on Faculty´s web page. During the period C there will be 21 hours lectures, including group work (article analysis and mini cases). In addition, independent reading of the textbooks.

Recommended optional programme components:
Subject studies in marketing.

Recommended or required reading:
Parolini, C.: The Value Net – A Tool for Competitive Advantage, 1999; Axelsson, B. & Easton, G.: Industrial Networks: A New View of Reality, eds 1992; Håkansson, H. & Snehota, I eds: Developing Relationships in Business Networks, 1995 (sections given by the lecturer before the course).

Check availability from here.
Assessment methods and criteria:
Pre-exam and literature examination.

Grading:
1-5.

Person responsible:
Researcher Satu Nätti.

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruotsalainen Keijo
Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 4-6
Learning outcomes:
The objective of the course is to provide the mathematical foundations of numerical methods, to analyze their basic theoretical properties (stability, accuracy and computational complexity), and demonstrate their performances on examples.
Learning outcomes **:** The student recognizes what numerical solution methods can be used to solve some spesific mathematical problems, can perform the required steps in the numerical algorithm and is able to perform the error analysis.
Contents:
Numerical linearalgebra. Basics of the approximation theory. Numerical quadratures.Numerical methods for ordinary and partial differential equations.
Learning activities and teaching methods:
Lectures 4h/week. Two intermediate exams or one final exam.
Recommended or required reading:

- K. Ruotsalainen, Numeeriset menetelmät (lecture notes in finnish)
- Faires and Burden; Numerical methods
- A. Quarteroni, R. Sacco and F Salieri; Numerical mathematics

Prequisites: Calculus 1, Calculus 2, Matrix algebra and Differential Equations.

521453A: Operating Systems, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Leikkaavuudet:

ay521453A Operating Systems (OPEN UNI) 5.0 op

Language of instruction:
In Finnish.
Learning outcomes:
The objective of the course is to provide basic knowledge of computer operating system structures and functioning.
Learning outcome: After the course the student is capable of explaining the basic structure and functioning of operating system. He/She is able to point the problems related to process management and synchronization as well as is able to apply learned methods to solve basic problems. Student is capable of explaining the cause and effect related to deadlocks and is able to analyse them related to common circumstances in operating systems. Additionally, the student is able to explain the basics of memory management, the use of virtual memory in modern operating systems as well as the structure of the most common file-systems.

Contents:
Operating system structure and services, process management, process synchronization, deadlocks, memory management, virtual memory, file-systems.
Learning activities and teaching methods:
The course consists of lectures and laboratory work, which includes pre-exercise and guided exercise performed in a group of one or two students in the unix environment. The final grade is based on the final examination and accepted laboratory work.
Recommended optional programme components:
Elementary Programming, Embedded Systems Programming, Computer Engineering
Recommended or required reading:
Lecture notes (in Finnish) and exercise material. Silberschatz A., Galvin P., and Gagne G.: Operating System Concepts, 6th edition (or newer), John Wiley & Sons, Inc., 2003. Chapters 1-12.

521238S: Optoelectronic Measurements, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Anssi Mäkynen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521094S Optoelectronic Sensors of Future 5.0 op

Language of instruction:
Finnish.
Timing:
Period 6.
Learning outcomes:

The goal of this course is to make the student familiar with the measurements utilizing optoelectronics and optics, measurement principles, sensors and device configurations.
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 or verbal report.
Contents:
Principles of optoelectronic measurements. Surface inspection, distance and profile measurements. Non-destructive testing methods. Optical measurements at process control. Material analyses with optical methods. New optoelectronic measurement principles.
Learning activities and teaching methods:
Lectures and exercises. Final exam.
Recommended or required reading:
Lecture notes. P.G. Cielo: Optical Techniques for Industrial Inspection, Academic Press, 1988.

521450S: Optoelectronics, 4 op

Voimassaolo: - 31.07.2014

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 5-6
Learning outcomes:
To give the basic knowledge of the transmitter and receiver electronics used in optoelectronic applications, and basic theory of optical fibers and their usage in various applications.
Learning outcomes: On completion of the study module students should be able to explain the principles of operation of the photoconductors and photochannels (optic fibres), semiconductor light sources and photodetectors used in optoelectronic measurements and telecommunications, paying due attention to factors affecting their performance. They should also be able to outline circuit-level structures for light source control circuits and photodetector preamplifiers and be capable of comparing them in terms of their main performance parameters. They should also be reasonably able to use the main principles of signal processing that are required for the design of optoelectronic measurement applications.

Contents:
Geometrical and physical optics, optical fibers and their properties, sources of radiation (the radiation of black body, LED- and laser structures), photodetectors (photo conductive detector, light multiplier, PIN- and AP-diodes, position sensitive detectors), light source modulation, preamplifiers and their bandwidth/stability/noise analysis, the signal analysis methods used in optoelectonics
Learning activities and teaching methods:
Lectures and exercises. May include a seminar. Final exam.
Recommended optional programme components:
Principles of Semiconductor Devices.
Recommended or required reading:
Lecture notes. S. Kasap: Optoelectronics and Photonics, Principles and Practises, Prentice Hall 2001. J. Wilson, J. Hawkes, "Optoelectronics, an introduction", Prentice Hall, 3ed, ISBN 0-13-103961-X.

815301A: Parallel programming, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Vesanen

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS
Timing:
4th - 5th year, period 2

Learning outcomes:
Objective: The course covers basics of parallel and concurrent programming and the basic control structures of concurrency. Also basics of distributed programming are discussed.
Learning Outcomes: Knowing the basics of parallel and concurrent programming and the basic design patterns relevant to concurrency. Familiarity with the basics of distributed programming.
Ability to construct multi-threaded programs with basic synchronizing structures in Java.
Ability to analyze concurrent programs and to find common programming errors relevant to concurrency.
Contents:
Introduction to concurrency, Basics of concurrency in Java, Mutual exclusion problem, Semaphores, Monitors, Message passing, Distributed programming, Error handling.
Learning activities and teaching methods:
Lectures 36h and exercises 27h.

Target group:
4th - 5th year
Recommended optional programme components:
Introduction to Programming
Recommended or required reading:
Hartley, Stephen J.: Concurrent Programming: The Java Programming Language Oxford University Press 1998. Chapters 3 - 7.
Ben-Ari, M.: Principles of Concurrent and Distributed Programming, Prentice Hall 1990 Chapter 3
Lea, Doug: Concurrent Programming in Java, design Principles and Patterns Second Edition, Addison-Wesley 2000: (1.3 Design Forces, 1.4. Before/After Patterns, 2.2.5 Deadlock, 2.2.6 Resource Ordering, 3.1 Dealing with Failure, 3.3.4. Confinement and Nested Monitors, 4.1 Oneway messages).
Assessment methods and criteria:
Exam.
Grading:
1-5
Person responsible:
Ari Vesanen

521497S: Pattern Recognition and Neural Networks, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521289S Machine Learning 5.0 op

Learning outcomes:
The course provides knowledge of the basic theory and methods of pattern recognition which is a central area of artificial intelligence. Special emphasis is given to statistical classifiers and neural networks.
Learning outcomes: After passing the course, the student can explain the statistical background of pattern recognition and can apply the knowledge on the design and implementation of practical classifiers. The student will be able to derive simple optimal classifiers from the theory and can perform

performance evaluation. The student can explain the basics of the Bayesian decision theory and can apply it to derive minimum error classifiers and minimum cost classifiers. The student can apply gradient search methods for finding linear discriminant functions. In addition, (s)he can explain the principles of selected neural networks.

Contents:
Bayesian decision theory, discriminant functions, parametric ja non-parametric classification, feature selection, classifier design and testing, sample classifiers, neural networks.
Learning activities and teaching methods:
Lectures and excersises. Compulsory programming task assignment. Written exam.
Recommended optional programme components:
The basic engineering math courses, programming skills.
Recommended or required reading:
Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001; Haykin S, Neural networks, MacMillan College Publishing Company, 1994 tai 1999; scientific articles, lecture transparencies.

812642S: Personalisation, profiling and segmentation for mobile, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Jouni Markkula

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS
Timing:
4th year, periods 1+2
Learning outcomes:
Objective: The course presents personalization and profiling principles, ap-proaches and practices applied in developing contemporary internet and mobile service and application. The course gives the students an understanding why and how services are personalized for the customers and what kind of methods and data are used for customer profiling by the service providers. The challenges and possibilities of personalization are also addressed from the research point of view.
Learning Outcomes: After completion of the course, the student can describe the principles and approaches of personalization of Internet and mobile services and applications. She or he is aware of the profiling done in Internet and can identify the personal data collection done by the service providers. She or he can also describe and analyse the privacy issues related to the personalized services and profiling. The student is able to identify and analyze the basic profiling ap-proaches and methods, search for more information about specific methods and apply them later on in service and application development. The student is also able to identify and specify relevant further research topics in the field.
Contents:
Principles of service and application personalization, personalization approaches, business aspects of personalization, context-based services, customer relationship management, profiling principles, profiling approaches and methods, customer segmentation, privacy and related legislation, personalization related standards, personal data management in profiling, social computing.
Learning activities and teaching methods:
Lectures, course project and seminar
Target group:
4th year
Recommended optional programme components:
-
Recommended or required reading:
Lecture slides, specified literature and other given material

Assessment methods and criteria:
Lecture diaries, essays or exam & course project report

Grading:
1-5
Person responsible:
Jouni Markkula

521025S: Power Electronics, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 4-5.
Learning outcomes:
The course provides the basic knowledge on switched-mode power supplies so that the student recognizes the typical terminology and different topologies as well as can estimate the voltage and current stresses for designing /selecting proper components.
Learning outcomes: On completion of the study module a student is able to discuss and write on the subject by using the terminology in the field of switching power supplies. He or she can analyze the operation of different switching power supplies in continuous and discontinuous conduction mode and in steady state operation. The student is able to design various switching power supplies different dc-dc -applications. The student 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 operation principle of single-phase ac-dc -converters based on the pulse width modulation.

Contents:
Introduction to switched-mode converters, Steady-state analysis in continuous and discontinuous conduction modes, Transformer isolated converters, Power-factor correction, Basic control principles.
Learning activities and teaching methods:
The course includes 3 h of lectures and 2 h of exercises per week. The course is passed by means of a final exam.
Recommended optional programme components:
Circuit Theory I-II, Analogue Electronics I-II.
Recommended or required reading:
R. W. Erickson, D. Maksimovic: Fundamentals of Power Electronics, 2nd ed.Kluwer Academic Publishers, 2004. Chapters 1-3, 5, 6,13; chapters 16-18 to most part.

521015A: Practical Training, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:
The technical goal of the training is to give a student a general insight of the field on which he or she 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. The objective of the series of lectures organised by the Faculty of Technology hich is included in the training requirements is to offer a student career training.
Learning outcomes: After practical training the student can describe one possible future job and its working environmnet from the point of view of his or her studies. The student can identify problmens in the work and suggest improvements. The student can find connections between work and studies.
Learning activities and teaching methods:
The students find their training job themselves. The Faculty of Technology together with the Career Services of the University of Oulu and with The Finnish Association of Graduate Engineers offers a series of lectures, Career Training for Technology Student, the participation in which is part of the practice. The series of lectures contains three parts the subject matters of which are job finding, employment and "human relations technique".
Assessment methods and criteria:
For candidate stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. The participation in Career Training for Technology Students is also marked on the training report. A more exact compilation instruction of the training report is on the WWW pages of the department and on the notice board.
Other information:
Practical training for developing expertise worth of three study points is included in the degree of the candidate of technology.

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 1-3.
Learning outcomes:
To give the students all the basic information that all electrical engineers needs about circuit techniques of analogue electronics and internal structure of digital circuits.
Contents:
Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar- and MOS-transistor amplifiers and how to bias them, small signal modeling and analyzing ac-properties of the amplifiers, internal structures of digital circuits (mainly CMOS), the principles of AD/DA - conversion and principles of VLSI-technology.
Learning activities and teaching methods:
Lectures and exercises. Final exam.
Recommended optional programme components:
Basic knowledge in Circuit Theory (Circuit Theory I). Also, understanding the basic operation of semiconductors helps (Principles of Semiconductor Devices).
Recommended or required reading:
Handout. Sedra, Smith: Microelectronic Circuits (4th edition), chapters 1, 3-5, 10.9, 13 and 14. OR Hambley: Electronics (2nd edition), chapters 1, 2, 3, 4, 5; 6 partially and some parts of other chapters.

721409P: Principles of Marketing, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Alajoutsijärvi, Kimmo Jouni

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay721409P Principles of Marketing (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ects.

Language of instruction:
Finnish.

Timing:
Period A.

Learning outcomes:
Upon the completion of this course, the students will have a general view of the background of academic marketing education and research; as well as understands the nature of marketing discipline. After the course, students will have knowledge about exchange in world history and understand the effects of industrialization to marketing science and practice. They will identify the connections between marketing and business economics and have acquired knowledge about business schools and their importance to business management. In addition, students will recognize the core concepts of marketing.

Contents:
The role of marketing education and research in business schools, definition and phenomena's of marketing, the history of marketing, marketing as a part of business management, core concepts of marketing, marketing as a practice and science.

Learning activities and teaching methods:
25 hours of lectures and independent reading of the textbooks.

Recommended or required reading:
Gummesson, E.: Suhdemarkkinointi: 4P.stä 30R:ään. Kauppakaari Oy. 1997.

Check availability from here.
Assessment methods and criteria:
Lectures and literature examination.

Grading:
1-5.

Person responsible:
Professor Kimmo Alajoutsijärvi.

521205A: Principles of Semiconductor Devices, 4,5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Marina Tjunina

Opintokohteen kielet: Finnish

Leikkaavuudet:

521071A Principles of Semiconductor Devices 5.0 op

Language of instruction:
In Finnish.
Timing:
Period 3-4.
Learning outcomes:

The students are introduced to principles of operation and characteristics of semiconductor devices.
Learning outcomes: Student is able to describe main characteristics of semiconductor materials and junctions, main types of semiconductor devices, their design and main operational characteristics.
Student is able to explain physical principles of operation of idealized devices. Student is able to estimate main parameters of idealized devices.
Contents:
Semiconductor pn-junctions, metal-semiconductor junctions, heterojunctions. Diodes. Bipolar junction transistors. Field effect transistors. Semiconductor lasers. Switching devices.
Learning activities and teaching methods:
Lectures and calculation exercises. Final exam.
Recommended optional programme components:
Basic physics. Introduction to materials physics. Electronic components.
Recommended or required reading:
Selected chapters from Streetman, B.: Solid State Electronic Devices, Prentice-Hall, New Jersey, 2000. Lecture notes.

031072S: Principles of the Boundary Element Method, Homework Exercise, 2 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Hamina, Martti Aulis

Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Learning outcomes:
The purpose of the homework exercise is to deepen the students understanding on the implementation of a mathematical algorithm.
Learning Outcomes **:** The student will be faced against various problems which occur while implementing a numerical solution by using the Boundary Element Method. This will be very instructive for the student.
Contents:
A homework exercise from the field of the course: Principles of the Boundary Element Method. Usually it consists of programming and documentation of a boundary element algorithm (C, MATLAB, Fortran, etc.). Literature work is also optional. A reasonable documentation is required.
Recommended optional programme components:
Principles of the boundary element method.

521217S: Printed Electronics, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hast, Jukka Tapio

Opintokohteen kielet: Finnish

Leikkaavuudet:

521089S Printed Electronics 5.0 op

Ei opintojaksokuvauksia.

031021P: Probability and Mathematical Statistics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031021P Probability and Mathematical Statistics (OPEN UNI) 5.0 op

Language of instruction:
Finnish
Timing:
Period 4-6
Learning outcomes:
The course provides the student the fundamental knowledge of the basic concepts of probability, random variables, management of statistical material, hypothesis testing and estimation methods. Learning outcomes **:** After completing the course the student is able to use the basic concepts of probability and most important random variables and is also able to apply these to calculate probabilities and expected values. The student is also able to analyze statistical material by calculating confidence intervals, formulating and testing hypotheses and by performing maximum likelihood estimations.
Contents:
Basic concepts of probability, conditional probability, discrete and continuous random variables and their distributions, expectation and variance, joint distributions, central limit theorem, elements of statistics, interval of confidence, hypothesis testing, maximum likelihood estimation.
Learning activities and teaching methods:
Term course. Lectures 4 h/week. Two examinations or a final examination.
Recommended optional programme components:
Calculus I and Calculus II.
Recommended or required reading:
Milton J.S. and Arnold J.C.: Introduction to Probability and Statistics, McGraw-Hill (1992).

721412P: Product and Market Strategies, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Salo, Jari Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay721412P Product and Market Strategies (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
5 ects.

Language of instruction:
Finnish.

Timing:
Period A.

Learning outcomes:
After having passed this course, students will have a basic level understanding of the concepts and tools linked to product and market strategies. The course provides fundamental review of pertinent issues considered in marketing management related issues. The course improves students an ability to evaluate different product and market situations among industries and increases the understanding of making strategic product/market decisions.
Contents:
1) General tools of marketing management and analysis,
2) value perceived by consumers,

3) product strategies,
4) market segmentation and
5) new product development.
Learning activities and teaching methods:
24 h lectures, case exercises, group discussions and independent reading of the textbooks
Recommended or required reading:
Porter, M.E.: Competitive Advantage (1985); Kotler, P. & Keller, K.: Marketing Management. (2006 or older) and other material named by the lecturer.

Check availability from here.
Assessment methods and criteria:
Lectures, literature examination and case exercise.
Grading:
1-5.

Person responsible:
Doctoral Student Ilkka Ojansivu.

521024A: Programmable Electronics, 5 op

Voimassaolo: 01.08.2005 - 31.07.2014
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Antti Mäntyniemi
Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-3.
Learning outcomes:
The objective of the course is to deepen the understanding of basic digital logic with practical design exercises.
Learning outcomes: Upon completing the required coursework, the student is able to analyse the operation of a simple digital device and to formulate a design specification document. The student is also able to formulate a design document of a simple digital system and based on that to describe the behaviour of a digital system with VHDL-language and to implement the device with an FPGA-circuit.
Contents:
Design specification, logic design, VHDL-language, logic simulation, logic synthesis, FPGA-programming.
Learning activities and teaching methods:
The course is based on a starting lecture and collaborative exercises. The course consists of three subtasks. In the first task the structure and operation of a digital device is analysed and documented. The result of the task is a design specification. In the second task a Register Transfer Level description following the design specification is designed. In the third task the behaviour of the logic is described using VHDL-language and the operation of the logic is verified with logic simulator software and tested in practice with a programmable logic device. The course is passed by accepted and documented exercises.

Recommended optional programme components:
Digital Techniques I and Computer Engineering.
Recommended or required reading:
Instruction site in Optima and sample documents.

521143A: Programming, 7,5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 4-6.
Learning outcomes:
Learning outcomes: Upon completing the required coursework, the student is able to evaluate algorithms and data structures and alternatives for implementing them. Moreover, the student is able to design and implement algorithms and data structures using different programming paradigms.
Contents:
Data structures, algorithms, complexity, programming paradigms.
Learning activities and teaching methods:
Will be lectured first time in spring term 2010
Recommended optional programme components:
Elementary programming, Embedded Systems Programming
Recommended or required reading:
Will be announced later

555282A: Project Management, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Jokinen, Tauno Jaakko, Jaakko Kujala

Opintokohteen kielet: Finnish

Leikkaavuudet:

555288A	Project Management	5.0 op
555285A	Project management	5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:
Finnish
Contents:
Upon completion the student should be able to:
Apply the advanced concepts of project management.
Learning activities and teaching methods:
Lectures, exercises, learning report
Assessment methods and criteria:
Evaluation of learning report

721533A: Project Management, 5 op

Voimassaolo: - 31.07.2010

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

521225S: RF Components and Measurements, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Häkkinen, Jari Hannu
Opintokohteen kielet: Finnish

Language of instruction:
In Finnish. In English, if there are at least 3 international students in class.
Timing:
Period 1-3.
Learning outcomes:
The course covers common passive components and their measurement techniques used at RF and microwave frequencies. The course provides ability to know components selection principles and ability to conduct measurements related to electromagnetic fields and high frequency circuits.
Learning outcomes **:** After completing the course the student has knowledge of the behavior of passive components at RF frequencies, knows the fabrication methods of components and is also able to apply the knowledge to practical applications. The student also knows the operating principles of transfer lines, antennas and filters and of their design. The student can apply the fundamentals of RF and microwave techniques to measurements, is able to make the measurements of RF components, has knowledge of the operating principles of RF region measurement equipment and is able to compare the usability of different measurement techniques in different measurement situations. In addition the student knows how to perform typical measurements of RF region magnitudes (power, frequency, impedance and noise)
Contents:
Fundamentals of RF and microwave techniques, components in microwave circuits, measurement instruments, measuring of power, frequency, impedance and noise, time-domain and active circuit measurements.
Learning activities and teaching methods:
Lectures, exercises, laboratory exercises. Final exam and passed laboratory exercises.
Recommended optional programme components:
Electronic components, Electronic Measurement Techniques, Basics of Radio Engineering.
Recommended or required reading:
Handout, Lecture notes. A. Lehto, A. Räisänen: Mikroaaltomittaustekniikka (in Finnish), R. Ludvig, P. Bretchko: RF circuit Desing: Theory ans Applications, Prentice Hall 2000and literature announced at the beginning of the lectures.

521381S: Radio Communication Channels, 4,5 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Karhu Seppo
Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Periods 2-3.

Learning outcomes:
After having passed the course a student is familiar with the basics of radiowave propagation over terrestrial and satellite channels. He/she understands the composition and importance of the propagation models and can apply them in practice. The emphasis in the course is on mobile communication channels.

Learning outcomes: After completing the course, the student can define what the radio channel is and is able to distinguish it into modellable parts. He/she is capable to adopt radio wave propagation mechanisms: free-space propagation, absorption, scattering, reflection, refraction, diffraction and multipath propagation. The student can also describe how the radiation properties of different kind of antennas affect a radio channel and how the radio wave propagation impairments on the quality of radio communication can be overcome by using different kind of antennas. In addition, the student can apply physical and empirical models of path loss, slow fading (shadowing), narrowband or wideband fast fading and noise in order to calculate the link budget, power delay profile and other characteristics of a radio link. He/she can analyze which are the dominating propagation mechanisms in a fixed terrestrial radio link, in a fixed satellite link, outdoors (megacell, macrocell and microcell) and indoors (picocell). Moreover, he/she is able to calculate the effects of the dominating propagation mechanisms on different kind of radio channels. He/she can summarize how to overcome the radio channel impairments. The student can also measure the characteristics of wideband radio channel using a vector network analyser and report the measurement results.

Contents:
Basics of electromagnetic radiation. Different mechanisms of radiowave propagation: absorption, scattering, reflection, refraction and diffraction. Importance of radiowave propagation in the design of cellular communication systems. Effects of antennas on the radio channel. Principles of propagation modelling. Radiowave propagation phenomena over fixed terrestrial radio links and over fixed satellite links. Radio channel modelling for cellular systems (macrocells and microcells). Radio channels of mobile satellite links (megacells). Multipath propagation and its effects on narrowband and wideband radio channels. Radiowave propagation inside or into buildings (picocells). Simulation of narrowband and wideband radio channels. Mitigation methods of propagation phenomena. Measurement exercise of a wideband indoor radio channel.
Learning activities and teaching methods:
Lectures, exercises and the compulsory radio channel measurement exercise. The course is passed with a final examination and an accepted measurement report. In the final grade, the weight for the examination is 0.75 and for the design exercise 0.25.
Recommended optional programme components:
Basics of Radio Engineering, Stochastic Processes
Recommended or required reading:
Simon R. Saunders: Antennas and propagation for wireless communication systems. John Wiley & Sons Ltd, 1999, Chapters 1-14. Also ‘Simon R. Saunders & Alejandro Aragón-Zavala: Antennas and propagation for wireless communication systems, second edition. John Wiley & Sons Ltd, 2007, Chapters 1-15' is suitable for the course book.

521335S: Radio Engineering 1, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521326S Radio Engineering 1 5.0 op

Language of instruction:
In Finnish (fall 2010), In English (fall 2011).
Timing:
Period 1-3.
Learning outcomes:
Learning outcomes: After completing the course the student recognizes different kind of impedance matching methods and can design the impedance matching network using discrete components and microstrip lines. She /he can also explain factors, which are limiting the bandwidth of impedance matching networks. Student can design the impedance matching for a low noise amplifier. In the impedance matching the noise figure is minimized

or the gain is maximized. The impedance matching can also be made for the constant gain. Student can explain the principle of a single ended, balanced and double balanced mixer and the advantages and the disadvantages of these mixers. She/he can design a power divider and a directional coupler. Student can also explain the principle of an automatic gain control (AGC). Student can classify power amplifiers and can in the basic case design the matching network for a power amplifier.

Contents:
Definitions of noise terms, impedance matching using discrete components, microstrip matching networks, RF transistor amplifier design, active and passive mixers, power dividers, directional couplers, automatic gain control (AGC), power amplifier design.

Learning activities and teaching methods:
Lectures and exercises in total 4 hours in a week. Design exercise with ADS-simulation software. The course is passed with final examination and accepted design exercise. In the final grade the weight for the exam is 0.75 and for the design exercise 0.25.
Recommended optional programme components:
Basics of Radio Engineering.
Recommended or required reading:
Lecture notes. R. Ludwig & P. Bretchko: RF Circuit Design Theory and Applications, 2000. G. Gonzales: Microwave Transistor Amplifiers Analysis and Design, 1997.

521375S: Radio Engineering II, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: English

Leikkaavuudet:

521327S Radio Engineering II 6.0 op

Language of instruction:
In English.
Timing:
Period 4-6.
Learning outcomes:
The aim is to understand the basic theory and techniques of design in transceivers at the system level. After passing the course the student knows, what should be taken into account when functional blocks of a transceiver are connected so that the performance requirements are achieved.
Learning outcomes: After completing the course the student recognizes the blocks of a transmitter and can explain the principle of a transmitter. She/he can classify different architectures used in transmitters and understand the basis for them. Student can define parameters used in the transmitter system level design and can design a transmitter at the system level so that the requirements for the system are fulfilled. She/he can explain nonlinear distortion and can design the automatic gain control in the system level. Student can also explain factors, which are important for the selection of DA- and AD-converters. She/he can derive various methods to create the in phase and the quadratute components of a signal. She/he can also explain the principles of frequency synthesis in a transmitter.
Contents:
Designing transceivers at the system level, transceiver architectures, performance characteristics of transceivers, factors which limit the performance of transceivers, nonlinearities, design of RF and IF stages, placement of the A/Dconverter in receivers, frequency synthesis, design and implementation examples.
Learning activities and teaching methods:

Two hours of lectures in a week. Demonstrations (eight hours) and design exercise with ADS-simulation software. The course is passed with final examination and accepted design exercise. In the final grade, the weight for the examination is 0.75, and for the design exercise 0.25. Course will be given every second year in even years.

Recommended optional programme components:
Radio Engineering I.

Recommended or required reading:
Lecture notes. Walter Tuttlebee: Software Defined Radio. Enabling Technologies, chapters1-4, 2002. U. L. Rohde, J.C. Whitaker & T.T.N Bucher: Communications Receivers: DSP, Software Radios and Design, 3rd edition, 2001. V. Manassewitsch: Frequency Synthesizers, Theory and Design, 1987.

031024A: Random Signals, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.

Timing:
Period 1-2.

Learning outcomes:
The course acts as a mathematical introduction to statistical methods used in signal processing.
Learning outcomes **:** After the course the student is able to study the stationarity, the ergodicity and the frequency content of random signals. The student is able to explain the mathematical grounds of the most central optimal systems used in signal estimation and detection, and can solve related elementary problems. Further, the student can solve simple problems related to Markov chains.

Contents:
Random variable. Random signal. Stationarity, ergodicity, autocorrelation. Power spectral density. Noise. Autoregressive, Markov, Gaussian and Poisson processes. Markov chains. Signal estimation, Wiener-filter and orthogonality principle. Matched filter, signal detection and MAP-receiver.

Learning activities and teaching methods:
Lectures 4 h/week, class room exercises 2 h/week. Home assignments. Two partial exams or final exam.

Recommended optional programme components:
Matrix Algebra, Probability and Mathematical Statistics, Signals and Systems.

Recommended or required reading:
Lecture notes (an online version in English is available), exercise materials (in Finnish). Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

812340A: Real Time Software Design, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Zeeshan Asghar

Opintokohteen kielet: English

ECTS Credits:
6 ECTS

Timing:
4th year, periods 2+3

Learning outcomes:
Objective: The course gives the student the specific ability to develop software for time critical applications, ranging from simple household appliances to safety critical control systems at a nuclear plant. The student will learn to identify time-critical elements in a system. The student will be instructed on a real-time design methodology from the initial requirement phase to the final execution phase, whether the project is a small team effort, or part of a large distributed design group
Learning Outcomes: The students will acquire an object oriented approach to solve the problems found in real-time systems. The students will be aware of the specific problems facing the real-time software designer, and become familiar with the main design patterns to solve those problems. The students will become familiar with tools, mechanisms and platforms for Java and C languages that support real-time system
Contents:
Contents:
• Introduction to Real Time Systems
• Characteristics of Real Time Systems
o Timeliness
o Resource management
o Safety and Reliability
o Concurrency
o Security
• Methodologies and design patterns for Real time systems
• Real time programming in C/C++
• Real time programming in Java

Learning activities and teaching methods:
Lectures, Group Project.

Recommended optional programme components:
Introduction to Embedded Systems, Object-Oriented Analysis and Design.
Recommended or required reading:
Lecture notes.
Douglass B.P. 1998, Real-Time UML - Developing Efficient Objects for Embed-ded Systems, Addison-Wesley ISBN 0-201-49837-5.
Assessment methods and criteria:
Exam + Project evaluation.

Grading:
1-5
Person responsible:
Dr. Seamus Hickey

521260S: Representing Structured Information, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Language of instruction:
In English.
Timing:
Period 1-3.
Learning outcomes:
Learning outcomes: Upon completing the required coursework, the student is able to read XML-based descriptions; to identify their elements and relations between them. The student is able to evaluate and

compare existing descriptions. Moreover, the student is able to design and document descriptions and to implement programs that use existing and self made descriptions. Finally, the student is able to create Web Services that utilize XML representations.
Contents:
XML and XML Schema, parsing XML, XML & Web Services, tools for writing XML, processing XML in programs, implementing programs processing XML.
Learning activities and teaching methods:
Lectures, programming exercises and project work
Recommended optional programme components:
Programming
Recommended or required reading:
Will be announced later

555348S: Research Project in Technology Management, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Haapasalo, Harri Jouni Olavi

Opintokohteen kielet: English

Leikkaavuudet:

555379S Research Project in Industrial Engineering and Management 5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:
English
Learning outcomes:
The student is offered an opportunity to combine and apply knowledge from earlier courses in technology management in form of a broad research project. The student familiarizes himself/herself with doing research and reporting their findings.
Learning outcomes: After finishing the course, the student will able to analyze and develop company activities using technology management methods.
Contents:
Completion of the course is agreed on one-to-one with the instructor. An accepted completion of the work requires planning of a research plan, familiarization with related literature, presented a solution to the researched question, and a written report. It is also possible to complete the course as a broader work piece of more than 5 ects credits if agreed so with the instructor.

465075A: Research Techniques for Materials, 3,5 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Karjalainen, Pentti

Opintokohteen kielet: Finnish

Leikkaavuudet:

465105A Research techniques for materials 5.0 op

Language of instruction:
Finnish
Learning outcomes:

This course gives an introduction to the broad spectrum of experimental techniques used in materials research, excluding materials testing. The principles, advantages and limitations of the various methods and their field of applications are described.
Learning outcomes: Upon completing of the required coursework, the student can explain the structure, functioning and contrast formation as well as factors affecting the resolution of various metal microscopes. He/she is also able to explain the concepts of the thermal analysis, dilatometry, and magnetic and electrical measurements and list typical applications for these techniques and methods.
Contents:
Optical microscopy; Transmission and scanning electron microscopes; Microanalysis; Quantitative metallography and image analysis; Spectroscopic methods; Thermal, dilatometric,
electric and magnetic methods; Measurement of residual stresses; Demonstrations of some techniques
Learning activities and teaching methods:
Lectures and demonstrations will be held during the 1st period. The final assessment will be in the form of a final exam.
Study material: Lecture notes
Kettunen, P.O.: Elektronimikroskopia I ja II, Otakustantamo: Espoo, 1983

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:
Learning outcomes: After passing the course the student is able to work as an active, responsible and initiative member of a project group. The student can apply the theoretical knowledge of his/her area in a creative way to solve a practical research problem, implement the methods needed in the work with a programming language, and document the results of the work in the form of a scientific publication.
Contents:
In this course a small-scale research work on information processing is carried our as a part of the activities of a research group. The topics are chosen according to the needs of current research projects. The main emphasis is in developing and applying information processing methods. Implementation of a method in Matlab, C or Java environment is usually required.
Learning activities and teaching methods:
The work is started by getting a short introduction to the goals and activities of the research group, and by agreeing with the advisor about the contents of the given work. Before starting the work, it should be agreed about its different phases, practical implementation and supervision. Typically the work is divided into: studying the theory, programming, testing, preparing the document, and final presentation of the results.
Recommended optional programme components:
A good general success in studies is required. Good programming skill is a plus. Additional conditions can be set on the basis of the given problem.
Recommended or required reading:
Books and scientific articles related to the given research problem.

521201S: Research methods of Thin Films for Electronics, 3,5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Marina Tjunina

Opintokohteen kielet: English

Language of instruction:
In English.
Timing:

Period 5-6.
Learning outcomes:
The students are introduced to methods and processes of growth of thin films and to methods of research of growth, microstructure, and chemical composition of thin films.
Learning outcomes : Student is able to describe characteristics of materials in thin-film form, main methods of deposition of thin films, main experimental methods of materials characterization (thickness, chemical composition, morphology, crystal and electronic structure), strongly localized research methods, and methods of studies of dynamic properties. Student is able to explain processes of growth of thin films, physical principles and limits of research methods, relationship between measurement results and materials parameters. Student is able to select appropriate research methods and properly apply them.

Contents:
Thin films for electronics. Methods of deposition. Growth processes. Methods of studies of thickness, microstructure, and chemical composition. Methods of x-ray and electron diffraction. X-ray, electron, and ion spectroscopy. Electron, tunnelling, atomic force, and near-field microsopes. Infra-red and Raman spectroscopy.
Learning activities and teaching methods:
Lectures, demonstrations, and calculation exercises. Final exam. The course is provided biannially.
Recommended optional programme components:
Basic physics. Introduction to materials physics
Recommended or required reading:
Selected chapters from M. Ohring: The materials science of thin films, Academic Press, 1992, 2002. Lecture notes.

901008P: Second Official Language (Swedish), 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Language Centre

Opintokohteen kielet: Swedish

Leikkaavuudet:

ay901008P Second Official Language (Swedish) (OPEN UNI) 2.0 op

Ei opintojaksokuvauksia.

555347S: Seminar in Technology Management, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Haapasalo, Harri Jouni Olavi

Opintokohteen kielet: English

Leikkaavuudet:

555378S Seminar in industrial engineering and management 5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:
English
Learning outcomes:
The aim of the course is to go deeper into the specific questions of technology management and doing related research. A student may specify his/her studies in a certain area by completing a seminar or a research project.
Learning outcomes: After finishing the course, the student will able to present research areas related to technology management. The student will also able to assess related research and to critically discuss it.
Contents:

Each seminar piece discusses a certain topic in technological management in great detail. The topic area is specified according to students' wishes. On top of lectures the course includes completion of a personal research report.

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521362S Electonics and Communications Engineering Seminar 0.0 op

Language of instruction:
Finnish/English
Learning outcomes:
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.
Learning outcomes: After completing the course the student can prepare a presentation of predetermined length of her/his thesis and have experience on presenting the topic. In addition, she/he has experience on evaluating other students' presentations and has a general view of completed diploma theses.

Contents:
The content is determined by the diploma work topics and other current research topics.
Learning activities and teaching methods:
The student is required to participate in at least 4 seminars. In one of those, the student has to give an oral presentation of his/her diploma work. Presentations are given in English. Seminars are given during the whole year when necessary.
Recommended or required reading:
Instructions for preparing a diploma work in the Department of Electrical Engineering.

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Myllylä, Risto Antero

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish. Materials also available in English.

Timing:
Period 1-2.
Learning outcomes:
The objective of the course is to present common practical solutions for electrically measuring physical quantities. This course covers especially sensors and methods used in process industry.
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.

Learning activities and teaching methods:
Lectures and exercises. The course is passed by a final exam.
Recommended or required reading:
H. N. Norton: Handbook of Transducers, Prentice Hall P T R, 1989 or 2002; lecture notes (in Finnish); exercise notes (also in English)

521486S: Signal Processing Systems, 4 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannuksela, Jari Samuli

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Period 1-3.
Learning outcomes:
The objective of the course is to provide advanced understanding on the organization of signal processing systems, including the implementations of the most common structural elements and algorithms, and on the use of design tools.
Learning outcomes: After the course the student can explain the challenges of signal processing hardware, software, and design methodologies. He 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. In addition, the student is able to explain the most important algorithm implementation structures and can identify their usage contexts. After the course the 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 (particularly DCT), polyphase filters, 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.

Learning activities and teaching methods:
The course consists of lectures and several design exercises out of which at least five needs to be passed. The final grade is based on the combined points obtained from the exercises and the final exam.

Recommended optional programme components:
Digital Filters, Computer Engineering, Digital Techniques II

Recommended or required reading:
Lecture notes and exercise materials. Material is in English.

521365S: Simulations and Tools for Telecommunications, 3,5 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Risto Vuohtoniemi
Opintokohteen kielet: Finnish

Language of instruction:
Lectures are in Finnish. The course book and lecture notes are in English. If the teacher in English speaking, also the lectures are in English.
Timing:
Periods 5-6.
Learning outcomes:
The goal is to familiarize the students with simulation of communication systems, protocols, algorithms and transceiver RF/IF-blocks. The course gives answers to questions why, when and how to simulate. In addition to simulation principles also communication system simulations especially in the baseband level are considered as well as brief overview to simulations in the network level and RF/IF parts.

Learning outcomes: A student recognizes problems and limitations related to simulations. A student can select a suitable simulation method and knows how to validate the model. Student knows how to generate signals, random numbers and noise as well as fading channels. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results. A student can explain principles of network level simulations. Furthermore, a student recognizes common communications and RF/IF 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. The common simulation packages communication and RF systems are presented.

Learning activities and teaching methods:
Lectures 2 hours per week (including program introductions) and a compulsory design exercise.
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 final examination and acceptably passed design exercise.

521457A: Software Engineering, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning
Opintokohteen kielet: English
Leikkaavuudet:

ay521457A	Software Engineering (OPEN UNI)	5.0 op

Learning outcomes:
The purpose of this course is to give an overview of software development related to real-time systems.

Learning outcomes: After finishing the course, the student knows the basic concepts of software and real-time systems, the different areas of project management, the phases of software development and the goals and tasks of them, is able to use structural methods for defining systems and knows the principles of object-oriented design and analysis. After the course, the student has basic knowledge of utilizing software tools for structural analysis and design.
Contents:
Problematics of software development and the special features of real-time systems in this regard. Software development is viewed in regard to project management and actual implementation: 1. process models, 2. requirements specification, 3. project management basics:
design, metrics, risk management, resource management, followup, quality control, product control, 5. structural analysis and design, 5. software testing methods and strategies, 6. introduction to object-oriented analysis and design.
Learning activities and teaching methods:
The course consists of lectures and a laboratory design exercise.
The course is completed by a final exam and a successfully completed exercise.
Recommended optional programme components:
Introduction to Programming
Recommended or required reading:
R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005, chapters 1-11, 13-14 and 21-27. Older editions (4th and 5th) can also be used as a reference. In this case the lectures are based on chapters 1-20.

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Learning outcomes:
The student is familiarised with the phases of the software engineering process and project work. The theories from earlier studies are implemented in practice. The student gains experience of real-life software development and testing.
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.
Learning activities and teaching 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.
Recommended optional programme components:
521457A Software Engineering, 521453A Operating Systems, 521482A Programming Exercise and varying project related background reading.
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.

813323A: Software Quality and Quality Techniques, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Tervonen, Ilkka Tapio

Opintokohteen kielet: Finnish

ECTS Credits:
3 ECTS
Timing:
4th year, period 2
Learning outcomes:
Objective: The course introduces different perspectives for software quality and provides an introduction to software quality assurance standards, quality techniques and defect classification. The course focuses on reviewing and inspection in particular, but also process improvement with patterns is introduced. The students practice conventional and web-based inspection in small teams and reading technique in individual inspection.
Learning Outcomes: After finishing the course the student understands the software quality concept, recognizes quality models and can apply them in software quality measurement. The student knows different review and inspection methods and can inspect software descriptions and use supporting tools. The student knows dependability concept and Musa's reliability engineering. The student knows post-mortem review methods and can apply them.
Contents:
Quality models, review, inspection, inspection process improvement, quality metrics, defect taxonomy, dependability, post-mortem review
Learning activities and teaching methods:
Lectures, study group working, essay, inspection exercises

Recommended optional programme components:
Software engineering, Object oriented analysis and design
Recommended or required reading:
Galin D., Software Quality Assurance: From theory to implementation, Addison-Wesley, 2004
Gilb T., and Graham D., Software Inspection, Addison-Wesley, Wokingham, England, 1993
Gillies A.C, Software Quality: Theory and Management, Second edition, International Thomson Computer Press, London, UK, 1997
Wiegers K.E., Peer Reviews in Software, Addison-Wesley, 2002
Lecture material http://www.tol.oulu.fi/users/ilkka.tervonen/LaTe_engl.html
Assessment methods and criteria:
Study group working or essay, inspection exercises
Grading:
1-5
Person responsible:
Ilkka Tervonen

813322A: Software Testing, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Kokkoniemi, Jouni Kalevi

Opintokohteen kielet: Finnish

ECTS Credits:
3 ECTS
Timing:
3th year, period 4

Learning outcomes:
Objective: The course introduces the basic concepts of testing, test planning and reporting, and software testing as part of the software development process at different stages. In addition, we go through various testing techniques and test automation. The course design and testing, practicing various techniques of software testing tools.
Learning Outcomes: After finishing course the student manages basic concepts related to testing and the testing process, he knows the various stages of testing, he knows how the test can be carried out, and he will be able to plan and to re-port to the testing. In addition, after the course the student to know how to test different types of applications and how testing can be automated.
Contents:
Basics of software testing, unit testing, integration testing, system testing, documenting tests, designing tests, test case design, recression testing, object-oriented software testing, quality of Web pages and testing Internet applications, and test metrics
Learning activities and teaching methods:
Lectures and Large exercise or an alternative way (mainly for foreign students)
Recommended optional programme components:
-
Recommended or required reading:
Lecture material and varied literature each year, which is given in the lectures start
Assessment methods and criteria:
Lecture diaries and assignment concerning software testing (Large exercise has been reported by assignment)
Grading:
Pass / Fail

Person responsible:
Jouni Kokkoniemi

521410S: Special Course in Electronic Design, 4 - 7 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Language of instruction:
The course and exercises are held in Finnish. (In English if the are more than 2 international students).
Timing:
Period 1-2.
Learning outcomes:
The contents of this course vary yearly, containing current topics of electronics design.
Learning outcomes: Varies with the course contents

Contents:
The contents and extent of the course are defined every year by the beginning of the semester. The course may include RFIC design, analysis and linearization techniques of nonlinear circuits, or digital error correction of A/D converters, for example. The weight is mostly planned to be in the analysis of nonlinear and/or time-varying circuits.
Learning activities and teaching methods:
The extent varies, and may contain a design exercise.
Recommended optional programme components:
Knowledge in circuit theory, and analog, digital and RF design is expected.
Recommended or required reading:
The course material is announced yearly.

521108S: Special Course in Optical Measurements, 5 - 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Anssi Mäkynen

Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 3.
Learning outcomes:
Course contents vary each year dealing with current topics in optics and optical measurements.
Contents:
Contents and the amount of credits are confirmed separately each year.
Learning activities and teaching methods:
Implementation and extent vary each year. The course may include l ectures, term papers, exercises or design exercises.
Recommended optional programme components:
Courses in optics or optical measurements
Recommended or required reading:
Course material will be announced separately each year.

802632S: Special course for teachers of mathematics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802641S	Special Course for Teachers of Mathematics: Training	2.0 op
802640S	Special Course for Teachers of Mathematics: High School Mathematics	3.0 op
802639S	Special Course for Teachers of Mathematics: Content Planning	5.0 op

ECTS Credits:
10 cr
Learning outcomes:
On successful completion of this course, the student will be able to
- combine mathematical thinking and teaching
- plan mathematical tasks which support profound mathematical understanding rather than computational proceedures
Contents:
This module aims at bridging the gap between the mathematical content in the BSc with the skills needed for teaching at schools. It consists of the following parts:

Content planning (4 cr)

This part involves planning and implementing tutorials for conceptual understanding for freshmen. The planning is done as group work and it is supported by a seminar.

Matriculation exam questions (3 cr)

This part is delivered by the normal school teachers. It covers scoring of the national exam's questions.

Other (3 cr)

This part contains practical experience of working as a teacher of mathematics, e.g. as a tutor.

Person responsible:
Peter Hästö

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Lasse Holmström

Opintokohteen oppimateriaali:
Duda, Richard O. , , 2001
Theodoridis, Sergios , , 2002
Webb, A. R , , 2002

Opintokohteen kielet: Finnish

ECTS Credits:
10 cr
Learning outcomes:
On successful completion of this course, the student will be able to
- describe the most important classical classification and feature extraction methods that are based on continous distributions.
- apply these methods to practical problems.
- derive the mathematical results that motivate some of the classification and feature extraction methods.

Contents:
Pattern recognition consists of measuring and observing natural objects, analysis of these measurements and recognition of objects on the basis this analysis. The course is an introduction to the concepts and theory of statistical pattern recognition which focuses on the automatic, probability theory based classification of objects based on features derived from the measurements.
Person responsible:
Lasse Holmström

521484S: Statistical Signal Processing, 5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Periods 4-6.
Learning outcomes:
This course provides basic knowledge of statistical signal processing, in particular, estimation theory and its applications in signal processing.
Learning outcomes: Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-

variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.
Contents:
1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.
Learning activities and teaching methods:
Lectures, exercises and Matlab design exercise. The course is passed with final exam and accepted Matlab exercise
Recommended optional programme components:
Algebra, Statistics, Signals and Systems.
Recommended or required reading:
J. Mendel: Lectures in estimation theory for signal processing, communications and control, Prentice-Hall, 1995. M.D. Srinath, P.K. Rajasekaran, R. Viswanathan: Introduction to Statistical Signal Processing with Applications, Prentice-Hall, 1996, Chapter 3. Lecture notes and exercise material.

721519P: Strategic Management, 5 op

Voimassaolo: 01.08.2008 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Sari Laari-Salmela

Opintokohteen kielet: English

Leikkaavuudet:

ay721519P Strategic Management (OPEN UNI) 5.0 op

ECTS Credits:
5 ects.

Language of instruction:
English.

Timing:
Period A.

Learning outcomes:
After the course students recognize the different schools of strategic management, are able to define the central concepts, understand the links between strategy, markets and operations of an organization and are able to develop and communicate a strategy having clear market value. The aim of this course is to increase understanding of the nature of the generative mechanisms through which the strategies are formed.
Contents:
How could we model organizational change processes involving genuine uncertainties, and, at the same time, model individuals and organizations as being able to make strategic choices? The purpose of this course is twofold: First, the aim is to introduce the basic concepts, historical developments and schools of strategic management. Second, the course explores the contemporary developments in strategic thinking from the point of view of high-growth ventures.
Learning activities and teaching methods:
The course will be taught in intensive sessions consisting of field work, workshops, guest lectures and group-work. The main method is solution creation to real business situations by using problembased learning. 70 % attendance of sessions is required. Further details will be provided by the responsible person in the first session.
Recommended or required reading:
Johnson, G., K. Scholes & R. Whittington. Exploring corporate strategy (Prentice Hall); Mintzberg, H., B. Ahlstrand & J. Lampel. Strategy safari: the complete guide through the wilds of strategic management (Prentice Hall /Financial Times); Article collection.

Check availability from here.
Assessment methods and criteria:
Assessment will be based on interview analysis, group exam and group assignment.
Grading:

1-5.

Person responsible:
Sari Laari-Salmela.

811388A: Symbian Programming, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Information Processing Science
Arvostelu: 1 - 5, pass, fail
Opettajat: Juustila, Antti Juhani
Opintokohteen kielet: Finnish

ECTS Credits:
4 ECTS
Timing:
4th year, period 1

Learning outcomes:
Objective: The objective of the course is to increase the undestanding of different hardware and software platforms, their commonalities and differences, especially focusing on the Symbian Operating System (OS). The course considers the Symbian OS from the perspective of an application programmer. The course is one of the group of courses focusing on different development platforms.
Learning Outcomes: The student understands the basic architecture, functionality and special features of the Symbian OS. The course is practical, focusing on programming in the Symbian OS.
Contents:
The architecture and versions of the Symbian OS. Development tools and languages. Development process. Programming practices and idioms. Ap-plication architecture. Processes and threads. Descriptors. Data structures. Ac-tive objects.
Learning activities and teaching methods:
Lectures 20 h, exercises 18 h, exercise work. Independent reading of articles.
Target group:
4th year
Recommended optional programme components:
Compulsory prerequisite course is the Basics of C++ programming language. The Operating systems course (Dept of Electrical Engineering at the Faculty of Technology) is a recommended prerequisite course.

Recommended or required reading:
Harrison: Symbian OS C++ for Mobile Phones, John Wiley & Sons, 2003. Jo Stichbury: Symbian OS Explained, John Wiley & Sons, 2004.
Assessment methods and criteria:
Exercise work.
Grading:
Numerical grading based on the exercise work.

Person responsible:
Antti Juustila

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Language Centre
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay900060A Technical Communication (OPEN UNI) 2.0 op
470218P Written and Oral Communication 3.0 op

Ei opintojaksokuvauksia.

903010P: Technical German 1, 6 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Language Centre
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: German

Ei opintojaksokuvauksia.

903012P: Technical German 3, 6 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Language Centre
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: German

Ei opintojaksokuvauksia.

521440S: Technical Optics, 4 op

Voimassaolo: - 31.07.2011
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Anssi Mäkynen
Opintokohteen kielet: Finnish

Language of instruction:
Finnish.
Timing:
Period 1-2.
Learning outcomes:
The goal of this course is to make a student familiar with the facts of geometrical and physical optics, optical components and optical instruments needed to perform optical design.
Learning outcomes: Upon completion of the course, the student is capable of explaining the basic facts of geometrical and physical optics and explaining the operating principles of simple optical components and instruments as well as the factors affecting their performance. He is able to describe an optical system as a principal point representation, is able to trace the most important paraxial rays through the system and estimate the radiometric properties and resolving power of an ideal optical system. He is able to name and identify the main aberrations of an optical system, explain how aberrations affect its resolving power and how the ability of resolving details is described and measured. The student is capable of designing and optimizing simple lens systems using optical design software tools. He is able to describe the properties of laser beam and to design lens systems for laser beam modification.

Contents:
Basics of geometrical and physical optics, optical components and instruments. Optical design software tools.
Learning activities and teaching methods:
Lectures, exercises. Final exam.
Recommended or required reading:
Lecture notes, Lectures are based on: F. L. Pedrotti, L. M. Pedrotti, L. S. Pedrotti: Introduction to Optics, 3rd ed. Pearson Education, 2007; Hecht: Optics, 4th ed. Addison-Wesley, 2002; D.C. O'Shea: Elements of Modern Optical Design. John Wiley & Sons, 1985.

521359A: Telecommunication Engineering 1, 2,5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish.
Timing:
Periods 2-3.
Learning outcomes:
To learn the basic principles of analog amplitude, phase and frequency modulation methods, their implementation methods, and to compare their performance under the influence of noise and single-tone interference. The course aids to understand digital communication systems that are based on discrete message signals.
Learning outcomes:
After completing the course student can identify operation principles of the most important functional blocks for an analog telecommunication system. Student also can tell operation principles of various analog carrier- and pulsemodulation methods both in time- and frequency domains. Student can also analyze the limitations resulting from channel interference and also estimate the influence of non-ideal realizations and operations on system performance. Student can also perform numerical SNR-, etc. calculations.

Contents:
Basic blocks of a communication system, linear and angle modulations, phase-lock loop and its applications, analog and digital pulse modulations, multiplexing methods, comparison of modulation methods without interference, SNR performance analysis of various continuous-wave and pulse modulations and their comparison, influence of a single-tone interference and phase-error, threshold effect, methods to improve system performance.

Learning activities and teaching methods:
Lectures and exercises. A final exam concludes the course.
Recommended optional programme components:
Signals and Systems, Stochastic Processes.
Recommended or required reading:
R.E. Ziemer & W.H. Tranter: Principles of Communications # Systems, Modulation and Noise, 5th edition, 2002, John Wiley & Sons, chapter 1 partly, all of ch 3 and ch 6 partly.

521361A: Telecommunication Engineering II, 3 op

Voimassaolo: 01.08.1950 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521330A Telecommunication Engineering 5.0 op

Language of instruction:
In Finnish.
Timing:
Period 3-4.
Learning outcomes:
To learn the basics of digital transmission systems that are based on amplitude, phase and frequency modulation of a discrete-valued symbol sequence, the influence of transmission channel on system performance, the basics of information and coding theory.
Learning outcomes:
After completing the course student can tell and analyze the essential and optional blocks of a digital communication system both in time and in frequency domain. Student can tell the limitations resulting from transmission channel and can tell various methods to combat such effects. Using simple assumptions, student can analyze system performance mathematically and compare various modulation methods from the viewpoint of system resources. Student can evaluate standards and specifications of communication systems. Student can also apply obtained knowledge for practical system and sub-system design.

Contents:
Basic blocks of a digital transmission system, baseband digital transmission, digital continuous-wave modulations (ASK, MPSK, MFSK), correlation and matched filter receivers, receiver structures and their bit error probability performance with AWGN channel, effect of band-limiting and multipath propagation, basics of information theory, discrete channel models, entropies, source coding, channel capacity, basics of error-correction coding methods.
Learning activities and teaching methods:
Lectures and exercises. A final exam concludes the course.
Recommended optional programme components:
Stochastic Processes
Recommended or required reading:
R.E. Ziemer & W. H. Tranter: Principles of Communications - Systems, Modulation and Noise, 5th edition, 2002, John Wiley & Sons, chapter 7, partially chapters 8 and 10

521366S: Telecommunication Engineering Project, 3,5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Timing:
Period 1-6.
Learning outcomes:

To introduce the student into the design, implementation and/or testing of a certain part of communication system.
Learning outcomes:
After completing the course student can - depending on the work subject - either solve, design, construct, measure, simulate, or analyze limited telecommunication and radio system and sub-system problems. Thus student applies the technical knowledge aquired from advanced cources into practical engineering tasks. In addition, student can document technical and scientific results

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 telecommunication laboratory 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 EE department's diploma thesis must be followed.
Recommended optional programme components:
Depending on the subject matter of exercise: Digital Communications, Digital Signal Processing or Radio Engineering or suitable advanced courses of the telecommunication laboratory.

521368S: Telecommunications Signal Processing 1, 5,5 op

Voimassaolo: 01.08.2004 - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juntti, Markku Johannes
Opintokohteen kielet: Finnish

Language of instruction:
In English.
Timing:
Period 3-4.
Learning outcomes:
Statistical signal processing knowledge is deepened to adaptive signal processing and spectrum estimation.

Learning

outcomes: Upon completing the required coursework, the student is

able to use the basic methodology of signal processing to design

communication systems and their receivers. He or she will be able

to design and implement various equaliser algorithms. The student

can design linear filters for statistical signal processing

applications.

Contents:
Optimal linear filters, spectrum estimation, iterative matrix algorithms, stochastic gradient algorithms, recursive least squares methods
Learning activities and teaching methods:
Lectures and exercises in total 6 hours in two weeks. The course is passed with final examination.
Recommended optional programme components:
Statistical signal processing, Telecommunication Engineering II.
Recommended or required reading:
Parts from: Simon Haykin: Adaptive Filter Theory, 3rd ed. Prentice Hall, 1996. (989 pages) ISBN: 0-13-322760-X. and P. Stoica & R. Moses: Introduction to Spectral Analysis. Prentice-Hall, 1997 (319 pages) ISBN 0-13-258419-0. H. Meyr, M. Moeneclaey & S. A. Fechtel: Digital Communi-cation Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998.

521265A: Telecommunications Software, 5 op

Voimassaolo: 01.08.2005 - 31.07.2012

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Junzhao Sun

Opintokohteen kielet: English

Learning outcomes:
The course provides systematic knowledge of telecommunication software principles and protocol engineering.
Learning Outcomes: Upon completion of the course, students should be able to:
- create and minimize a finite state machine,
- perform reachability analysis on a communicating finite state machine,
- create and identify behavioral properties of a petri net,
- perform coverability analysis on a petri net,
- describe data using ASN.1,
- encode ASN.1 type declaration to transfer syntax using BER,
- apply graphical SDL to model a protocol,
- generate test sequences for a finite state machine with T-, D-, W-, and U-methods,
- explain the key concepts of conformance testing methodology, and
- apply TTCN-3 core language to describe a test suite.

Contents:
Principles, specification, verification, validation, synthesis, description languages and testing of telecommunication protocols.

Learning activities and teaching methods:
The course comprises of lectures and exercises. The course is passed with a final exam and an approved practical work.

Recommended optional programme components:
Software engineering.

Recommended or required reading:
Gerard J. Holzmann, Design and Validation of Computer Protocols, Prentice-Hall, 1991. Andrew S. Tanenbaum, Computer Networks, 4th edition, Prentice Hall, 2003.

521167S: Testing Techniques of Electronics, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

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

Timing:
Period 3.

Learning outcomes:
In this course students become familiar with testing methods and testing equipment used in electrical industry.
Learning outcomes: After completing the course the student is able to explain how testing affects the quality and reliability of electrical products. Additionally, the student can estimate how the selected testing techniques and the measurement results generated enable the control of the manufacturing process. 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 (DfT). Additionally, the student is able to use different manufacturing testing techniques, such as automatic testing equipment, boundary-scan and built-in-self-test (BIST).

Contents:

Quality and reliability, controlling the manufacturing process using test results, automatic test equipment, test strategies, design for testability, boundary-scan, built-in self-test (BIST).
Learning activities and teaching methods:
Lectures and laboratory exercises. Final exam and passed laboratory exercises.
Recommended optional programme components:
Electronic Measurement Techniques.
Recommended or required reading:
Lecture notes. T. L. Landers, W. D. Brown, E. W. Fant, E. M. Malstrom, N. M. Schmitt: Electronics Manufacturing Processes. B. Davis: The Economics of Automatic Testing. M.L. Bushnell, V.D. Agrawal: Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits. M. Burns, G. W. Roberts: An Introduction to Mixed-Signal IC Test and Measurement.

031026A: Variational Methods, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Hamina, Martti Aulis
Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Timing:
Period 4-6
Learning outcomes:
Introduction to calculus of variations.
Learning Outcomes **:** The student will be able to identify and solve analytically variational problems by forming and solving the corresponding Euler equation. He can transform a boundary value problem into the variational form. The student can construct approximate solutions by using the Galerkin method.
Contents:
Calculus of variations, Euler equation, generalized coordinates. Variational formulation of a boundary value problem. Hilbert space, Galerkin method
Learning activities and teaching methods:
Lectures and classroom exercices.
Recommended optional programme components:
Calculus I and II, matrix algebra and differential equations.
Recommended or required reading:
Rektorys K.: Variational Methods in Mathematics. Gelfand I. , Fomin S.: Calculus of Variations.

764627S: Virtual measurement environments, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764327A Virtual measurement environments 5.0 op

Ei opintojaksokuvauksia.

761104P: Wave Motion, 3 op

Opiskelumuoto: Basic Studies
Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761310A Wave motion and optics 5.0 op

761310A-01 Wave motion and optics, lectures and exam 0.0 op

761310A-02 Wave motion and optics, lab. exercises 0.0 op

761114P-01 Wave motion and optics, lectures and exam 0.0 op

761114P-02 Wave motion and optics, lab. exercises 0.0 op

761114P Wave motion and optics 5.0 op

ECTS Credits:
3 credits
Language of instruction:
Lectures and exercises in Finnish. Material in English.
Timing:
Spring
Learning outcomes:
The student can classify different types of wave motions and knows the characterizing quantities (wavelength, period, wave speed), can apply geometrical optics to simple mirror and lens systems, knows the meaning of interference and diffraction and can apply these in simple cases.
Contents:
Basic course on wave motion, and geometric and wave optics.
Wave motion and propagation. Acoustics. Geometric optics: basic principles, mirrors and lenses. Electromagnetic waves. Wave optics: interference, diffraction, and polarization. Optical instruments. Photometry. Laser.
Learning activities and teaching methods:
Lectures 32 h, exercises 10 h, four mini examinations and one end examination or a final examination.
Target group:
For students of minor subject.
Recommended optional programme components:
Upper secondary school physics and mathematics.
Person responsible:
Sami Heinäsmäki
Other information:
https://wiki.oulu.fi/display/761104P/

031045S: Wavelet Transform in Numerical Analysis, 8 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: Finnish

Language of instruction:
Finnish
Learning outcomes:
The objectives are the mathematical foundations of the wavelet transform and their construction methods. The fast wavelet transform is introduced and will be applied for the numerical approximation of the solution of partial differential equations.
Learning outcomes: The student knows the basic properties of the wavelets and their construction methods. He/She learns how to solve some partial differential equations by means of the fast wavelet transform.
Contents:

Wavelet transform. Frames and the Riesz basis. Orthogonal and biorthogonal wavelets. Fast wavelet transform. Solution of partial differential equations.
Learning activities and teaching methods:
Lectures in agreement (4 h/week and exercises 2h/week). Two intermediate exams or one final exam.
Recommended optional programme components:
Calculus 1, Calculus 2, Matrix algebra, Differential equations, Numerical Methods, Signals and Systems, Variational methods.
Recommended or required reading:
- I. Daubechies; Ten lectures on wavelets
- A. Louis, P. Maas andA. Richter; Wavelets

811345A: Web-information Systems Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Katja Leiviskä

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS
Timing:
4th year, periods 1+2
Learning outcomes:
Objective: Web-information systems design, techniques and concepts of Web-information systems. The course provides theoretical and practical information of Web-information systems design.
Learning Outcomes: After passing the course, a student understands Web-information systems design, techniques and concepts of Web-information sys-tems. Also a student has a basic knowledge how to design Web-information sys-tems.
Contents:
Web-information systems design, techniques and concepts of Web-information systems.
Learning activities and teaching methods:
Lectures 30 hours, exercises 30 hours

Target group:
4th year
Recommended optional programme components:
Mandatory course : Content creation in new media. A recommended course is Object oriented analysis and design.

Recommended or required reading:
Lecture handouts and Lowe David & Hall Wendy, Hypermedia & the Web: An Engineering Approach, John Wiley & Sons. Richard Vidgen, David Avison, Bob Wood and Trevor Wood-Harper. Developing Web Information Systems, Butterworth-Heineman, 2002.
Assessment methods and criteria:
A practical work and examination

Grading:
1-5
Person responsible:
Katja Leiviskä

521316A: Wireless Communications 1, 4 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Opettajat: Matti Latva-aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

521329A	Hands-on Course in Wireless Communication	5.0 op
521307A	Laboratory Exercises on Analogue Electronics	5.0 op
521316S	Introduction to Broadband Transmission Techniques	5.0 op

Language of instruction:
English
Timing:
Periods 1-3
Learning outcomes:
The target is to introduce the key transmission technologies used in modern broadband wireless systems and to introduce the most common wireless standards.

Learning outcomes: Upon completing the required coursework, student can distinguish the basic transmission technologies used in the most important commercial wireless communication systems. Furthermore, the student can differentiate and compare the key points behind these technologies, why they are used and what are their advantages and disadvantages. Student can explain how the wireless channel impacts the design of the overall system. The most relevant standards are introduced and explained, so that student can attain information from past and especially the forthcoming wireless standards. Student can also observe and explain the performance of these technologies with variable system and channel parameters through the course laboratory exercise.
Contents:
Wideband radio channels, multiple access techniques, spread spectrum and DS-CDMA techniques, OFDM techniques,UWB techniques, positioning, applications and most common standards.
Learning activities and teaching methods:
Lecturers, lab exercise, final exam
Recommended or required reading:
Defined during the lectures

521320S: Wireless Communications 2, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S	Wireless Communications I	5.0 op
521323S	Wireless Communications 2	5.0 op

Language of instruction:
In English.
Timing:
Period 1-3.
Learning outcomes:
Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.
Learning outcomes: After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to to make the performance comparison of them.

Student can explain design methods signals for bandlimited channels and can classify different channel equalizers, and perform the performance analysis. In addition, the student can utilize channel capacity evaluation for fading channels, he/she recognizes the basic methods for link adaptation and multiantenna communication.

Contents:
Radio channel models, channel capacity, digital modulation method and their performance in AWGN-channel, carrier and symbol synchronization, performance of digital modulation in fading channel, diversity techniques, adaptive modulation and coding, multiantenna techniques and channel equalizers in wireless communication.
Learning activities and teaching methods:
Lectures and exercises in total 4 hours in a week during periods 1-3. The course is given in English. The course is passed with final examination (during lecture periods possibility to pass with intermediate exams) and accepted design exercise. Grade is based on exam.
Recommended optional programme components:
Telecommunication Engineering II. Also recommended: Statistical Signal Processing, Radio Communication Channels.
Recommended or required reading:
Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of J.G. Proakis: Digital Communications, 4th ed, 2001. Also, additional material from other sources.

521317S: Wireless Communications 3, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Latva-aho

Opintokohteen kielet: English

Language of instruction:
English.
Timing:
Period 4-6.
Learning outcomes:
Target is to deepen the understanding of the fundamental transmission concepts used in broadband systems.

Learning outcomes: Upon completing the required coursework, the student can define the design criteria for CDMA and OFDM based wireless systems. Student can also interpret and explain the different receiver algorithm designs used in these technologies. During the course it is explained how these technologies are deployed in current and future wireless systems. After the course student has understanding on the applicability of these technologies to different types of scenarios and applications. With this knowledge the student can justify why certain solutions will be used or considered for future wireless systems and roughly compare their performance.
Contents:
Broadband channels and their modeling, CDMA techniques and modems, performance of CDMA systems, design of OFDM systems and modems, future mobile technologies.
Learning activities and teaching methods:
lecturers, lab exercise, final exam. Lectured only every second year in English (odd years)
Recommended or required reading:
Wireless communications, A. Molisch, John Wiley & Sons 2005. Introduction to Spread Spectrum Communications,R. L. Peterson, R. E. Ziemer, D. E. Borth, Prentice-Hall, 1995. OFDM for Wireless Multimedia Communications, R. Prasad, and R. Van Nee, Artech House, 2000.

521114S: Wireless Measurements, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Esko Alasaarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

521097S Wireless Measurements 5.0 op

Language of instruction:
In Finnish or in English if three or more foreign students participate.

Timing:
Period 4
Learning outcomes:
The objective of the course is to supply student with basic understanding of methods, standards and components, which are needed in the wireless measurements of industrial, traffic, environmental and healthcare applications.
Learning outcomes: Upon completing the course, the student can apply wireless technologies in industrial, traffic, environmental and healthcare measurements. He/she can tell and argument the benefits and challenges of using wireless measurement solutions and is able to apply the most important standards in his/her engineering work. In addition, he/she can use a representing set of industrial and scientific applications of wireless measurements to develop his/her own solutions.

Contents:
Basics of wireless measurement technologies and standards, wireless sensors and sensor networks, wireless industrial measurement and testing applications, wireless measurement applications in traffic, wireless environmental measurements and wireless human health monitoring.
Learning activities and teaching methods:
The course is lectured intensively within one period. At the end of the period the students prepare presentations about contemporary themes selected by them or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.
Recommended optional programme components:
Basics of measurement technology and Electronic measurement technology or equivalent basic knowledge.

Recommended or required reading:
Lecture notes (in English) prepared by the teacher and contemporary seminar presentations with their source material.
Assessment methods and criteria:
The course is passed with a literal final exam (70 %) and a contemporary seminar (30 %)

521219S: X-ray Methods, 4,5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

Language of instruction:
In Finnish. In English if there are more than 5 international students in the class.
Timing:
Period 4-5.
Learning outcomes:
The course provides the basic concepts of x-ray diffraction and spectroscopy applicable to the study of composition, crystal structure, and structure imperfections of materials. In addition, the students are introduced to experimental diffraction work.
Learning outcomes: After completing the course, student can explain the general principles of interaction between x-rays and solid matter and can explain the physics underlying behind these phenomena. Student can explain the

origin and generation of x-ray radiation, can explain the main x-ray detection technologies, and x-ray measurement techniques. Also, student can explain how to experimentally measure the crystal structure, grain size, and stress state of a material by using x-ray diffraction methods (XRD).

Contents:

Generation and properties of x-rays. Chemical analysis by x-ray spectroscopy, WDS and EDS. X-ray scattering. X-ray diffraction methods. Determination of crystal structure and phase composition. Analysis of grain size, texture and stresses. Electron and neutron diffraction.

Learning activities and teaching methods:

Lectures and calculation exercises. Three laboratory exercises under instruction of assistant lecturer. Final grade of the course will be a weighted average of theoretical examination (2/3) and laboratory exercises (1/3).

Recommended or required reading:

Lecture notes and B.E.Warren: X-ray Diffraction, Addison-Wesley Publishing Company, Inc., 1969 and some other books informed later.