Opasraportti

ITEE/ Electrical Engineering + Wireless Communications Engineering (2016 - 2017)

Tutkintorakenteet

MSc. Engineering, Electrical Engineering

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Option (60 - 80 op)

Compulsory, choose one of the options and one of the related advanced modules.

Apart from the below courses, the advanced module can contain also courses from other options as well as e.g. natural sciences or economics courses that support your degree.

Please note: there may be mistakes in module size limits which should not affect your choices.

Electronics Design

H451229: Module of the Option, Electronics Design, 60 - 87 op
- *Module of the option, complysory studies 30 ECTS crcr*
  - A451221: Module of the Option, Electronics Design, 30 - 38 op
    - *Compulsory studies, Total 30 ECTS cr*
      - 521405A: Electronic System Design, 5 op
      - 521326S: Radio Engineering 1, 5 op
      - 521423S: Embedded System Project, 5 op
      - 521088S: Optoelectronics, 5 op
      - 521305S: Computer Aided Circuit Design, 5 op
- *Advanced module, 1. electronics design, electronics design (optional, 18 ECTS cr)*
  - A451289: Advanced module/Electronics design, electronics design (obligatory), 15 - 40 op
    - *Obligatory courses, Total 18 ECTS cr*
      - 521435S: Electronics Design III, 6 op
      - 521445S: Digital Techniques 3, 6 op
      - 521300S: Electronics Design and Construction Exercise, 6 op
- *Advanced module, 1. electronics design, electronics design (obligatory 39 op)*
  - A451290: Advanced module/Electronics design, electronics design (optional), 25 - 41 op
- *Advanced module, 2. digital systems design, obligatory courses Total 16 ECTS cr*
  - A451273: Advanced Module/Electronics Design, Digital Systems Design (obligatory), 16 - 21 op

Obligatory courses, 16 ECTS cr
521445S: Digital Techniques 3, 6 op
521453A: Operating Systems, 5 op
521457A: Software Engineering, 5 op
Advanced module, 2. digital systems design, optional courses, 41 ECTS cr.
A451274: Advanced Module/ Electronics Design, Digital Systems Design (optional), 9 - 41 op

Electronics materials and components

H451226: Module of the Option, Electronics Materials and Components, 60 - 80 op
Module of the option, compulsory courses 30 ECTS cr
A451222: Module of the Option, Electronics Materials and Components, 35 - 41 op
Compulsory courses, Total 30 ECTS cr
521073S: Electroceramics and Intelligent Materials, 5 op
521326S: Radio Engineering 1, 5 op
521443S: Electronics Design II, 5 op
521075S: Microelectronics Packaging Technologies, 5 op
521225S: RF Components and Measurements, 5 op
521074S: Microelectronics and Micromechanics, 5 op
Advanced module:Electronics Materials and Components, compulsory courses (min. 2 courses) 10-15 ECTS cr
A451291: Advanced Module, Electronics Materials and Components, 10 - 52 op
Advanced module, Obligatory courses (min. 2 courses) 10-15 ECTS cr
521072S: Microsensors, 5 op
521080S: X-ray Diffraction, 5 op
521079S: Introduction to Nanotechnology, 5 op
Advanced Module, Electronics Materials and Components (optional studies 42-47 ECTS cr)
A451294: Advanced Module, Electronics Materials and Components (optional studies), 37 - 47 op

Telecommunication Engineering

H453221: Module of the Option, Telecommunication Engineering, 60 - 80 op
Advanced module, obligatory courses, 10-36 ECTS cr
A453273: Advanced module, Telecommunication Engineering, 10 - 47 op
Advanced module mandatory courses, choose min. 2 courses, 10-36 ECTS cr
521377S: Communications Networks II, 7 op
521317S: Wireless Communications II, 8 op
521327S: Radio Engineering II, 6 op
521325S: Communication Signal Processing II, 5 op
Antennas (even years), Radiochannels (odd years)
521386S: Radio Channels, 5 op
521388S: Antennas, 5 op
Advanced Module, Telecommunication Engineering (optional studies) 11-37 ECTS cr
A453295: Advanced Module, Telecommunication Engineering (optional studies), 11 - 37 op

Photonics and Measurement Techniques

H451227: Module of the Option, Photonics and Measurement Technology, 60 - 80 op
Module of the option, compulsory studies, 30 ECTS cr
A451223: Module of the Option, Photonics and Measurement Techniques, 30 - 41 op
Compulsory courses, 30 ECTS cr
521091S: Technical Optics, 5 op
521096S: Measurement Systems, 5 op
521443S: Electronics Design II, 5 op
521088S: Optoelectronics, 5 op
521124S: Sensors and Measuring Techniques, 5 op
Advanced Modules, Optical and Electrical Measurement Techniques, 15 ECTS cr
A451292: Advanced Module, Optical and Electrical Measurement Techniques, 15 - 57 op
Advanced module, complusory studies 15 ECTS cr
521240S: Biophotonics and Biomedical Optics, 5 op
521093S: Biomedical Instrumentation, 5 op
521094S: Optoelectronic Measurements, 5 op
A451293: Advanced Module,Testing Techniques and Printed Electronics, 10 - 57 op

Advanced module, complusory studies 10 ECTS cr
521089S: Printed Electronics, 5 op
521098S: Testing techniques of Electronics, 5 op
Optional studies, 42-47 op
A451295: Advanced Module, The Photonics and Measurement (optional studies), 42 - 47 op
Optional studies, add optional courses 42-47 ECTS cr
521322S: Telecommunication Engineering Project, 5 op
521025S: Power Electronics, 5 op
521097S: Wireless Measurements, 5 op
521115S: EMC Design, 5 op
521410S: Special Course in Electronic Design, 4 - 7 op
521308S: Electronic Research Exercise, 5 op

Advanced practical training (3 op)

521016A: Advanced Practical Training, 3 op

Master's Thesis (30 op)

Choose your Thesis category among the following:

523991S Electronics design; 523992S Electronics materials and components; 523993S Photonics and measurement technology; 521998S Telecommunication Technology

The Master's Thesis requires a written maturity test.

Master's Programme in Wireless Communications Engineering

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Module of the option (40 op)

All courses are compulsory.

A451225: Module of the Option, Wireless Communications Engineering, 40 - 65 op
Compulsory
031025A: Introduction to Optimization, 5 op
521321S: Elements of Information Theory and Coding, 5 op
521316S: Broadband Communications Systems, 5 op
521323S: Wireless Communications I, 5 op
521340S: Communications Networks I, 5 op
521348S: Statistical Signal Processing 1, 5 op
521324S: Statistical Signal Processing II, 5 op
521385S: Mobile Telecommunication Systems, 5 op

Advanced module (16 - 31 op)

Either Antennas or Radio Channels is chosen as compulsory (they are lectured in alternate years). Futhermore, choose the minimum of two courses from the set list.

A453271: Advanced module, Wireless Communications Engineering, 16 - 35 op

Two courses from this set of four courses must be selected
521377S: Communications Networks II, 7 op
521327S: Radio Engineering II, 6 op
521317S: Wireless Communications II, 8 op
521325S: Communication Signal Processing II, 5 op
One of these courses, Antennas or Radio Channels, must be selected, and the other one can be placed into elective studies if it wish to taken.
521388S: Antennas, 5 op
521386S: Radio Channels, 5 op

Supplementary module/Electives, WCE (16 - 31 op)

Choose from the set courses to reach the minimum of 120 ECTS degree (including the thesis and practical training).

A453246: Supplementary module/Electives, Wireless Communications Engineering, 10 - 41 op
Alternative
900017Y: Survival Finnish, 2 op
900013Y: Beginners' Finnish Course 1, 3 op
900053Y: Beginners' Finnish Course 2, 5 op
521318S: Modern Topics in Telecommunications and Radio Engineering, 3 - 7 op
521225S: RF Components and Measurements, 5 op
521443S: Electronics Design II, 5 op
521435S: Electronics Design III, 6 op
521410S: Special Course in Electronic Design, 4 - 7 op
521305S: Computer Aided Circuit Design, 5 op
521307A: Laboratory Exercises on Analogue Electronics, 5 op
521097S: Wireless Measurements, 5 op
813621S: Research Methods, 5 op
521273S: Biosignal Processing I, 5 op
521259S: Digital Video Processing, 5 op
521145A: Human-Computer Interaction, 5 op
521279S: Signal Processing Systems, 5 op
521148S: Ubiquitous Computing Fundamentals, 5 op
521281S: Application Specific Signal Processors, 5 op
521493S: Computer Graphics, 7 op
521290S: Distributed Systems, 5 op
521466S: Machine Vision, 5 op
521147S: Mobile and Social Computing, 5 op
521260S: Programmable Web Project, 5 op
521479S: Software Project, 7 op

Advanced practical training (3 op)

521016A: Advanced Practical Training, 3 op

Master's Thesis (30 op)

The Master's Thesis requires a written maturity test.

521998S: Master's Thesis in Telecommunication Engineering, 30 op

Degree Programme in Electrical Engineering, B.Sc.

Tutkintorakenteen tila: published

Lukuvuosi: 2016-17

Lukuvuoden alkamispäivämäärä: 01.08.2016

Basic and Intermediate Studies (130 - 140 op)

A451120: Basic and Intermediate Studies, Electrical Engineering, 150 - 170 op

Choice of second domestic language, written and spoken. Basic and Intermediate Studies are 124 ECTS cr (includes 2 ECTS cr Swedish and 4 ECTS cr English)

- 901048Y: Second Official Language (Swedish), Written Skills, 1 op
- 901049Y: Second Official Language (Swedish), Oral Skills, 1 op
- 900081Y: Second Official Language (Finnish), Written Skills, 1 - 2 op
- 900082Y: Second Official Language (Finnish), Oral Skills, 1 - 3 op

Choose the minimum of 4 ects ofEnglish or German modules

- 902142Y: Business Correspondence, 2 op
- 902145Y: Working Life Skills, 2 op
- 902147Y: Academic Vocabulary for Science and Technology, 2 op
- 902149Y: Mechanics of Writing, 2 op
- 902150Y: Professional English for Technology, 2 op
- 903024Y: Elementary Course in German 1, 3 - 4 op
- 903025Y: Elementary Course in German 2, 3 - 4 op
- 903029Y: Intermediate Course in German 1, 3 - 4 op
- 903030Y: Intermediate Course in German 2, 3 - 4 op

Compulsory to all

- 521004P: Orientation to Electronics and Communications Engineering, 1 op
- 031010P: Calculus I, 5 op
- 031078P: Matrix Algebra, 5 op
- 761111P: Basic mechanics, 5 op
- 521077P: Introduction to Electronics, 5 op
- 521109A: Electrical Measurement Principles, 5 op
- 521141P: Elementary Programming, 5 op
- 031075P: Calculus II, 5 op
- 031076P: Differential Equations, 5 op
- 031021P: Probability and Mathematical Statistics, 5 op
- 521301A: Digital Techniques 1, 8 op
- 521302A: Circuit Theory 1, 5 op
- 031077P: Complex analysis, 5 op
- 031080A: Signal Analysis, 5 op
- 766319A: Electromagnetism, 7 op
- 521329A: Hands-on Course in Wireless Communication, 5 op
- 521303A: Circuit Theory 2, 5 op
- 766349A: Wave motion and optics, 7 op
- 521337A: Digital Filters, 5 op
- 521330A: Telecommunication Engineering, 5 op
- 521104P: Introduction to Material Physics, 5 op
- 521071A: Principles of Semiconductor Devices, 5 op
- 521431A: Principles of Electronics Design, 5 op
- 030005P: Information Skills, 1 op

Module preparing for the option (40 op)

Electrical engineering

A451126: Module Preparing for the Option, Electrical Engineering, 40 - 47 op

Module preparing for the option, electrical engineering 40 ECTS cr

- 521432A: Electronics Design I, 5 op
- 521404A: Digital Techniques 2, 5 op
- 521384A: Basics in Radio Engineering, 5 op
- 521070A: Introduction to Microfabrication Techniques, 5 op
- 521307A: Laboratory Exercises on Analogue Electronics, 5 op
- 521287A: Introduction to Computer Systems, 5 op
- 521304A: Filters, 5 op
- 521092A: Electronic Measurement Techniques, 5 op

Telecommunication Technology

A451123: Module Preparing for the Option, Telecommunication Engineering, 20 - 40 op
Telecommunications, 40 ECTS cr
521432A: Electronics Design I, 5 op
521328A: Simulations and Tools for Telecommunications, 5 op
521384A: Basics in Radio Engineering, 5 op
521370A: Laboratory Exercises in Telecommunication Engineering, 5 op
521307A: Laboratory Exercises on Analogue Electronics, 5 op
521287A: Introduction to Computer Systems, 5 op
521304A: Filters, 5 op
521484A: Statistical Signal Processing, 5 op

Teacher

A451124: Module Preparing for the Option, Prerequisite for Physics Teacher Education (obligatory), 20 - 31 op
The module includes 30 cr compulsory courses
802357A: Euclidean Spaces, 5 op
802164P: Series and Integral, 5 op
802151P: Introduction to mathematical deduction, 5 op
806113P: Introduction to Statistics, 5 op
802328A: Basics in Number Theory, 5 op
766344A: Nuclear and particle physics, 5 op
A451125: Module Preparing for the Option, Prerequisite for Physics Teacher Education (optional), 9 - 30 op
Choose mathematics and physics courses 10 ECTS cr to your degree.
802320A: Linear Algebra, 5 op

BSc thesis and related studies (10 op)

The extent of the BSc thesis in Electrical Engineering is 8 credits. Choose 523990A Electrical Engineering or 523993A Telecommunication

Electrical Engineering

523990A: Bachelor's Thesis / Electrical Engineering, 8 op
900060A: Technical Communication, 2 op

Telecommunication

523993A: Bachelor's Thesis / Telecommunication Engineering, 8 op
900060A: Technical Communication, 2 op

Optional studies

Optional courses to complete the 180 credit degree can be selected e.g. from other engineering branches, natural sciences and business studies. Practical training, 3 credits, can also be included. Each student's optional studies are approved by programme administration. Some recommended courses in the Finnish language study guide.

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

801389A: Basic Geometry, 6 op
780109P: Basic Principles in Chemistry, 4 op
761668S: Computational physics and chemistry, 6 op
763628S: Condensed matter physics, 10 op

477622A: Control System Design, 5 op
521223S: Electronic and Optoelectronic Materials, 5 op
521275A: Embedded Software Project, 8 op
902144Y: Environmental Issues, 2 op
521150A: Introduction to Internet, 5 op
802119P: Linear Algebra II, 5 op
521216S: Microelectronics Packaging Technology and Reliability, 7 op
A451224: Module of the Option, Telecommunication Engineering, 40 - 41 op
800322A: Multidimensional analysis, 8 op
521288S: Multiprocessor Programming, 5 op
902148Y: Negotiations and Meeting Skills, 2 op
031022P: Numerical Analysis, 5 op
031051S: Numerical Matrix Analysis, 5 op
521015A: Practical Training, 3 op
902146Y: Presentation Skills, 2 op
521350S: Seminar in Telecommunication and Radio Engineering, 1 op
521486S: Signal Processing Systems, 4 op
766330A: Structure of matter, 6 op
464061A: Techniques of Creative Working, 3 op
766348A: Thermophysics, 7 op
766328A: Thermophysics, 6 op
766329A: Wave motion and optics, 6 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

H451229: Module of the Option, Electronics Design, 60 - 87 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Module of the option, complysory studies 30 ECTS crcr

A451221: Module of the Option, Electronics Design, 30 - 38 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies, Total 30 ECTS cr

521405A: Electronic System Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period 1

Learning outcomes:

1. 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.
2. is able to calculate problems, caused by electrical disturbances, crosstalk and non-idealities of electrical components.
3. can calculate reliability of an electrical device or system.
4. The main goal of the course is to introduce methods and techniques needed in designing larger electronic entities such as equipment and systems.

Contents:

Power supplies, thermal design, grounding, transmission of fast signals by using transmission lines, electrical disturbances, crosstalk, non-idealities of electrical components, reliability of electronics.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes 30 h of lectures and 20 h of exercises.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course.

Prerequisites and co-requisites:

Both Principles of Electronics Design and Analogue Electronics I must have been accepted.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Ward & Angus: Electronic Product Design, Hall&Hall&McCall: High speed Digital Design, Montrose: EMC and the Printed Circuit Board, Ott: Noise Reduction Techniques. Eric Bogatin: Signal and Power Integrity – Simplified, 2. ed.

Assessment methods and criteria:

The course is passed by means of a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 0 - 5. In the numerical scale 0 stands for a fail.

Person responsible:

Kari Määttä

Working life cooperation:

No.

521326S: Radio Engineering 1, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 1

Learning outcomes:

1. The student recognizes different kind of impedance matching methods and can design the impedance matching network using lumped components and microstrip lines.

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

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

4. In the impedance matching the noise figure is minimized or the gain is maximized. The impedance matching can also be made for the constant gain.

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

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

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

8. The student can classify power amplifiers and can in the basic case design the matching network for a power amplifier.

Contents:

Impedance matching using lumped components, microstrip matching networks, low noise amplifier (LNA) design, active and passive mixers, power dividers, directional couplers, automatic gain control (AGC), power amplifier design.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h, exercises 16 h and the compulsory RF design work with ADS simulation software (20 h).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

Basics of Radio Engineering

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Parts from D.M. Pozar: Microwave Engineering, 3rd edition, John Wiley & Sons, Inc., 2005. Also, additional material from other sources.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Risto Vuohtoniemi

Working life cooperation:

No

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Lecturing in Finnish, material available in English

Timing:

Spring, periods 3-4.

Learning outcomes:

1. After passing the course a student can explain the life cycle of the embedded system, the characteristic features related to embedded systems development, and the risks involved.
2. 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.
3. 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.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course is run in a project work in groups of two and follow up the progress reporting meetings. Lectures 20 h, laboratory exercise in period 1-3 120 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521412A Digital Techniques I
Also recommended 521275A Embedded Software Project, 521432A Electronics Design I.

Recommended optional programme components:

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

Recommended or required reading:

Berger, Arnold S. (2002) Embedded Systems Design: An introduction to Processes, Tools, & Techniques, CMP Books, USA. ISBN:1578200733.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Juha Röning

Working life cooperation:

None.

521088S: Optoelectronics, 5 op

Voimassaolo: 01.01.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Kostamovaara
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

1. is able to explain the principles of operation of optical fibres and wavequides

2. is able to explain the principles of operation of semiconductor light sources and photo detectors, and knows the factors affecting their performance

3. is able to outline the circuit-level structures for optical transmitter circuits and photo detector preamplifiers

4. is able to compare their performance in terms of the main performance parameters

Contents:

Wave/particle dualism of optical radiation, optical waveguides and their properties, sources of radiation (LED- and laser structures), photo detectors (PIN- and AP-diodes,SPAD), light source modulation, preamplifiers and their bandwidth/stability/noise analysis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h, may include a seminar.

Target group:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Prerequisites and co-requisites:

Principles of semiconductor devices.

Recommended optional programme components:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Recommended or required reading:

Lecture notes, S. Kasap: Optoelectronics and Photonics, Principles and Practices, Prentice Hall 2013, 2nd Ed.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Kostamovaara

Working life cooperation:

Does not apply.

521305S: Computer Aided Circuit Design, 5 op

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

521332S	Computer Aided Circuit Design	4.0 op
521332S-01	Computer Aided Circuit Design, exam	0.0 op
521332S-02	Computer Aided Circuit Design, exercise workt	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

1. can explain the operation and requirements of the common simulation algorithms
2. can choose the most appropriate simulation algorithm to any design task

3. can recognize, solve, and circumvent the commonly emerging problems in circuit simulations
4. can choose the correct excitations and build the necessary test benches for circuit simulations

Contents:

Operation of a circuit simulator. The principles and limitations of different circuit simulation algorithms. Device-level and behavioral modeling.

Mode of delivery:

Classroom

Learning activities and teaching methods:

30h lectures and several simulation excercises.

Target group:

MSc students

Prerequisites and co-requisites:

Background in circuit theory and analog design.

Recommended optional programme components:

-

Recommended or required reading:

Kundert: Designer's Guide to Spice and Spectre. Kluwer Academic

Assessment methods and criteria:

Examined either by weekly simulation excercises or a final exam and a simulation exercise. Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

PhD Janne Aikio

Working life cooperation:

-

Advanced module, 1. electronics design, electronics design (optional, 18 ECTS cr)

A451289: Advanced module/Electronics design, electronics design (obligatory), 15 - 40 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses, Total 18 ECTS cr

521435S: Electronics Design III, 6 op

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

ECTS Credits:

6

Language of instruction:

In Finnish (English as a book examination)

Timing:

Autumn, period 2

Learning outcomes:

1. On completion of the study module students should be able to detail the advantages of differential signal processing in IC realizations and
2. to analyze and design differential amplifiers and other electronic blocks for implementation in an IC environment.
3. They should be able to explain how an SC (switched capacitor) technology functions and to apply such a technology to sampling and filtering.
4. They should also be able to describe the principles for realizing continuous filters in IC technologies, to explain the principles of the delta–sigma technology
5. and to apply it for realizing integrated DA and AD converters.
6. They should be able to account for the functioning, use and architecture of a phase-locked loop,
7. to explain the functioning of an MOS transistor in the area of weak inversion and to indicate how use can be made of this functional area in circuit design.

Contents:

Advanced operational amplifier topologies, especially differential ones, bandgap and PTAT bias circuits and references, problems related to the design of multi-stage amplifiers (output stages, LP /LV implementations), signal sampling and error sources related to it, SC-techniques (especially in filters), implementation principles of continuous time IC filters, DS techniques in general and particularly in AD/DA converters, operations with frequency/phase domain signals, design of IC layout.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30h and Exercises 20 h; Self-study or in a group of two persons: laboratory exercise 40 h (CAD tools used in IC design and familiarization into the complete analogue IC design flow) and learning without guidance either privately or in a group 69 h.

Target group:

Electrical Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Electronics Design II, Filters, Introduction to Microfabrication Techniques (recommended).

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes: 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.

Assessment methods and criteria:

Passed final exam and exercise work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Tarmo Ruotsalainen

Working life cooperation:

-

521445S: Digital Techniques 3, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

ECTS Credits:

6

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Spring, peridos 3-4

Learning outcomes:

1. knows the phases of the design process of hardware parts of digital system implemented in FPGA or ASIC technologies, and understands their purpose, and the problems and aims associated with different design tasks

2. is able to use the tools needed in industrial design projects.

Contents:

1. Digital systems design process. 2. Assertion-based verification, 3. Universal verification methodology (UVM) 4. ASIC design and verification (technology choice, logic synthesis, physical synthesis, timing analysis, power analysis, design for testability). 5. Use of SystemC language in the modeling of digital circuits. 6. Architecture-level synthesis of digital circuits.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 20h/ exercises 20h (group work)/ independent work 120h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1 and Digital techniques 2

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No.

521300S: Electronics Design and Construction Exercise, 6 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521441S Electronics Design and Construction Exercise 6.5 op

ECTS Credits:

6

Language of instruction:

Finnish, English

Timing:

Periods 3-4

Learning outcomes:

1 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.
2 is able to use independently without any help professional methods, software packages, measurement devices and tools.
3 Objective: 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.

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 or part of the research project going on in Electronics or other laboratory. The subject of the work can be own suggestion of the student or a pre-selected course subject, which enables comprehensive training of skills needed for the design of a modern electronic device.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

Independent design and construction work 180h

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course

Prerequisites and co-requisites:

Student must have passed following courses: Analogue Electronics I-II, Digital Techniques I-II, Electronic System Design and Filter Theory.

Recommended optional programme components:

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

Recommended or required reading:

Not defined

Assessment methods and criteria:

The task can be carried out by a student or by a team of two students. The grade will be decided on the basis of the statement of the instructor, realization of the device and the report provided by the student.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 0 - 5. In the numerical scale 0 stands for a fail.

Person responsible:

Kari Määttä

Working life cooperation:

No

Advanced module, 1. electronics design, electronics design (obligatory 39 op)

A451290: Advanced module/Electronics design, electronics design (optional), 25 - 41 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced module, 2. digital systems design, obligatory courses Total 16 ECTS cr

A451273: Advanced Module/Electronics Design, Digital Systems Design (obligatory), 16 - 21 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses, 16 ECTS cr

521445S: Digital Techniques 3, 6 op

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

ECTS Credits:

6

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Spring, peridos 3-4

Learning outcomes:

1. knows the phases of the design process of hardware parts of digital system implemented in FPGA or ASIC technologies, and understands their purpose, and the problems and aims associated with different design tasks

2. is able to use the tools needed in industrial design projects.

Contents:

1. Digital systems design process. 2. Assertion-based verification, 3. Universal verification methodology (UVM) 4. ASIC design and verification (technology choice, logic synthesis, physical synthesis, timing analysis, power analysis, design for testability). 5. Use of SystemC language in the modeling of digital circuits. 6. Architecture-level synthesis of digital circuits.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 20h/ exercises 20h (group work)/ independent work 120h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1 and Digital techniques 2

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No.

521453A: Operating Systems, 5 op

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

ay521453A	Operating Systems (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

In Finnish, material available in English

Timing:

Spring, period 4

Learning outcomes:

1. is capable of explaining the basic structure and functioning of operating system

2. 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

3. is capable of explaining the cause and effect related to deadlocks and is able to analyse them related to common circumstances in operating systems

4. 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

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

Lectures 30 h, laboratory exercise 6 h, the rest as independent work. The laboratory work, including pre-exercise and guided exercise performed in a group of one or two students in the unix environment, covers core topics of the course.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and 521267A Computer Engineering

Recommended optional programme components:

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

Recommended or required reading:

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.

Assessment methods and criteria:

The course is passed the final examination and accepted laboratory working.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Röning

Working life cooperation:

-

521457A: Software Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Leikkaavuudet:

ay521457A	Software Engineering (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Material available in English.

Timing:

Spring, periods 3.

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, follow up, quality control, product control, 4. software testing methods and strategies, 5. introduction to object-oriented analysis and design. 6. Agile software development.

Mode of delivery:

Face-to-face.

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. Lectures 30 h, laboratory design (in period 3) 12 h, the rest of the self-study.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming.

Recommended optional programme components:

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

Recommended or required reading:

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.

Assessment methods and criteria:

Final exam and accepted laboratory exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Röning

Working life cooperation:

-

Advanced module, 2. digital systems design, optional courses, 41 ECTS cr.

A451274: Advanced Module/ Electronics Design, Digital Systems Design (optional), 9 - 41 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

H451226: Module of the Option, Electronics Materials and Components, 60 - 80 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Module of the option, compulsory courses 30 ECTS cr

A451222: Module of the Option, Electronics Materials and Components, 35 - 41 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory courses, Total 30 ECTS cr

521073S: Electroceramics and Intelligent Materials, 5 op

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

521103S Electroceramics and Intelligent Materials 4.0 op

ECTS Credits:

5 ECTS credits / 132.5 hours of work

Language of instruction:

Finnish and English

Timing:

The course is held in the period 2 biannually. The course is held next on autumn 2017.

Learning outcomes:

1. Student is able to estimate the properties and usability of functional ceramics in different electronics components applications and perform calculatory structural dimensioning for them.

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

3. Student is able to interpret new research results of the field and recognize their application areas.

Contents:

Microstructures and special features of ceramic materials. Dielectric, polarization and electrical conductivity properties and influence of lattice defects on them. Fabrication and processing of ceramics. Ceramic conductors and insulators, piezoelectric and ferroelectric ceramics, pyroelectric and electro-optic ceramics, magnetic ceramics.

Mode of delivery:

The course will be implemented as face to face teaching.

Learning activities and teaching methods:

The implementation methods of the course vary. The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 30 hours of guided teaching events and 102.5 hours of teaching without guidance either privately or in a group.

Target group:

Master's level students.

Prerequisites and co-requisites:

The recommended prerequisite is to familiarize with the course 521104P Introduction to Materials Physics

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes. Text book A.J. Moulson and J.M. Herbert: Electroceramics, Wiley, 2003.

Assessment methods and criteria:

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

Grading:

The final exam utilizes a numerical grading scale 1-5.

Person responsible:

Antti Uusimäki

Working life cooperation:

No

521326S: Radio Engineering 1, 5 op

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

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 1

Learning outcomes:

1. The student recognizes different kind of impedance matching methods and can design the impedance matching network using lumped components and microstrip lines.

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

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

4. In the impedance matching the noise figure is minimized or the gain is maximized. The impedance matching can also be made for the constant gain.

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

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

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

8. The student can classify power amplifiers and can in the basic case design the matching network for a power amplifier.

Contents:

Impedance matching using lumped components, microstrip matching networks, low noise amplifier (LNA) design, active and passive mixers, power dividers, directional couplers, automatic gain control (AGC), power amplifier design.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h, exercises 16 h and the compulsory RF design work with ADS simulation software (20 h).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

Basics of Radio Engineering

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Parts from D.M. Pozar: Microwave Engineering, 3rd edition, John Wiley & Sons, Inc., 2005. Also, additional material from other sources.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Risto Vuohtoniemi

Working life cooperation:

No

521443S: Electronics Design II, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In Finnish (In English if needed).

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies
2. should be able to analyze and design integrated electronic blocks based on these components, such as operational amplifiers, comparators and sampling circuits
3. should be able to estimate and minimize the effects of noise in electrical circuits
4. should be able to explain the terminology used with DA and AD conversion and converters
5. should be able to analyze and outline the main architectural principles and also to evaluate the characteristics of DA and AD converters

Contents:

Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Face-to-face teaching: Lectures 30h, exercises 20h. Self study: a small design work 20h. Learning without guidance either privately or in a group 60h.

Target group:

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

Prerequisites and co-requisites:

Principles of electronics design, Electronics design I

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521075S: Microelectronics Packaging Technologies, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Sami Myllymäki

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

3rd period

Learning outcomes:

1. Upon completing the course student can explain how electronics packaging technology has since invention of transistors to current date, and can estimate how this development is going to continue in future.

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

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

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

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

6. In addition he can explain why and how optoelectronics will be migrate towards circuit board and components on it.

Contents:

Trends of packaging and component technologies. Area array packaging techniques. BGA-components. Micro joining and bonding. Multi-chip-modules: MCM-L, MCM-D and MCM-C modules. Fine line techniques. System level packaging (SOC, SOP). Multilayer substrates and integration of passive components. 3-D packaging. Optoelectronics modules. MEMS components. Electronics applications to nanotechnology.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

Lecturing 24 h, practical work 12 h.

Target group:

Primarily major students of electrical engineering.

Prerequisites and co-requisites:

Recommended Introduction to Microfabrication Techniques.

Recommended optional programme components:

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

Recommended or required reading:

Rao R. Tummala(edit): Fundamentals of microsystems packaging, New York, McGraw-Hill, 2001. R. R. Tummala and M. Swaminathan, Introduction to System-on-Package (SOP), McGraw-Hill, 2008.

Assessment methods and criteria:

The course is completed with the final exam and finished course work.

Grading:

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

Person responsible:

Sami Myllymäki

Working life cooperation:

No

521225S: RF Components and Measurements, 5 op

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

ECTS Credits:

5 ECTS credits / 123,5 hours of work

Language of instruction:

Finnish. English, if there are at least 3 international students in class.

Timing:

The course is held in the 4^{th} period. It is recommended to complete the course during Master level studies.

Learning outcomes:

1. After completing the course the student has knowledge of the behavior of passive components at RF frequencies, knows the fabrication methods of components and is also able to apply the knowledge to practical applications.

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

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

4. The student knows how to perform typical measurements of RF region magnitudes (power, frequency, impedance and noise).

Contents:

Fundamentals of RF and microwave techniques, components in microwave circuits, measurement instruments, measuring of power, frequency, impedance and noise, time-domain and active circuit measurements.

Mode of delivery:

Face-to-face teaching, independent design exercises and laboratory exercises.

Learning activities and teaching methods:

Lectures 24 h, design execises 20 h, laboatory exercises 20 h, independent work 68,5 h.

Target group:

Masters students on electrical engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronic Components and Materials, Electronic Measurement Techniques, Basics of Radio Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Handout, Lecture notes. A. Lehto, A. Räisänen: Mikroaaltomittaustekniikka (in Finnish), I. Bahl: Luped Elements for RF and Microwave circuits, R. Ludvig, P.Bretchko: RF circuit Desing: Theory ans Applications, Prentice Hall 2000 and literature announced at the beginning of the lectures.

Assessment methods and criteria:

Final exam, design exercises and laboratory exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Merja Teirikangas

Working life cooperation:

No.

521074S: Microelectronics and Micromechanics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Krisztian Kordas
Opintokohteen kielet: English
Leikkaavuudet:

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

ECTS Credits:

5

Language of instruction:

English

Timing:

3rd period

Learning outcomes:

Objective: The course provides advanced knowledge on the semiconductor techniques of VLSI and on special topics of micromechanics and hybrid fabrication. Especially recent progress on the field is introduced in application point of view.
Learning outcomes: After completing the course the student can give account on correlations between basic physics/chemistry and materials processing/technology in microelectronics, micromechanics and nanotechnology. The student can describe design aspects and operation principles of micro and nano-devices. The students get acquainted with working in laboratory environment similar to those in academic and industrial research labs. Laboratory work practice on either (i) thin film fabrication in clean room, (ii) inkjet printing and electrical characterization of thin film devices with nanopartciles or (iii) synthesis of carbon nanotubes and characterization by electron microscopy techniques will provide a good opportunity also to learn how to design and run experiments safely and manage laboratory reports.

Contents:

Theory and practice of VLSI semiconductor fabrication technologies to support and deepen the understanding of general fabrication and operation principles introduced during previous courses. The state-of-the-art semiconductor devices and circuits: pushing the limits of dimensions and speed. Implementation of VLSI technologies in fabrication of components for micromechanics. Sensors (flow, pressure) and actuators (valves, pumps, motors, switches and components for micro-optics) using MEMSs. Devices on the nanoscale and integration of nanomaterials in microsystems: new concepts of design, fabrication and operation.

Mode of delivery:

Lectures, laboratory exercise with supervision and guidance.

Learning activities and teaching methods:

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

Target group:

Students of the University of Oulu.

Prerequisites and co-requisites:

Passing the basic course “521070A Introduction to microfabrication techniques” before the advanced course is recommended.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes and references therein.

Assessment methods and criteria:

Examination and completion of both laboratory exercise and report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading 1-5.

Person responsible:

Krisztian Kordas

Working life cooperation:

-

Advanced module:Electronics Materials and Components, compulsory courses (min. 2 courses) 10-15 ECTS cr

A451291: Advanced Module, Electronics Materials and Components, 10 - 52 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced module, Obligatory courses (min. 2 courses) 10-15 ECTS cr

521072S: Microsensors, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

Leikkaavuudet:

521228S Microsensors 4.0 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

English. Guidance and exams also possible in Finnish.

Timing:

The course is held in the 2nd period. Teaching is available every second year. The next arragment is autumn 2016.

Learning outcomes:

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

2. Student can explain the main fabrication methods, including thin-film technologies, micromachining methods, wet and dry etching techniques, and both laser and ion beam milling methods and their applications in microsensor fabrication.

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

Contents:

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

Mode of delivery:

Blended teaching (web-based and face-to-face teaching).

Learning activities and teaching methods:

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

Target group:

Master students in electrical engineering.

Prerequisites and co-requisites:

Recommended prerequisite is Bachelors degree in Electrical Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Will be informed at the beginning of the course.

Assessment methods and criteria:

This course utilizes continuous assessment. The method will be informed at the beginning of the course.

Grading:

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

Person responsible:

Jari Hannu

Working life cooperation:

No

521080S: X-ray Diffraction, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish, English if needed

Timing:

Autumn semester period 1. Lectured every other year.

Learning outcomes:

1. explain the general principles of interaction between X-rays and solid matter and the physics underlying behind these phenomena

2. explain how the crystal structure, phase ratio, grain size and stress state in a solid material with X-ray diffraction (XRD) method can be experimentally determined

Contents:

Generation, detection and properties of x-rays. X-ray scattering and diffraction methods. Determination of crystal structure and phase composition. Analysis of grain size, texture and stresses. Electron and neutron diffraction.

Mode of delivery:

Lectures, exercises and laboratory work.

Learning activities and teaching methods:

Lectures and exercises altogether 32 h / laboratory work 18 h / self-access writing of work report 30 h / self-access learning 52,5 h.

Target group:

Primarily for students in electrical engineering.

Prerequisites and co-requisites:

Basic physics and mathematics.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. For reference, parts from books B.E. Warren: X-ray diffraction, Addison-Wesley, 1969., B.D. Cullity and S.R. Stock: Elements of X-Ray Diffraction, 3rd Edition, 2001, Prentice Hall and some other books informed by lecturer.

Assessment methods and criteria:

Final grade of the course will be a weighted average of theoretical examination (2/3) and laboratory exercises (1/3). Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Hagberg

Working life cooperation:

No

Other information:

The course is held next on autumn 2017.

521079S: Introduction to Nanotechnology, 5 op

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

ECTS Credits:

5

Language of instruction:

English

Timing:

4th period

Learning outcomes:

1. The students will acquire the basic principles of nanoscience and technology.

2. The course will also help understanding and rational thinking concerning strategies towards practical synthesis and safe utilization of nanomaterials.

Contents:

Nanotechnology definitions and the nanomaterials around us. Synthesis methods for nanomaterials. Properties of nanomaterials. Health concers on nanomaterials. Integration and device development with nanomaterials. Current and future applications on nanomaterials.

Mode of delivery:

Lectures

Learning activities and teaching methods:

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

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Examination.

Grading:

Numerical grading 1-5.

Person responsible:
Krisztian Kordas
Working life cooperation:
-

Advanced Module, Electronics Materials and Components (optional studies 42-47 ECTS cr)

A451294: Advanced Module, Electronics Materials and Components (optional studies), 37 - 47 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

H453221: Module of the Option, Telecommunication Engineering, 60 - 80 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced module, obligatory courses, 10-36 ECTS cr

A453273: Advanced module, Telecommunication Engineering, 10 - 47 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced module mandatory courses, choose min. 2 courses, 10-36 ECTS cr

521377S: Communications Networks II, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Savo Glisic, Maria Kangas
Opintokohteen kielet: English

ECTS Credits:

7 ECTS cr / 158,5 hours of work

Language of instruction:

English

Timing:

Spring, periods 3-4

Learning outcomes:

1. Upon completing the required coursework, the student is able to construct simple theoretical queuing theory models and analyze the simulation results of these models.

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

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

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

5. The aim is to help the student to understand the basic principles of networking by providing a balance between the description of existing networks and the development of analytical tools

6. The descriptive material is used to illustrate the underlying concepts, and the analytical material is used to generate a deeper and more precise understanding of the concepts.

Contents:

Introduction to concepts in queuing theory, birth-death process, queuing systems and their measures of effectiveness, Little's result, blocking in queuing systems, open and closed (Jackson) queuing networks, advanced routing in data networks, multiple access techniques, network information theory, cognitive networks, network optimization theory, network stability theory, advanced spectra sharing schemes and networks microeconomics. The course presents the basic principles of queuing theory giving mathematical tools to apply the theory to practical communication systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 30 h and the compulsory design work with a simulation program (15 h).

Target group:

1 st year M.Sc. and WCE students.

Prerequisites and co-requisites:

Communication Networks I

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Savo Glisic and Maria Kangas

Working life cooperation:

No

521317S: Wireless Communications II, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Antti-Heikki Tölli
Opintokohteen kielet: English

ECTS Credits:

8

Language of instruction:

English

Timing:

Spring, periods 3-4

Learning outcomes:

1. Upon completing the required coursework, the student is familiarised with the channel capacity as the basic performance measure of wireless communication links, and can explain the effect of fading channel on the capacity in a single-user single-antenna se

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

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

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

5. Target is to deepen the understanding of the fundamental multiantenna transmission and reception concepts used in broadband wireless and in particular mobile systems.

Contents:

Capacity of point-to-point and multiuser wireless channels, point-to-point MIMO communications, multiuser multiple antenna communications in uplink and downlink, opportunistic communications, scheduling and interference management, coordinated multi-cell transmission.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 45 h, exercises 25 h and the compulsory design work with a simulation program (25 h)

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course

Prerequisites and co-requisites:

In addition to the course Wireless Communications I, a working knowledge in digital communications, random processes, linear algebra, and detection theory is required. Also, students are asked to read chapters 1-4 from the textbook before attending the course.

Recommended optional programme components:

Prior knowledge of information theory and convex optimisation is very useful but not mandatory.

Recommended or required reading:

D. N. C. Tse and P. Viswanath, Fundamentals of Wireless Communication. Cambridge University Press, 2005, Chapters 5-10, as well as, a few recent journal publications related to multiuser MIMO downlink. Supporting material: Cover & Thomas, "Elements of Information Theory", John Wiley & Sons; Boyd & Vandenberghe, "Convex Optimization", Cambridge University Press, 2004.

Assessment methods and criteria:

The course is passed with a final examination and the accepted simulation work report. The final grade is a weighted sum of exam (70%), homeworks (20%), and work report (10%).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Antti Tölli

Working life cooperation:

No

Other information:

Course replaces the old course 521317S Wireless Communications III.

521327S: Radio Engineering II, 6 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Risto Vuohtoniemi
Opintokohteen kielet: English
Leikkaavuudet:

521375S	Design of Tranceivers	5.0 op
521375S-01	Design of tranceivers, partial credit	0.0 op
521375S-02	Design of tranceivers, partial credit	0.0 op

ECTS Credits:

6

Language of instruction:

English

Timing:

Spring, period 3

Learning outcomes:

1. The student recognizes the blocks of a transceiver and can explain the operating principle of a transceiver.

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

3. The student can define parameters used in the transceiver system level design and can design a transceiver at the system level so that the requirements for the system are fulfilled.

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

5. The student can also explain factors, which are important for the selection of D/A- and A/D-converters and can derive various methods to create the in phase and the quadratute components

of a received signal.

6. The student can also explain the principles of frequency synthesis in a transceiver.

Contents:

Designing a transceiver at the system level, transceiver architectures, performance characteristics of transceivers, nonlinearities, factors which limit the performance of a transceiver, placement of the A /D-converter in a receiver, frequency synthesis, design and implementation examples.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h and the compulsory design exercise with ADS simulation software (40 h).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

Radio Engineering I

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Parts from books: A. Luzatto, G. Shirazi: Wireless Transceiver Design, John Wiley & Sons Ltd, 2007 and Walter Tuttlebee: Software Defined Radio.Enabling Technologies, John Wiley & Sons Ltd, 2002. Also, additional material from other sources.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Risto Vuohtoniemi

Working life cooperation:

No

521325S: Communication Signal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521360S	Synchronisation for Digital Receivers	4.0 op
521360S-01	Exam, Communication Signal Processing II	0.0 op
521360S-02	Synchronisation for Digital Receivers, exercise work	0.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period I. It is recommended to complete the course during the second year of master studies.

Learning outcomes:

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

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

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

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

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

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

Contents:

The structure of a communications transceiver, design and synthesis of synchronization algorithms, sampling rate conversion and filtering, I/Q imbalance, finite precision modeling of receive processing, implementation of receiver algorithms.

Mode of delivery:

Face-to-face teaching and independent simulation and design project.

Learning activities and teaching methods:

Lectures 16h, group project work 50h, and self-study.

Target group:

2nd year M.Sc. and WCE students.

Prerequisites and co-requisites:

Statistical signal processing, Digital Filters, Communications Signal Processing I, Wireless Communications I.

Recommended optional programme components:

Comminications Signal Processing I, Signal Processing Systems

Recommended or required reading:

Lecture notes and material, other literature listed therein. Key references: H. Meyr, M. Moeneclaey & S. A. Fechtel, Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998; R. Fasthuber, F. Catthoor, P. Raghavan & F. Naessens, Energy-Efficient Communication Processors, Springer, 2013.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Markku Juntti

Working life cooperation:

No

Antennas (even years), Radiochannels (odd years)

521386S: Radio Channels, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Berg

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 130 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period IV.

Learning outcomes:

1. will be able to define what the radio channel is and is able to distinguish it into modellable parts.

2. knows different radio wave propagation mechanisms.

3. can apply physical and empirical radio channel models.

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

5. will know how to measure the properties of different radio channels.

Contents:

The radio channels of different radio systems. Characterization of radio waves and propagation media. Different mechanisms of radio wave propagation: direct free-space propagation, absorption, scattering, reflection, refraction, diffraction, surface and ground waves, ionospheric waves and multipath propagation. Principles of the radio channel modelling. Noise calculations. Radio wave propagation phenomena over fixed terrestrial, ionospheric and satellite links. Radio channel modelling for outdoor mobile systems. Radio wave propagation inside or into buildings. Radio channels of mobile satellite links. Slow fading. Multipath propagation and its effects on narrowband and wideband radio channels. MIMO radio channels. Ultra wideband radio channels. Measurement methods of radio channels.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h / Exercises 12 h / compulsory laboratory work 14 h / Self-study 80 h.

Target group:

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

Prerequisites and co-requisites:

The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Basics of Radio Engineering, Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Simon R. Saunders & Alejandro Aragón-Zavala: Antennas and propagation for wireless communication systems. Second edition. John Wiley & Sons Ltd, 2007.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Markus Berg

Working life cooperation:

No

Other information:

Course will be given every second year in odd years.

521388S: Antennas, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Berg

Opintokohteen kielet: English

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

Spring, period 4

Learning outcomes:

1. knows antenna terminology and understands the role of antennas as a part of different radio systems.

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

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

4. will be able to design and analyze various antenna types and arrays using 3D electromagnetic simulation software.

Contents:

Introduction to different antenna types. Fundamental parameters of antennas. Antennas as a part of a radio system. Radiation of an antenna from the Maxwell's equations. Typical linear wire antennas. Loop antennas. Microstrip antennas. Antenna arrays. Antennas for wireless devices. Antenna - human body interaction. Base station antennas. 3D electromagnetic simulation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and exercises 40 h / Compulsory antenna design work with an electromagnetic simulation 25 h / Self-study 70 h

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Recommended literature: C.A. Balanis: Antenna Theory, Analysis and Design (Third Edition). John Wiley & Sons, 2005. Chapters 1-6 and 14.

Assessment methods and criteria:

The course is passed with a final examination and the accepted design work report. In the final grade of the course, the weight for the examination is 0.5 and that for the design work 0.5.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Markus Berg

Working life cooperation:

No

Other information:

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

Advanced Module, Telecommunication Engineering (optional studies) 11-37 ECTS cr

A453295: Advanced Module, Telecommunication Engineering (optional studies), 11 - 37 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

H451227: Module of the Option, Photonics and Measurement Technology, 60 - 80 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Module of the option, compulsory studies, 30 ECTS cr

A451223: Module of the Option, Photonics and Measurement Techniques, 30 - 41 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory courses, 30 ECTS cr

521091S: Technical Optics, 5 op

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

521090S Technical Optics 6.0 op

ECTS Credits:

5 ECTS credits / 138 hours of work

Language of instruction:

Finnish. Text book exams in English.

Timing:

Periodi 1.

Learning outcomes:

1. is capable of explaining the basic facts of geometrical and physical optics
2. is able of explaining the operating principles of simple optical components and instruments as well as the factors affecting their performance
3. is able to describe an optical system as a principal point representation
4. is able to trace the most important paraxial rays through the system
5. is able to explain the properties of a laser beam
6. is able to estimate the radiometric properties and resolving power of an ideal optical system
7. is 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
8. is capable of recognizing and explaining the difference between imaging, non-imaging and laseroptics as well as able to conclude from which of these viewpoints he/she should approach a given design task
9. is capable of designing and optimizing simple imaging and non-imaging lens systems as well as optics for laser beam modification using optical design software tools.

Contents:

Basics of geometrical and physical optics, optical components and instruments. Optical design software tools.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes 28 h lectures and calculation exercises, 20 h guided design exercises introducing to optical design tools and 90 h self-studies.

Target group:

All students of the University of Oulu can attend the course. Prime target 4th year students in Electrical Engineering degree program.

Prerequisites and co-requisites:

Completion of the course 766329A Wave Motion and Optics is recommended.

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Lecture handouts. Delivery through Optima. Recommended books: Donald C. O'Shea: Elements of Modern Optical Design. John Wiley & Sons, 1985; Frank L. Pedrotti, Leno M. Pedrotti, Leno S. Pedrotti: Introduction to Optics. 3rd ed., Pearson Education, 2007; Hecht: Optics. 4th ed. Addison-Wesley, 2002; Julio Chaves: Introduction to Nonimaging Optics. CRC Press, 2008.

Assessment methods and criteria:

Final exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Anssi Mäkynen

Working life cooperation:

No.

521096S: Measurement Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 128h

Language of instruction:

Finnish. English, if there are more than 2 foreign students.

Timing:

Period 2.

Learning outcomes:

1. is able to design a multisensor measurement systems which store the measurement data.
2. is able to assembly a multisensor measurement systems which store the measurement data.
3. is able to program with LabView.

Contents:

Basics of measurement and testing systems, especially wired and wireless data transmission. Data acquisition cards. Basics of LabView programming.

Mode of delivery:

face-to-face teaching.

Learning activities and teaching methods:

The course includes 28h lectures and guided exercises. 100 h self-studies.

Target group:

Master level students regardless of master's programme.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

This course compensates earlier courses with same core content but different course code or credit named Measuring and Testing Systems.

Recommended or required reading:

Course material is in English and Finnish and can be found in Optima.

Assessment methods and criteria:

Final exam and passed laboratory works.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Saarela

Working life cooperation:

No.

521443S: Electronics Design II, 5 op

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

ECTS Credits:

5

Language of instruction:

In Finnish (In English if needed).

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies
2. should be able to analyze and design integrated electronic blocks based on these components, such as operational amplifiers, comparators and sampling circuits
3. should be able to estimate and minimize the effects of noise in electrical circuits
4. should be able to explain the terminology used with DA and AD conversion and converters
5. should be able to analyze and outline the main architectural principles and also to evaluate the characteristics of DA and AD converters

Contents:

Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Face-to-face teaching: Lectures 30h, exercises 20h. Self study: a small design work 20h. Learning without guidance either privately or in a group 60h.

Target group:

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

Prerequisites and co-requisites:

Principles of electronics design, Electronics design I

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521088S: Optoelectronics, 5 op

Voimassaolo: 01.01.2014 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Kostamovaara
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

1. is able to explain the principles of operation of optical fibres and wavequides

2. is able to explain the principles of operation of semiconductor light sources and photo detectors, and knows the factors affecting their performance

3. is able to outline the circuit-level structures for optical transmitter circuits and photo detector preamplifiers

4. is able to compare their performance in terms of the main performance parameters

Contents:

Wave/particle dualism of optical radiation, optical waveguides and their properties, sources of radiation (LED- and laser structures), photo detectors (PIN- and AP-diodes,SPAD), light source modulation, preamplifiers and their bandwidth/stability/noise analysis.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h, may include a seminar.

Target group:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Prerequisites and co-requisites:

Principles of semiconductor devices.

Recommended optional programme components:

This course is targeted mainly for the students of electrical engineering degree program, but available for other students as well.

Recommended or required reading:

Lecture notes, S. Kasap: Optoelectronics and Photonics, Principles and Practices, Prentice Hall 2013, 2nd Ed.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Kostamovaara

Working life cooperation:

Does not apply.

521124S: Sensors and Measuring Techniques, 5 op

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

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 1.

Learning outcomes:

After the course the student is capable to explain the operating principles of different sensors and can select a right sensor for each measuring target. He/she is able to quantify the requirements that affect sensor selection as well as recognize and evaluate the uncertainty of a measurement. In addition the student is able to plan and design sensor signal conditioning circuits.

Contents:

Methods for measuring displacement, velocity, acceleration, torque, liquid level, pressure, flow, humidity, sound and temperature. Ultrasound, optical and nuclear measurement techniques and applications, material analyses such as pH measurement and gas concentration, pulp and paper measurements and smart sensors.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 26h, exercises 12h and self-study 100h.

Target group:

4 year students.

Prerequisites and co-requisites:

No.

Recommended optional programme components:

No.

Recommended or required reading:

H. N. Norton: Handbook of Transducers, Prentice Hall P T R, 1989 or 2002; lecture and exercise notes.

Assessment methods and criteria:

The course is passed by a final exam and passed exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Igor Meglinski

Working life cooperation:

No.

Advanced Modules, Optical and Electrical Measurement Techniques, 15 ECTS cr

A451292: Advanced Module, Optical and Electrical Measurement Techniques, 15 - 57 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced module, complusory studies 15 ECTS cr

521240S: Biophotonics and Biomedical Optics, 5 op

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 2

Learning outcomes:

On successful completion of the course, students will be able to categorize the basic principles of modern optical and laser-based diagnostic modalities and instruments used in advanced biomedical research and clinical medicine. They will be able to demonstrate detailed understanding and

evaluate the key biophotonics techniques underlying day-to-day clinical diagnostic and therapies and industrial applications in pharmacy, health care and cosmetic products. They can operate with the selected techniques of their choice.

Contents:

The course includes in-depth coverage of state-of-the-art optical imaging and spectroscopy systems for advanced biomedical research and clinical diagnosis, fundamental properties of light such as coherence, polarization, angular momentum, details of light interaction with tissue, and modern imaging system. Coherent Optical Tomography (OCT), Laser Doppler Flowmetry, Laser Speckle Imaging (LSI), Photo-Acoustic Tomography (PAT), Tissue polarimetry; Optical and Near-Infra-Red Spectroscopy (NIRS), Confocal and Fluorescence Microscopies; Tissue Optics: Light/matter interactions, index of refraction, reflection, optical clearing, absorption, Mie scattering, Rayleigh scattering, Monte Carlo modelling.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures/exercises 42 h and self-study 100 h.

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

A new course

Recommended or required reading:

V.V Tuchin: Handbook of Optical Biomedical Diagnostics, SPIE Press, 2002; V.V Tuchin: Handbook of Coherent Domain Optical Methods, Springer, 2nd edition, 2013. D.A Boas, C. Pitris, N. Ramanujam, Handbook of Biomedical Optics, CRC Press, 2011.

Assessment methods and criteria:

The course is passed by the final exam and with the assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S	Biomedical Instrumentation	6.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 3.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures/exercises 42 h and self-study 100 h.

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None

Recommended optional programme components:

Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:

R. S. Khandpur: Biomedical Instrumentation, Technology and Applications, McGraw-Hill, 2005 and J. G. Webster: Medical Instrumentation, Application and Design, 4th edition, John Wiley & Sons, 2010.

Assessment methods and criteria:

The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521094S: Optoelectronic Measurements, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521238S Optoelectronic Measurements 4.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Period 4

Learning outcomes:

Objective: The goal of this course is to make the student familiar with optical measurement principles, sensors and device configurations used in industrial inspection tasks.
Learning outcomes: Upon completion of the course, the student is able to explain the operating principles of the most common optical measurement methods used in industrial production, name the factors affecting their performance, design certain sensor systems and evaluate the applicability of measurement methods for various measurement tasks. Additionally he is able to independently find information and discover the operating principles of various optical measurements and to condense the collected information into written and verbal report.

Contents:

Principles of optical measurements. Surface inspection, distance and profile measurements. Non-destructive testing methods. Optical measurements for process control. Material analyses with optical methods.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes 42 h lectures or calculation exercises and 100 h self-studies.

Target group:

4th year students

Prerequisites and co-requisites:

Completion of the course 766329A Wave Motion and Optics is recommended.

Recommended optional programme components:

Course replaces earlier by same name but different code and credit points.

Recommended or required reading:

Lecture handouts and discourse material prepared by students. Delivery through Optima.

Assessment methods and criteria:

Final exam and a passed discourse.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

A451293: Advanced Module,Testing Techniques and Printed Electronics, 10 - 57 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced module, complusory studies 10 ECTS cr

521089S: Printed Electronics, 5 op

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

521217S	Printed Electronics	4.0 op
521095S	Advanced Course of Printed Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish. English if more than two international students in the course.

Timing:

Period 2.

Learning outcomes:

1. Knows the most typical materials and printing methods suitable for their processing
2. Can explain the principles of materials and printing methods
3. Can utilize the material and manufacturing process knowledge to design fabrication processes for electrical components
4. Can analyse how the selected materials and printing methods influence on the performance of electrical components

Contents:

Materials (conductive and semi-conductive polymers, photoactive polymers, dielectrics, particle based inks) and processing methods (screen printing, gravure printing, flexo printing, inkjet) utilized in printed electronics, surface wetting and film formation, printed electrical components (passive components, solar cells, light emitting diodes, transistors) and their fabrication. Possibilities and challenges of printing based processing methods and how to take them into account in the printed electronics fabrication.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Combined lectures and exercises 30 h and self-study 100 h

Target group:

Primarily for the students of electrical engineering

Prerequisites and co-requisites:

None.

Recommended optional programme components:

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

Recommended or required reading:

D.R. Gamota, P. Brazis, K. Kalyanasundaram and J. Zhang, "Printed organic and molecular electronics", handout

Assessment methods and criteria:

Course is completed by final examination.

Grading:

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

Person responsible:

Tapio Fabritius

Working life cooperation:

Not included.

521098S: Testing techniques of Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Fabritius

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish. English, if there are more than 2 foreign students.

Timing:

Period 4.

Learning outcomes:

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

Contents:

Overview of different testing methods, constructions of testers, test fixtures, test signal generation and measurement, mixed-signal test buses, DC- and parametric measurements, dynamic tests, AD /DA converter tests, DSP-based tests, data analysis, embedded testing, design for testability, Boundary scan, test applications.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24h/Exercises 12h/laboratory work 4h and self-studying 100h.

Target group:

Course is compulsory for the Electrical engineering students in the advanced module of Testing techniques and printed electronics.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronics Design I, Electronic Measurement Techniques.

Recommended optional programme components:

This course compensates 521167S Testing Techniques of Electronics or 521173S Mixed-signal Testing if the student hasn't got credits from either one of those.

Recommended or required reading:

M. Burns, G. W. Roberts: An Introduction to Mixed-Signal IC Test and Measurement, Lecture slides. Additional material will be announced at the beginning of the course.

Assessment methods and criteria:

Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Tapio Fabritius

Working life cooperation:

No.

Optional studies, 42-47 op

A451295: Advanced Module, The Photonics and Measurement (optional studies), 42 - 47 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional studies, add optional courses 42-47 ECTS cr

521322S: Telecommunication Engineering Project, 5 op

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

521387S Telecommunication Engineering Project 4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English/Finnish

Timing:

Fall or Spring, periods 1-4

Learning outcomes:

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

osakokonaisuuksia.

2. osaa soveltaa teoreettisissa opinnoissa saamiaan tietoja käytännön insinöörityöhön.

3. osaa dokumentoida teknillisen tai tieteellisen työnsä tuloksia.

Contents:

Varies depending on the topic.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

The design exercise is done in a group of one or two students depending of work's difficulty. The design exercise can be simulation or implementation work. The work can be defined by the Department of Communications Engineering or by industry. In the later case a proposal must be submitted to the teacher before beginning of the work. Also, student must meet the schedule and deadlines given by a supervisor before starting the work. In preparing the work report document the writing instructions of DCE department's diploma thesis must be followed.

Target group:

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

Prerequisites and co-requisites:

Depending on the subject: advanced courses dealing with telecommunication systems, digital communications, digital signal processing or/and radio engineering.

Recommended optional programme components:

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

Recommended or required reading:

Varies depending on the topic.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Markus Berg / Antti Tölli

Working life cooperation:

No

521025S: Power Electronics, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period 3

Learning outcomes:

1. is able to discuss and write on the subject by using the terminology in the field of switching power supplies.

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

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

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

5. The course provides the basic knowledge on switched-mode power supplies so that the student recognizes the typical terminology and different topologies.

Contents:

Introduction to switched-mode converters, Steady-state analysis in continuous and discontinuous conduction modes, Transformer isolated converters. Basics of ac-modeling of switched-mode converters.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes 30 h lectures and 20 h of exercises.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course

Prerequisites and co-requisites:

Courses Circuit Theory I-II, Electronics Design I-II or equivalent.

Recommended optional programme components:

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

Recommended or required reading:

R. W. Erickson, D. Maksimovic: Fundamentals of Power Electronics, 2nd ed. Kluwer Academic Publishers, 2004. Chapters 1-3, 5, 6, 7, 8 to most part and chapter 13. Lecture notes.

Assessment methods and criteria:

The course is passed by means of a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 0 - 5. In the numerical scale 0 stands for a fail.

Person responsible:

Kari Määttä

Working life cooperation:

No

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Saarela
Opintokohteen kielet: English
Leikkaavuudet:

521114S	Wireless Measurements	4.0 op

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

ECTS Credits:

5 ECTS credits / 128h

Language of instruction:

In Finnish or in English if two or more foreign students participate.

Timing:

Period 3.

Learning outcomes:

1. can tell and justifying argument the benefits and challenges of using wireless measurement solutions
2. can apply the most important standards when designing wireless measurement solutions
3. can apply wireless technologies in industrial, traffic, environmental, home and healthcare measurements

Contents:

Basics of wireless measurement technologies and standards, wireless sensors and sensor networks, wireless building and smart home applications, wireless measurement applications in traffic, wireless environmental measurements and wireless human health monitoring.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 22h. Seminars 6-12h depending on the number of students participating the course. The students prepare seminar presentations about contemporary topics selected by themselves or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.

Target group:

Master level students regardless of master's programme.

Prerequisites and co-requisites:

No prerequirements, but basics of measurements systems are recomended.

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Lecture notes and seminar reports is Optima.

Assessment methods and criteria:

The course is passed with a written final exam (70 %) and a contemporary seminar (30 %).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grade is on numerical scale 1-5.

Person responsible:

Juha Saarela

Working life cooperation:

No.

521115S: EMC Design, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Sorvoja

Opintokohteen kielet: Finnish

Leikkaavuudet:

521172S EMC Design 4.0 op

521172S-02 EMC Design, Exercise work 0.0 op

521172S-01 EMC Design, Exam 0.0 op

ECTS Credits:

5

Language of instruction:

Finnish. English, if there are more than 2 foreign students.

Timing:

Period 4.

Learning outcomes:

1. is able to name common EMC standards

2. is able to use EMC testing equipment and methods

3. can explain the noise coupling mechanisms

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

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

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

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

Contents:

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

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

The course includes 20 h lectures and calculation exercises, laboratory exercises 16h and 100 h self-studies.

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Tim Williams: EMC for Product Designers, 4th edition, Oxford: Newnes, 2007. Lecture slides.

Assessment methods and criteria:

Final exam and passed laboratory exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Hannu Sorvoja

Working life cooperation:

-

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

Voimassaolo: 01.08.2006 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

ECTS Credits:

4-7 ECTS cr, depending on the yearly contents.

Language of instruction:

Finnish or English (if there are at least two foreign students) .

Timing:

Autumn, periods 1

Learning outcomes:

Vary depending on the content.

Contents:

The contents will be fixed yearly during the spring semester. It may be related to RFIC design, or non-linear circuit analysis, for example.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Varies yearly. The course may contain excercises or a design exercise.

Target group:

Electrical Engineering MSc students

Prerequisites and co-requisites:

Background in circuit theory and analog and RF design.

Recommended optional programme components:

-

Recommended or required reading:

Depends on the contents.

Assessment methods and criteria:

Depends on the implementation. May contain design exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521308S: Electronic Research Exercise, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Kostamovaara

Opintokohteen kielet: Finnish

Leikkaavuudet:

521436S Electronic Research Exercise 3.5 op

ECTS Credits:

5

Language of instruction:

Finnish and English

Timing:

Autumn/spring, periods 1-4

Learning outcomes:

1. is able to carry out a small-scale research activity within the field of electronic circuit/system design

2. is able to report on his/her results orally and on paper

Contents:

This course includes a practical work, in which the student will familiarize himself/herself into a selected topic of electronics under the guidance of a senior researcher working in electronics laboratory, and will also prepare a research report on his/her topic. In practice, this activity may involve a literature study covering the recent research publications on the particular topic, for example. The work may also include circuit design, simulations and board level testing. The topics arise from the current research activities of electronics laboratory. This course prepares the student for his/her diploma thesis work and is especially suitable for a student interested in post graduate studies.

Mode of delivery:

Supervised self-study.

Learning activities and teaching methods:

Independent work under supervision 120 h.

Target group:

Students, who are interested in electronics designs, and want to focus especially on research.

Prerequisites and co-requisites:

Depends on the particular topic, typical prerequisites are Electronics design II and Digital techniques II courses.

Recommended optional programme components:

No direct connections.

Recommended or required reading:

Books, journals and conference proceedings.

Assessment methods and criteria:

Written research report, may be completed with oral presentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical scale 1-5.

Person responsible:

Juha Kostamovaara

Working life cooperation:
Not valid.

521016A: Advanced Practical Training, 3 op

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

521026S	Advanced practical training	5.0 op

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
1-6
Learning outcomes:
After advanced practical training the student can describe one possible future job, or another kind of position in an already familiar working environment. The student can identify problems in the working environment and solve them. The student can apply theoretical knowledge acquired in the studies to practical tasks. The student can identify roles of a diploma-engineer in the work place.
Contents:
Training in the research laboratories, development laboratories and process laboratories, among others, of the industry and institutions in the field of their study is recommended to the students. The basic requirement is that the practice must be performed in a job supervised by a person who has taken an engineering degree.
The technical goal of practical training is to give a general insight of the field in which the trainee will work after having taken the degree and to support and to promote theoretical studying. Likewise, the training has to acquaint the trainee with the social points of the industrial production and with industrial safety and has to give a sufficient picture of the technical details of the performing of different work. Furthermore, the training has to give a general idea of the technical and economic organizing, administration and management of a company and its production.
Mode of delivery:
Independent work.

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

A451225: Module of the Option, Wireless Communications Engineering, 40 - 65 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruotsalainen Keijo
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall semester, periods 1-2

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h / Group work 20 h.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

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

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

-

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

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes, Timo Kokkonen

Opintokohteen kielet: English

Leikkaavuudet:

521323S Wireless Communications 2 5.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Fall, period 2

Learning outcomes:

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

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

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

4. can form an encoder and decoder for common binary block codes, and is capable of using tables of the codes and shift register when solving problems.

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

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

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

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Face-to-face teaching (lectures and exercises) 64 h and group working.

Target group:

1 st year M.Sc. and WCE students

Prerequisites and co-requisites:

Signal Analysis, Telecommunication Engineering

Recommended optional programme components:

Wireless Communications I and the course support each other. Their simultaneous studying is recommended.

Recommended or required reading:

Parts from books Thomas M. Cover & Joy A. Thomas: Elements of Information Theory, 2nd ed. John Wiley & Sons, 2006 ISBN-13 978-0-471-24195-9, ISBN-10 0-471-24195-4, and S. Benedetto and E. Biglieri: Principles of Digital Transmission with Wireless Applications, 1999, Chapters 3, 10 and in part 11 and 12. Lecture notes and other literature.

Assessment methods and criteria:

The course is passed with weekly exams (only during lecture periods) or with final exam and possible additional course tasks defined in the beginning of the course.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Markku Juntti / Timo Kokkonen

Working life cooperation:

No

521316S: Broadband Communications Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Opettajat: Matti Latva-aho, Petri Luoto

Opintokohteen kielet: English

Leikkaavuudet:

521316A	Broadband Communications Systems	4.0 op
521316A-01	Introduction to Broadband Transmission Techniques, exam	0.0 op
521316A-02	Introduction to Broadband Transmission Techniques, exercise work	0.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 1

Learning outcomes:

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

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

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

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

past and especially the forthcoming wireless standards.

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

Contents:

Digital transmission link, wideband radio channels, multiple access techniques, spread spectrum and CDMA techniques, OFDM techniques, applications and most common standards, future mobile communication systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Defined during the lectures; recommended reading: Wireless Communications, 2nd ed, Andreas F. Molisch, Wiley 2010.

Assessment methods and criteria:

The course is passed with a final examination and the accepted simulation work report. Grade is based on exam.

Grading:

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

Person responsible:

Matti Latva-aho

Working life cooperation:

-

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

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

ECTS Credits:

5 ECTS cr / lecture 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. can analyze the performance of multilevel digital modulation methods in AWGN channel

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

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

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

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

6. can classify different channel equalizers, and perform the performance analysis

Contents:

Digital modulation methods and their performance in AWGN-channel, radio channel models, performance of digital modulation in fading channel, diversity techniques, channel equalizers in wireless communication channel, carrier and symbol synchronization.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, exercises 14 h and the compulsory design work with a simulation program (20 h)

Target group:

1st year WCE students and M.Sc. students (i.e., 4th year in EE degree programme)

Prerequisites and co-requisites:

521330A Telecommunication Engineering 521316S Broadband Communications Systems

Recommended optional programme components:

-

Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of book: J.G. Proakis: Digital Communications, 4th ed, McGraw Hill, 2001.

Assessment methods and criteria:

The course is passed with final examination and accepted design exercise. Grade is based on exam. Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Jari Iinatti

Working life cooperation:

No

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Savo Glisic, Ivana Kovacevic
Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 132,5 hours of work

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. Upon completing the required coursework, the student is able to list and understand the functionalities of different layers of OSI and TCP/IP protocol models

2. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE, LTE, LTEA, IEEE802.xx systems and incoming 5G.

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

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

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

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

Contents:

Communications architecture and protocols, adaptive network and transport layers, mobility management, cellular/multihop cellular networks, network security, network management, ad hoc and sensor networks, cross-layer optimization, complex networks, networks economics, examples of wireless communication networks. The goal is to present the fundamentals of the structure, protocol and structure of digital data transmission networks. Technical implementation and application of the common data and local networks are also discussed.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and the compulsory design work with a simulation program (15 h).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Savo Glisic and Maria Kangas

Working life cooperation:

No

521348S: Statistical Signal Processing 1, 5 op

Voimassaolo: 01.08.2016 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juntti, Markku Johannes
Opintokohteen kielet: Finnish
Leikkaavuudet:

521484A Statistical Signal Processing 5.0 op

Ei opintojaksokuvauksia.

521324S: Statistical Signal Processing II, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juntti, Markku Johannes
Opintokohteen kielet: English
Leikkaavuudet:

521373S Statistical Signal Processing 2 6.0 op
521373S-01 Statistical Signal Processing 2, exam 0.0 op
521373S-02 Statistical Signal Processing 2, exercise work 0.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Spring, period 3. It is recommended to complete the course during the first year of master studies.

Learning outcomes:

1. is able to use the methodology of statistical signal processing in the design communication transceivers.

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

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

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

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

6. can use Simulink for performance simulations.

7. understands the principles of receiver algorithm design based on statistial models and optimization theory.

Contents:

Review of linear algebra, estimation and optimization, tasks and the structure of a communications transceiver, use of statistical optimization for algorithm design, optimal linear filters, matrix and adaptive algorithms, linear and nonlinear equalizers, parameter estimation and synchronization, spatial signal processing.

Mode of delivery:

Face-to-face teaching and independent simulation project group work.

Learning activities and teaching methods:

Lectures 32h, exercises 14h, group project work 30h, and self-study.

Target group:

1st year M.Sc. and WCE students.

Prerequisites and co-requisites:

Statistical signal processing, Matrix Algebra, Basics of Optimization, Telecommunication Engineering.

Recommended optional programme components:

Supports learning in Wireless Communications II. It is recommended to take the courses in parallel.

Recommended or required reading:

Lecture notes and material, other literature listed therein. Key references: J. Choi: Adaptive and Iterative Signal Processing in Communications, Cambridge University Press, 2006; S. Haykin: Adaptive Filter Theory, 3rd ed. Prentice Hall, 1996; J. M. Mendel: Lessons in Digital Estimation Theory, 2nd ed., Prentice-Hall, 1995.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Markku Juntti

Working life cooperation:

No

521385S: Mobile Telecommunication Systems, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Katz, Marcos Daniel
Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 16 h and the compulsory design work with a simulation program (16 h)

Target group:

2nd year M.Sc. and WCE students

Prerequisites and co-requisites:

Telecommunication Engineering, Broadband Communications Systems and Wireless Communications I.

Recommended optional programme components:

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

Recommended or required reading:

The course material will be defined at the beginning of the course.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Marcos Katz

Working life cooperation:

-

Other information:

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

A453271: Advanced module, Wireless Communications Engineering, 16 - 35 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Two courses from this set of four courses must be selected

521377S: Communications Networks II, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Savo Glisic, Maria Kangas
Opintokohteen kielet: English

ECTS Credits:

7 ECTS cr / 158,5 hours of work

Language of instruction:

English

Timing:

Spring, periods 3-4

Learning outcomes:

1. Upon completing the required coursework, the student is able to construct simple theoretical queuing theory models and analyze the simulation results of these models.

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

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

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

5. The aim is to help the student to understand the basic principles of networking by providing a balance between the description of existing networks and the development of analytical tools

6. The descriptive material is used to illustrate the underlying concepts, and the analytical material is used to generate a deeper and more precise understanding of the concepts.

Contents:

Introduction to concepts in queuing theory, birth-death process, queuing systems and their measures of effectiveness, Little's result, blocking in queuing systems, open and closed (Jackson) queuing networks, advanced routing in data networks, multiple access techniques, network information theory, cognitive networks, network optimization theory, network stability theory, advanced spectra sharing schemes and networks microeconomics. The course presents the basic principles of queuing theory giving mathematical tools to apply the theory to practical communication systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, exercises 30 h and the compulsory design work with a simulation program (15 h).

Target group:

1 st year M.Sc. and WCE students.

Prerequisites and co-requisites:

Communication Networks I

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Savo Glisic and Maria Kangas

Working life cooperation:

No

521327S: Radio Engineering II, 6 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Risto Vuohtoniemi
Opintokohteen kielet: English
Leikkaavuudet:

521375S	Design of Tranceivers	5.0 op
521375S-01	Design of tranceivers, partial credit	0.0 op
521375S-02	Design of tranceivers, partial credit	0.0 op

ECTS Credits:

6

Language of instruction:

English

Timing:

Spring, period 3

Learning outcomes:

1. The student recognizes the blocks of a transceiver and can explain the operating principle of a transceiver.

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

3. The student can define parameters used in the transceiver system level design and can design a transceiver at the system level so that the requirements for the system are fulfilled.

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

5. The student can also explain factors, which are important for the selection of D/A- and A/D-converters and can derive various methods to create the in phase and the quadratute components of a received signal.

6. The student can also explain the principles of frequency synthesis in a transceiver.

Contents:

Designing a transceiver at the system level, transceiver architectures, performance characteristics of transceivers, nonlinearities, factors which limit the performance of a transceiver, placement of the A/D-converter in a receiver, frequency synthesis, design and implementation examples.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h and the compulsory design exercise with ADS simulation software (40 h).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

Radio Engineering I

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Parts from books: A. Luzatto, G. Shirazi: Wireless Transceiver Design, John Wiley & Sons Ltd, 2007 and Walter Tuttlebee: Software Defined Radio.Enabling Technologies, John Wiley & Sons Ltd, 2002. Also, additional material from other sources.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Risto Vuohtoniemi

Working life cooperation:

No

521317S: Wireless Communications II, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Antti-Heikki Tölli
Opintokohteen kielet: English

ECTS Credits:

8

Language of instruction:

English

Timing:

Spring, periods 3-4

Learning outcomes:

1. Upon completing the required coursework, the student is familiarised with the channel capacity as the basic performance measure of wireless communication links, and can explain the effect of fading channel on the capacity in a single-user single-antenna se

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

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

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

5. Target is to deepen the understanding of the fundamental multiantenna transmission and reception concepts used in broadband wireless and in particular mobile systems.

Contents:

Capacity of point-to-point and multiuser wireless channels, point-to-point MIMO communications, multiuser multiple antenna communications in uplink and downlink, opportunistic communications, scheduling and interference management, coordinated multi-cell transmission.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 45 h, exercises 25 h and the compulsory design work with a simulation program (25 h)

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course

Prerequisites and co-requisites:

In addition to the course Wireless Communications I, a working knowledge in digital communications, random processes, linear algebra, and detection theory is required. Also, students are asked to read chapters 1-4 from the textbook before attending the course.

Recommended optional programme components:

Prior knowledge of information theory and convex optimisation is very useful but not mandatory.

Recommended or required reading:

D. N. C. Tse and P. Viswanath, Fundamentals of Wireless Communication. Cambridge University Press, 2005, Chapters 5-10, as well as, a few recent journal publications related to multiuser MIMO downlink. Supporting material: Cover & Thomas, "Elements of Information Theory", John Wiley & Sons; Boyd & Vandenberghe, "Convex Optimization", Cambridge University Press, 2004.

Assessment methods and criteria:

The course is passed with a final examination and the accepted simulation work report. The final grade is a weighted sum of exam (70%), homeworks (20%), and work report (10%).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Antti Tölli

Working life cooperation:

No

Other information:

Course replaces the old course 521317S Wireless Communications III.

521325S: Communication Signal Processing II, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juntti, Markku Johannes
Opintokohteen kielet: English
Leikkaavuudet:

521360S	Synchronisation for Digital Receivers	4.0 op
521360S-01	Exam, Communication Signal Processing II	0.0 op
521360S-02	Synchronisation for Digital Receivers, exercise work	0.0 op

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period I. It is recommended to complete the course during the second year of master studies.

Learning outcomes:

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

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

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

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

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

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

Contents:

The structure of a communications transceiver, design and synthesis of synchronization algorithms, sampling rate conversion and filtering, I/Q imbalance, finite precision modeling of receive processing, implementation of receiver algorithms.

Mode of delivery:

Face-to-face teaching and independent simulation and design project.

Learning activities and teaching methods:

Lectures 16h, group project work 50h, and self-study.

Target group:

2nd year M.Sc. and WCE students.

Prerequisites and co-requisites:

Statistical signal processing, Digital Filters, Communications Signal Processing I, Wireless Communications I.

Recommended optional programme components:

Comminications Signal Processing I, Signal Processing Systems

Recommended or required reading:

Lecture notes and material, other literature listed therein. Key references: H. Meyr, M. Moeneclaey & S. A. Fechtel, Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998; R. Fasthuber, F. Catthoor, P. Raghavan & F. Naessens, Energy-Efficient Communication Processors, Springer, 2013.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Markku Juntti

Working life cooperation:

No

One of these courses, Antennas or Radio Channels, must be selected, and the other one can be placed into elective studies if it wish to taken.

521388S: Antennas, 5 op

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

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

521380S-02 Antennas, partial credit 0.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

Spring, period 4

Learning outcomes:

1. knows antenna terminology and understands the role of antennas as a part of different radio systems.

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

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

4. will be able to design and analyze various antenna types and arrays using 3D electromagnetic simulation software.

Contents:

Introduction to different antenna types. Fundamental parameters of antennas. Antennas as a part of a radio system. Radiation of an antenna from the Maxwell's equations. Typical linear wire antennas. Loop antennas. Microstrip antennas. Antenna arrays. Antennas for wireless devices. Antenna - human body interaction. Base station antennas. 3D electromagnetic simulation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and exercises 40 h / Compulsory antenna design work with an electromagnetic simulation 25 h / Self-study 70 h

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Recommended literature: C.A. Balanis: Antenna Theory, Analysis and Design (Third Edition). John Wiley & Sons, 2005. Chapters 1-6 and 14.

Assessment methods and criteria:

The course is passed with a final examination and the accepted design work report. In the final grade of the course, the weight for the examination is 0.5 and that for the design work 0.5.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Markus Berg

Working life cooperation:

No

Other information:

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

521386S: Radio Channels, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Markus Berg
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 130 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period IV.

Learning outcomes:

1. will be able to define what the radio channel is and is able to distinguish it into modellable parts.

2. knows different radio wave propagation mechanisms.

3. can apply physical and empirical radio channel models.

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

5. will know how to measure the properties of different radio channels.

Contents:

The radio channels of different radio systems. Characterization of radio waves and propagation media. Different mechanisms of radio wave propagation: direct free-space propagation, absorption, scattering, reflection, refraction, diffraction, surface and ground waves, ionospheric waves and multipath propagation. Principles of the radio channel modelling. Noise calculations. Radio wave propagation phenomena over fixed terrestrial, ionospheric and satellite links. Radio channel modelling for outdoor mobile systems. Radio wave propagation inside or into buildings. Radio channels of mobile satellite links. Slow fading. Multipath propagation and its effects on narrowband and wideband radio channels. MIMO radio channels. Ultra wideband radio channels. Measurement methods of radio channels.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h / Exercises 12 h / compulsory laboratory work 14 h / Self-study 80 h.

Target group:

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

Prerequisites and co-requisites:

The required (or recommended) prerequisite is the completion of the following courses prior to enrolling for the course: Basics of Radio Engineering, Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Simon R. Saunders & Alejandro Aragón-Zavala: Antennas and propagation for wireless communication systems. Second edition. John Wiley & Sons Ltd, 2007.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Markus Berg

Working life cooperation:

No

Other information:

Course will be given every second year in odd years.

A453246: Supplementary module/Electives, Wireless Communications Engineering, 10 - 41 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Supplementary Module
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Alternative

900017Y: Survival Finnish, 2 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay900017Y	Survival Finnish Course (OPEN UNI)	2.0 op

Proficiency level:

A1.1

Status:

The course is intended for the international students in every faculty of Oulu University.

Required proficiency level:

No previous Finnish studies.

ECTS Credits:

2 ECTS credits

Language of instruction:

Finnish and English

Timing:

-

Learning outcomes:

By the end of the course the student can understand and use some very common everyday expressions and phrases, and s/he can locate informational content in simple texts and messages. The student also knows the basic characteristics of Finnish language and Finnish communication styles.

Contents:

This is an introductory course which aims to help students to cope with the most common everyday situations in Finnish. During the course, students learn some useful everyday phrases, some general features of the vocabulary and grammar, and the main principles of pronunciation.

The topics and communicative situations covered in the course are: general information about the Finnish language, some politeness phrases (how to greet people, thank and apologize), introducing oneself, giving and asking for basic personal information, numbers, some time expressions (how to tell and ask the time, days of the week, time of day), food, drink and asking about prices.

The structures studied are: personal pronouns and their possessive forms, forming affirmative, negative and interrogative sentences, the conjugation of some verbs, the basics of the partitive singular and some local cases for answering the ‘where'-question.

Mode of delivery:

Multi-modal teaching (Contact teaching, on-line teaching and independent work)

Learning activities and teaching methods:

Lessons 1–2 times a week (12–14 h) and guided self study (36 h)

Target group:

International degree and post-graduate degree students and exchange students of the University

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Will be provided during the course.

Assessment methods and criteria:

Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grading scale is 1-5.

Person responsible:

Anne Koskela

Working life cooperation:

-

Other information:

Sign-up in WebOodi.

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay900013Y	Beginners' Finnish Course 1 (OPEN UNI)	2.0 op

Proficiency level:

A1.2

Status:

The course is intended for the international students in every faculty of Oulu University.

Required proficiency level:

A1.1, Completion of the Survival Finnish course (900017Y) or the equivalent language skills.

ECTS Credits:

3 ECTS credits

Language of instruction:

As much Finnish as possible; English will be used as a help language.

Timing:

-

Learning outcomes:

By the end of the course the student can understand and use some familiar and common everyday expressions relating to her/himself and everyday situations. S/he can interact in a simple way provided the other person talks slowly and clearly and is willing to help. The student is able to read short simple texts and messages dealing with familiar topics. S/he also deepens her/his understanding of the Finnish language and communication styles.

Contents:

This is lower elementary course which aims to help students to learn communication skills in ordinary everyday situations. During the course, students broaden their vocabulary and knowledge of grammar and principles of pronunciation. They also practise to understand easy Finnish talk about everyday subjects, and reading and writing short and simple texts/messages.

The topics and communicative situations covered in the course are: talking about oneself, one's family, studies and daily routines, as well as asking about these things from other person, expressing opinions, describing people and things, talking about weather and seasons, the names of the months and colours.

The structures studied are: verb types, basics of the change of the consonants k, p and t in verbs and nouns, the genitive and partitive cases, possessive structure, some declension types for nouns (word types) and the basics of the local cases.

Mode of delivery:

Contact teaching and guided self study

Learning activities and teaching methods:

Lessons 2 times a week (26 h) and guided self study (50 h)

Target group:

International degree and post-graduate degree students and exchange students of the University

Prerequisites and co-requisites:

Completion of the Survival Finnish Course

Recommended optional programme components:

-

Recommended or required reading:

Gehring, S. & Heinzmann, S. Suomen mestari 1 (chapters 3 - 5)

Assessment methods and criteria:

Regular and active participation in the weekly lessons (twice a week), homework assignments and written exam at the end of the course will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grading scale is 1-5.

Person responsible:

Anne Koskela

Working life cooperation:

-

Other information:

Sign-up in WebOodi. The course will start right after the Survival Finnish course.

900053Y: Beginners' Finnish Course 2, 5 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900053Y Beginners' Finnish Course 2 (OPEN UNI) 4.0 op

Proficiency level:

A1.3

Status:

The course is intended for the international students in every faculty of Oulu University.

Required proficiency level:

A1.2, completion of the Beginners' Finnish course 1 (900013Y) or the equivalent language skills.

ECTS Credits:

5 ECTS credits

Language of instruction:

As much Finnish as possible; English will be used as a help language.

Timing:

-

Learning outcomes:

By the end of the course the student can understand and use some very common everyday expressions and sentences. S/he can communicate in easy and routine tasks requiring a simple and direct exchange of information on familiar everyday matters. The student understands different kinds of short texts. S/he can for example locate important information in them. In addition, s/he has acquired more detailed knowledge of the language and culture.

Contents:

This is a post-elementary course. During the course students learn more about communication in ordinary everyday situations in Finnish. They also extend their vocabulary and knowledge of grammar. Students practise understanding simple Finnish talk and short texts.

The topics and communicative situations covered in the course are: asking for and giving directions, asking for help/favours, carrying out transactions in shops and restaurants, talking about the past, asking for and expressing opinions and feelings, accommodation, travelling, vehicles, work, professions, food, drink and parties.

The structures studied are: the local cases, nominative plural (basic form plural), imperfect (past tense of verbs), part of the imperative, more declension types for nouns (word types), more about the change of the consonants k, p and t in verbs and nouns, declension of the demonstrative pronouns and personal pronouns, more about the partitive case, basics of the object cases, postpositions and some sentence types in Finnish.

Mode of delivery:

Contact teaching and guided self study

Learning activities and teaching methods:

Lessons 2 times a week (50 h) and guided self study (75 h)

Target group:

International degree and post-graduate degree students and exchange students of the University

Prerequisites and co-requisites:

Completion of the Beginners' Finnish Course 1

Recommended optional programme components:

-

Recommended or required reading:

Gehring, S. & Heinzmann, S.: **Suomen mestari 1** (kappaleet 6-9)

Assessment methods and criteria:

Regular and active participation in the weekly lessons (twice a week), homework assignments and written midterm and final exams will be observed in assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grading scale is 1-5.

Person responsible:

Anne Koskela

Working life cooperation:

-

Other information:

Sign-up in WebOodi. The lessons will be held **twice a week** during a 13-week period.

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

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

ECTS Credits:

3-7

Language of instruction:

English

Timing:

Fall&Spring, periods 1-4

Learning outcomes:

After completing the course the student understand and is able to analyze basic principles of the topic which has been presented in the course. The final outcomes will be defined based on the contents.
Objective: Depending on each year's topic, the course gives either an overview or deepens knowledge of actual topics and applications on radio techniques and telecommunications. The course comprises varying topical subjects, applications, research areas. Depending on the subject, the course may comprise a seminar of essays that practices a student for spontaneously acquiring information, improves readiness for making a master's thesis and readiness for performing in front of an audience.

Contents:

Varies yearly based on actual topics in telecommunications and radio engineering.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and/or exercises and/or design exercise and/or seminars depending on the topic of the year. The start and implementation of the course will be informed separately. The course can be given several times with different contents during the academic year and it can be included into the degree several times.

Target group:

1 st and 2 nd year M.Sc. and WCE students.

Prerequisites and co-requisites:

Will be defined based on the contents.

Recommended optional programme components:

-

Recommended or required reading:

Will be defined in the beginning of the course.

Assessment methods and criteria:

Depends on the working methods.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Matti Latva-aho

Working life cooperation:

-

Other information:

521225S: RF Components and Measurements, 5 op

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

ECTS Credits:

5 ECTS credits / 123,5 hours of work

Language of instruction:

Finnish. English, if there are at least 3 international students in class.

Timing:

The course is held in the 4th period. It is recommended to complete the course during Master level studies.

Learning outcomes:

1. After completing the course the student has knowledge of the behavior of passive components at RF frequencies, knows the fabrication methods of components and is also able to apply the knowledge to practical applications.

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

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

4. The student knows how to perform typical measurements of RF region magnitudes (power, frequency, impedance and noise).

Contents:

Fundamentals of RF and microwave techniques, components in microwave circuits, measurement instruments, measuring of power, frequency, impedance and noise, time-domain and active circuit measurements.

Mode of delivery:

Face-to-face teaching, independent design exercises and laboratory exercises.

Learning activities and teaching methods:

Lectures 24 h, design execises 20 h, laboatory exercises 20 h, independent work 68,5 h.

Target group:

Masters students on electrical engineering

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronic Components and Materials, Electronic Measurement Techniques, Basics of Radio Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Handout, Lecture notes. A. Lehto, A. Räisänen: Mikroaaltomittaustekniikka (in Finnish), I. Bahl: Luped Elements for RF and Microwave circuits, R. Ludvig, P.Bretchko: RF circuit Desing: Theory ans Applications, Prentice Hall 2000 and literature announced at the beginning of the lectures.

Assessment methods and criteria:

Final exam, design exercises and laboratory exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Merja Teirikangas

Working life cooperation:

No.

521443S: Electronics Design II, 5 op

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

ECTS Credits:

5

Language of instruction:

In Finnish (In English if needed).

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies
2. should be able to analyze and design integrated electronic blocks based on these components, such as operational amplifiers, comparators and sampling circuits
3. should be able to estimate and minimize the effects of noise in electrical circuits
4. should be able to explain the terminology used with DA and AD conversion and converters
5. should be able to analyze and outline the main architectural principles and also to evaluate the characteristics of DA and AD converters

Contents:

Modeling of BJT and MOS transistors, CMOS and BJT building blocks especially as IC-realizations, noise and analysis of noise, internal structure of operational amplifiers, critical parameters, comparators, S/H-circuits, structures and properties of A/D and D/A converters.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Face-to-face teaching: Lectures 30h, exercises 20h. Self study: a small design work 20h. Learning without guidance either privately or in a group 60h.

Target group:

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

Prerequisites and co-requisites:

Principles of electronics design, Electronics design I

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521435S: Electronics Design III, 6 op

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

ECTS Credits:

6

Language of instruction:

In Finnish (English as a book examination)

Timing:

Autumn, period 2

Learning outcomes:

1. On completion of the study module students should be able to detail the advantages of differential signal processing in IC realizations and
2. to analyze and design differential amplifiers and other electronic blocks for implementation in an IC environment.
3. They should be able to explain how an SC (switched capacitor) technology functions and to apply such a technology to sampling and filtering.
4. They should also be able to describe the principles for realizing continuous filters in IC technologies, to explain the principles of the delta–sigma technology
5. and to apply it for realizing integrated DA and AD converters.
6. They should be able to account for the functioning, use and architecture of a phase-locked loop,
7. to explain the functioning of an MOS transistor in the area of weak inversion and to indicate how use can be made of this functional area in circuit design.

Contents:

Advanced operational amplifier topologies, especially differential ones, bandgap and PTAT bias circuits and references, problems related to the design of multi-stage amplifiers (output stages, LP/LV

implementations), signal sampling and error sources related to it, SC-techniques (especially in filters), implementation principles of continuous time IC filters, DS techniques in general and particularly in AD/DA converters, operations with frequency/phase domain signals, design of IC layout.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30h and Exercises 20 h; Self-study or in a group of two persons: laboratory exercise 40 h (CAD tools used in IC design and familiarization into the complete analogue IC design flow) and learning without guidance either privately or in a group 69 h.

Target group:

Electrical Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Electronics Design II, Filters, Introduction to Microfabrication Techniques (recommended).

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes: 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.

Assessment methods and criteria:

Passed final exam and exercise work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Tarmo Ruotsalainen

Working life cooperation:

-

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

Voimassaolo: 01.08.2006 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

ECTS Credits:

4-7 ECTS cr, depending on the yearly contents.

Language of instruction:

Finnish or English (if there are at least two foreign students) .

Timing:

Autumn, periods 1

Learning outcomes:

Vary depending on the content.

Contents:

The contents will be fixed yearly during the spring semester. It may be related to RFIC design, or non-linear circuit analysis, for example.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Varies yearly. The course may contain excercises or a design exercise.

Target group:

Electrical Engineering MSc students

Prerequisites and co-requisites:

Background in circuit theory and analog and RF design.

Recommended optional programme components:

-

Recommended or required reading:

Depends on the contents.

Assessment methods and criteria:

Depends on the implementation. May contain design exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521305S: Computer Aided Circuit Design, 5 op

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

521332S	Computer Aided Circuit Design	4.0 op
521332S-01	Computer Aided Circuit Design, exam	0.0 op
521332S-02	Computer Aided Circuit Design, exercise workt	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

1. can explain the operation and requirements of the common simulation algorithms
2. can choose the most appropriate simulation algorithm to any design task
3. can recognize, solve, and circumvent the commonly emerging problems in circuit simulations
4. can choose the correct excitations and build the necessary test benches for circuit simulations

Contents:

Operation of a circuit simulator. The principles and limitations of different circuit simulation algorithms. Device-level and behavioral modeling.

Mode of delivery:

Classroom

Learning activities and teaching methods:

30h lectures and several simulation excercises.

Target group:

MSc students

Prerequisites and co-requisites:

Background in circuit theory and analog design.

Recommended optional programme components:

-

Recommended or required reading:

Kundert: Designer’s Guide to Spice and Spectre. Kluwer Academic

Assessment methods and criteria:

Examined either by weekly simulation excercises or a final exam and a simulation exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

PhD Janne Aikio

Working life cooperation:

-

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Määttä
Opintokohteen kielet: Finnish
Leikkaavuudet:

521316A	Broadband Communications Systems	4.0 op
521433A	Laboratory Exercises on Analogue Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, periods 1-2

Learning outcomes:

1. is able to design basic electronic structural blocks and verify their functionality in a CAD simulation environment.

2. is able independently to realize and test a small-scale design object employing analogue circuit techniques.

Design exercises to deepen the understanding of the material presented in Principles of Electronics Design and Analogue Electronics I.

Contents:

Passive RC-circuits, diodes and their applications, bipolar transistor amplifiers, operational amplifiers and their applications, MOS-transistor, tuned circuit and amplifier, oscillator.

Mode of delivery:

Face-to-face teaching, partially independent work

Learning activities and teaching methods:

Independent design and simulating excercise 26 h and guided laboratory work 15 h. Group size is 1 - 2 students.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course.

Prerequisites and co-requisites:

Student must participate to courses Principles of Electronics Design and Electronics Design I, or he/she must have passed these courses earlier.

Recommended optional programme components:

Parallel to Electronics Design I.

Recommended or required reading:

Lecture notes of Principles of Ekectronic design and Electronics design 1.

Assessment methods and criteria:

Teacher accepts student's design work and measurement results in laboratory.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes verbal grading scale pass or fail

Person responsible:

Kari Määttä

Working life cooperation:

No

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Saarela
Opintokohteen kielet: English
Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 128h

Language of instruction:

In Finnish or in English if two or more foreign students participate.

Timing:

Period 3.

Learning outcomes:

1. can tell and justifying argument the benefits and challenges of using wireless measurement solutions
2. can apply the most important standards when designing wireless measurement solutions
3. can apply wireless technologies in industrial, traffic, environmental, home and healthcare measurements

Contents:

Basics of wireless measurement technologies and standards, wireless sensors and sensor networks, wireless building and smart home applications, wireless measurement applications in traffic, wireless environmental measurements and wireless human health monitoring.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 22h. Seminars 6-12h depending on the number of students participating the course. The students prepare seminar presentations about contemporary topics selected by themselves or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.

Target group:

Master level students regardless of master's programme.

Prerequisites and co-requisites:

No prerequirements, but basics of measurements systems are recomended.

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Lecture notes and seminar reports is Optima.

Assessment methods and criteria:

The course is passed with a written final exam (70 %) and a contemporary seminar (30 %).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Grade is on numerical scale 1-5.

Person responsible:

Juha Saarela

Working life cooperation:

No.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Arto Lanamäki

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the autumn semester, during periods 1 and 2. It is recommended to complete the course in the 1st autumn semester.

Learning outcomes:

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in

information systems and software engineering. The student is able to identify and describe the main research approaches and methods in information systems and software engineering and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

Contents:

Introduction to general scientific principles, scientific research practices and quality of scientific publications, qualitative research approaches and selected research methods, quantitative research approaches and selected research methods, design science research and selected methods, requirements and examples of Master's theses, evaluation of research.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

Completion of Bachelor's studies

Recommended optional programme components:

Recommended or required reading:

Lecture slides and specified literature

Assessment methods and criteria:

Accepted learning diary.

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

Working life cooperation:

No

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Tapio Seppänen
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

The course unit is held in the autumn semester, during period II. It is recommended to complete the course at the end of studies.

Learning outcomes:

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

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

3. implement small-scale software for signal processing algorithms

Contents:

Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

Lectures 10h, Laboratory work 20h, Self-study 20h, written examination.

Target group:

Students interested in biomedical engineering, at their master's level studies.
Students of the University of Oulu.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the Matlab. Basic knowledge of digital signal processing.

Recommended optional programme components:

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

Recommended or required reading:

The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The course ends with a written exam. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521259S: Digital Video Processing, 5 op

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

Ei opintojaksokuvauksia.

521145A: Human-Computer Interaction, 5 op

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

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, periods 2

Learning outcomes:

1. Knowledge of the Human Computer Interaction (HCI) fundamentals

2. Knowledge of evaluation techniques

3. Knowledge of prototyping techniques

4. Knowledge of how HCI can be incorporated in the software development process

Contents:

Human and computer fundamentals, design and prototyping, evaluation techniques, data collection and analysis.

Mode of delivery:

Face to face teaching.

Learning activities and teaching methods:

Lectures (20 h), exercises (20 h), and practical work (95 h). The course is passed with an approved practical work. The implementation is fully English.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

While no specific courses are not required, elementary programming and design skills are desired.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time. The course involves some basic programming.

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment is project-based. Students have to complete 4 individual exercises throughout the semester: 1: Using questionnaires; 2: Grouping & clustering; 3: Fitts' law; 4: Advanced evaluation & visualisations. Passing criteria: all 4 exercises must be completed, each receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Jorge Goncalves
Vassilis Kostakos

Working life cooperation:

-

521279S: Signal Processing Systems, 5 op

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

Learning outcomes:

1. Student can explain the challenges of signal processing hardware, software, and design methodologies.

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

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

4. Student has rudimentary practical skills in modeling, designing, and judging finite word length signal processing algorithms with Matlab and Simulink software tools.

Contents:

Binary and floating point arithmetic, DSP programming models and co-design, digital signal processors, algorithms and implementations, including CORDIC, transforms (FFT and DCT), multi-rate signal processing, polyphase filters, filter banks, adaptive algorithms and applications. The software environments of the course are Matlab with the Fixed Point Toolbox extension and Simulink with the DSP Blockset extension.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

The course consists of lectures (30 h) and design exercises (6-12 h). the rest as independent work (33h).

Target group:

Computer Science and Engineering students: This is an advanced-level course intended for masters-level students, especially to those that are specializing into signal processing. + Other Students of the University of Oulu.

Prerequisites and co-requisites:

521337A Digital Filters, 521267A Computer Engineering or 521286A Computer Systems, 8 ECTS cr or 521287A Introduction to Computer Systems, 5 ECTS cr

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521148S: Ubiquitous Computing Fundamentals, 5 op

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

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. has gained a good overview of the history and current state of ubiquitous computing

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

3. has learned how to carry out a research project, from initial research problem formulation to concept development, and further to in-the-wild evaluation and reporting using an academic format

Contents:

Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.

Mode of delivery:

Lectures, group project

Learning activities and teaching methods:

Lectures 20 h, exercises 22 h, project work 50 h, self-study 43 h. Exercises and project work are completed as group work.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

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

Recommended or required reading:

Required literature: John Krumm (editor) Ubiquitous Computing Fundamentals, Chapman & Hall, 2010, ISBN 978-1-4200-9360-5, 328 pages; selected scientific publications.

Assessment methods and criteria:

The course is graded based on the following criteria: - Attendance - Summaries of selected scientific publications - Interim reports during project work - Final project report.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Adjunct Professor Hannu Kukka

Working life cooperation:

The course teaches students how to design, implement, and evaluate an academic research project. Especially helpful to those students planning post-graduate studies.

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Boutellier, Jani Joosefi

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, period 1. Will be held next time in the autumn of 2016

Learning outcomes:

1. Can distinguish the main types of signal processors

2. Can design basic customized transport triggered architecture processors

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

4. Can match the processor performance and the application requirements

5. Applies the TTA codesign environment and Altera's FPGA tools to synthesize a system

Contents:

Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.

Mode of delivery:

Lectures, independent work, group work.

Learning activities and teaching methods:

Lectures 12h (participation mandatory); Instructed labs 12h. Independent work 111h

Target group:

Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.

Prerequisites and co-requisites:

521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 521337A digital filters, programming skills

Recommended optional programme components:

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

Recommended or required reading:

Handouts.

Assessment methods and criteria:

Participation in mandatory classes and approved project work.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Jani Boutellier

Working life cooperation:

No.

521493S: Computer Graphics, 7 op

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

521140S Computer Graphics 5.0 op

ECTS Credits:

7

Language of instruction:

In English.

Timing:

Spring, periods 4.

Learning outcomes:

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

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

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

4. has the necessary basic skills to use these basic algorithms available in OpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (OpenGL) for implementation.

Mode of delivery:

Face to face teaching.

Learning activities and teaching methods:

Lectures 30 h / Self-study and programming assignments 104 h

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Programming skills using C++; basic data structures; simple linear algebra. Additionally recommended prerequisite is the completion of the following course prior to enrolling for course unit: 521267A Computer Engineering or 521286A Computer Systems or 521287A Introduction to Computer Systems.

Recommended optional programme components:

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

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English) 5) Materials in the internet (e.g. OpenGL redbook) OpenGL Programming Guide or 'The Red Book': http://unreal.srk.fer.hr/theredbook/ OpenGL Video Tutorial: http://www.videotutorialsrock.com/opengl_tutorial/what_is_opengl/text.php

Assessment methods and criteria:

The assessment of the course is based on the exam (50%) and returned course work (50%).
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5, zero stands for fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Ojala, Timo Kullervo
Opintokohteen kielet: Finnish
Leikkaavuudet:

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

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, period 3.

Learning outcomes:

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

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

3. solve distributed systems related problems

4. design and implement a small distributed system

Contents:

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

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

Lectures 30 h, exercises 26 h, project work 50 h, self-study 54 h. Project work is completed as group work.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

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

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

Grading:

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

Person responsible:

Professor Timo Ojala

Working life cooperation:

None.

521466S: Machine Vision, 5 op

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Spring, periods 3.

Learning outcomes:

1. can utilize common machine vision methods for various image analysis problems

2. can detect and recognize objects using features computed from images

3. can use motion information in image analysis

4. can use model matching in image registration and object recognition

5. can explain the basics of geometric computer vision

6. can calibrate cameras

7. can use stereo imaging for 3D reconstruction

8. can use Matlab for implementing basic machine vision algorithms

Contents:

Course provides an introduction to machine vision, and its applications to practical image analysis problems. Common computer vision methods and algorithms as well as principles of image formation are studied. Topics: 1. Introduction, 2. Imaging and image representation, 3. Color and shading, 4. Image features, 5. Recognition, 6. Texture, 7. Motion from 2D image sequences, 8. Matching in 2D, 9. Perceiving 3D from 2D images, 10. 3D reconstruction.

Mode of delivery:

Face-to-face teaching, homework assignments.

Learning activities and teaching methods:

Lectures (20 h), exercises (16 h) and Matlab homework assignments (16 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

521467A Digital Image Processing

Recommended optional programme components:

521289S Machine Learning. This courses provide complementary information on machine learning methods applied in machine vision. It is recommended to be studied simultaneously.

Recommended or required reading:

Lecture notes and exercise material. The following books are recommended for further information: 1) Shapiro, L.G., Stockman,G.C.: Computer Vision, Prentice Hall, 2001. 2) R. Szeliski: Computer Vision: Algorithms and Applications, Springer, 2011. 3) D.A. Forsyth & J. Ponce: Computer Vision: A Modern Approach, Prentice Hall, 2002.

Assessment methods and criteria:

The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Denzil Teixeira Ferreira
Opintokohteen kielet: Finnish
Leikkaavuudet:

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

Proficiency level:

English B2 - C2

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4

Learning outcomes:

1. Ability to implement mobile user interfaces

2. Ability to implement online social network applications

3. Ability to explain the fundamental concepts of context awareness

4. Ability to explain the fundamental concepts of online communities

Contents:

Mobile interface design and implementation, mobile sensor acquisition, context awareness, social platforms, crowdsourcing, online communities, graph theory.

Mode of delivery:

Face to face teaching + independent work.

Learning activities and teaching methods:

Lectures, exercises, and practical work. The course is passed with an approved practical work. The implementation is fully English.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

Object oriented programming.

Recommended optional programme components:

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

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment is project-based. Students have to complete individual assignments throughout the semester and a final pair-based project: build a mobile application, conduct or analysis of data. Passing criteria: the assignments and the project must be must be completed, receiving more than 50% of the available points.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Denzil Ferreira

Working life cooperation:

None.

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S Programmable Web Project (OPEN UNI) 5.0 op

Status:

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

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

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

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

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

4. Is able to implement simple clients using Web technologies

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

Contents:

RESTful Web APIs, hypermedia, transactional/non-transactional databases , RESTful clients (HTML5 and Javascript).

Mode of delivery:

Web-based teaching and face-to-face teaching.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory work 15 h, the rest as self-study and group work. Each group implements programs and writes a report.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming. Applied Computing Project I is recommended.

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

This course unit utilizes continuous assessment. The project work is divided in different deadlines that students must meet to pass the course. Each deadline will be assessed after completion.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

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

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning
Opintokohteen kielet: English

ECTS Credits:

7

Language of instruction:

Finnish/English, material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.

Mode of delivery:

Face-to-face and independent studies.

Learning activities and teaching methods:

Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.

Assessment methods and criteria:

Project work and documentation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Röning

Working life cooperation:

-

521016A: Advanced Practical Training, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521026S	Advanced practical training	5.0 op

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
1-6
Learning outcomes:
After advanced practical training the student can describe one possible future job, or another kind of position in an already familiar working environment. The student can identify problems in the working environment and solve them. The student can apply theoretical knowledge acquired in the studies to practical tasks. The student can identify roles of a diploma-engineer in the work place.
Contents:
Training in the research laboratories, development laboratories and process laboratories, among others, of the industry and institutions in the field of their study is recommended to the students. The basic requirement is that the practice must be performed in a job supervised by a person who has taken an engineering degree.
The technical goal of practical training is to give a general insight of the field in which the trainee will work after having taken the degree and to support and to promote theoretical studying. Likewise, the training has to acquaint the trainee with the social points of the industrial production and with industrial safety and has to give a sufficient picture of the technical details of the performing of different work. Furthermore, the training has to give a general idea of the technical and economic organizing, administration and management of a company and its production.
Mode of delivery:
Independent work.

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

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

521998S: Master's Thesis in Telecommunication Engineering, 30 op

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

A451120: Basic and Intermediate Studies, Electrical Engineering, 150 - 170 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Basic and Intermediate Studies
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Choice of second domestic language, written and spoken. Basic and Intermediate Studies are 124 ECTS cr (includes 2 ECTS cr Swedish and 4 ECTS cr English)

901048Y: Second Official Language (Swedish), Written Skills, 1 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Swedish
Leikkaavuudet:

901060Y	Second Official Language (Swedish), Written Skills	1.0 op
ay901048Y	Second Official Language (Swedish), Written Skills (OPEN UNI)	1.0 op

901049Y: Second Official Language (Swedish), Oral Skills, 1 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Swedish
Leikkaavuudet:

901061Y	Second Official Language (Swedish), Oral Skills	1.0 op
ay901049Y	Second Official Language (Swedish), Oral Skills (OPEN UNI)	1.0 op

900081Y: Second Official Language (Finnish), Written Skills, 1 - 2 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Finnish

900082Y: Second Official Language (Finnish), Oral Skills, 1 - 3 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Finnish

Choose the minimum of 4 ects ofEnglish or German modules

902142Y: Business Correspondence, 2 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:

CEFR B2 - C1 (All Levels)

Status:

This module can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK), Faculty of Information Technology and Electrical Engineering (TST), and Oulu Mining School (KaTk).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 credits. The workload is 53 hours

Language of instruction:

English

Timing:

The course is run in both autumn and spring semesters.

Learning outcomes:

By the end of the course, you are expected to have:

- demonstrated the ability to write clear and effective business letters conveying information and details accurately
- demonstrated the ability to use an appropriate level of formality and style for business communications
- demonstrated mastery of the conventional formats and layouts of different types of business letters

Contents:

The aim of this course is to introduce different types of business correspondence and the format used when communicating in writing.
Different types of correspondence within a business, between businesses and between a business and the public.

Mode of delivery:

Self-access: the course operates within an Optima workspace, with online support from the teacher.

Learning activities and teaching methods:

Independent learning 54 hrs. You practice business correspondence writing entirely through e-learning. Instead of attending lectures, you will use the course Optima workspace; you pick up your lessons as Word documents and submit the assignments into your own personal folder. All materials are provided in an electronic form that can be downloaded. Feedback is given and problems dealt with via written electronic communication.

Target group:

Students in the engineering programmes (TTK and TST)

Prerequisites and co-requisites:

-

Recommended optional programme components:

This module is an elective course which follows PET for students in the engineering programmes (TTK and TST).

Recommended or required reading:

Course materials are provided in an electronic form that can be downloaded.

Assessment methods and criteria:

All assignments must be completed to a standard of effective business correspondence.
Lue lisää opintosuoritusten arvostelusta yliopiston verkkosivulta.

Grading:

Pass/Fail

Person responsible:

See contact teachers

Working life cooperation:

-

Other information:

-

902145Y: Working Life Skills, 2 op

Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:

CEFR B2 - C1 (All Levels)

Status:

This module can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK), Faculty of Information Technology and Electrical Engineering (TST), and Oulu Mining School (KaTk).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 ECTS credits. The workload is 53 hours.

Language of instruction:

English

Timing:

spring semester

Learning outcomes:

By the end of the module, you are expected to

1. have demonstrated a good basic vocabulary related to job applications, meetings and negotiations
2. have applied your knowledge and skills to create an effective job application.
3. be able to use appropriate conventions of content and style in business communication
4. be able to communicate on the telephone effectively and with a reasonable degree of fluency

Contents:

The aim of this module is to help you to develop the English language skills needed to deal with situations related to everyday working life. The course focuses on 4 basic areas:
i) business communication (telephoning skills and letter writing),
ii) social English in working life situations,
iii) applying for a job and
iv) a general introduction to the language of meetings and negotiations.

Mode of delivery:

Contact teaching and independent study

Learning activities and teaching methods:

Lessons 26 hours / independent work 27 hours. Active participation is essential. The course includes regular homework activities.

Target group:

Students in the engineering programmes (TTK and TST).

Prerequisites and co-requisites:

-

Recommended optional programme components:

This module is an elective course which follows PET for students in the engineering programmes (TTK and TST).

Recommended or required reading:

Course materials will be provided by the teacher in electronic form, to be downloaded and brought to class.

Assessment methods and criteria:

Participation in lessons is required, course assignments must be completed, and continuous assessment will be used. Students will be asked to take an end-of course exam if they have not otherwise demonstrated that they have achieved the learning outcomes by the end of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass/Fail

Person responsible:

See contact teachers

Working life cooperation:

-

Other information:

-

902147Y: Academic Vocabulary for Science and Technology, 2 op

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

CEFR Level: B2-C1 (All levels)

Status:

This module can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK), Faculty of Information Technology and Electrical Engineering (TST), and Oulu Mining School (KaTk).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 ECTS credits. The workload is 53 hours.

Language of instruction:

English

Timing:

The course is run in both autumn and spring semesters

Learning outcomes:

The general aim of this module is 1) to help you become aware of the strategies which best promote your skills to learn and memorise vocabulary, and 2) to activate and broaden your basic scientific vocabulary, i. e. the core vocabulary of scientific texts, which is principally the same regardless of the field (*the Academic Word List*).

The ultimate aim is to help you gain the skills to read and write academic / scientific text and to discuss related topics.

Learning outcomes: By the end of the course, you are expected to be able to
1) define what you need to know about a word or a lexical phrase in order to learn vocabulary
2) give examples of how words are built from meaningful parts
3) apply vocabulary learning techniques
4) explain and apply general academic / scientific vocabulary (AWL)
5) outline the characteristics of informal vs. formal / academic vocabulary
6) demonstrate basic academic writing and communication skills.

Contents:

To help you achieve the learning outcomes, you will be given many varied written and oral activities which focus primarily on practicing vocabulary learning strategies, word formation, and the use of the most frequent academic vocabulary (AWL sublists)

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

The course meets regularly for two hours per week (26h). Active participation is essential. Homework (27h) consists of some reading, written work, the preparation of one or two short presentations, which will be given in class to small groups of students, as well as other tasks (reading, listening & writing assignments), which give you a chance to develop and demonstrate the learned skills.
In addition, adequate mastery of the featured vocabulary will be verified in two tests, one around the midpoint and the other towards the end of the module.

Target group:

Students in the engineering programmes (TTK and TST)

Prerequisites and co-requisites:

The course may be taken after completion of PET (*Professional English for Technology – 2 op*).

Recommended optional programme components:

This module is an elective course which follows PET for students in the engineering programmes (TTK and TST).

Recommended or required reading:

Course materials will be provided by the teacher.

Assessment methods and criteria:

Regular and active participation in the weekly sessions will be observed in continuous assessment. In addition to this, satisfactory completion of the in-class/ homework assignments and the two vocabulary tests is required.
Lue lisää opintosuoritusten arvostelusta yliopiston verkkosivulta.

Grading:

Pass/Fail

Person responsible:

See contact teachers

Working life cooperation:

-

Other information:

-

902149Y: Mechanics of Writing, 2 op

Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:

CEFR B2-C1 (Average - Advanced)

Status:

This module can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK), Faculty of Information Technology and Electrical Engineering (TST), and Oulu Mining School (KaTk).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 credits. The workload is 53 hours.

Language of instruction:

English

Timing:

The course is run in both autumn and spring semesters.

Learning outcomes:

By the end of the modules, you are expected to

1. have demonstrated that you can organise the structure of sentences and paragraphs for clarity and impact
2. have shown that you can use punctuation appropriately
3. make appropriate stylistic choices in academic writing.

Contents:

The purpose of this distance-learning module is to help you develop essential writing skills for the production of academic and professional texts in technology.
The module covers three main topics: ordering information in sentences, punctuation and sentence style. During the module, students work independently, studying online handouts and consolidating their learning by working through online exercises.

Mode of delivery:

Web-supported independent study

Learning activities and teaching methods:

This module is completed through independent study of online resources (online handouts and exercises). An online tutor is available to answer questions and give guidance whenever necessary.

Target group:

Students in the engineering programmes (TTK and TST). Especially recommended for students with M or higher for English in matriculation exam.

Prerequisites and co-requisites:

-

Recommended optional programme components:

This module is an elective course which follows PET for students in the engineering programmes (TTK and TST).

Recommended or required reading:

Course materials are available online.

Assessment methods and criteria:

The module is assessed by a final test, which can be taken on any of three test dates (approximately a month apart) in a classroom on the Linnanmaa campus.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass/Fail

Person responsible:

See contact teachers

Working life cooperation:

-

Other information:

-

902150Y: Professional English for Technology, 2 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

902011P-05	TE3/ Professional English for Technology	2.0 op

Proficiency level:

CEFR B2 - C1

Status:

This module is the first English course for students in the engineering programmes in the Faculty of Technology (TTK), Faculty of Information Technology and Electrical Engineering (TST), and Oulu Mining School (KaTk).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 ECTS credits (The workload is 53 hours: about 2 hours of class work and 2 hours of homework per week during one semester.)

Language of instruction:

English

Timing:

Please see the schedule for your department for this course here (ctrl+enter).

Learning outcomes:

By the end of the module, you are expected

- to have demonstrated an ability to give an effective presentation of a product, company and process
- to have demonstrated appropriate strategies and techniques for learning English efficiently
- to be able to explain the influence of language on social and intercultural relationships in your future professional activities

Contents:

PET aims to help you develop a range of professional language skills related to your own specialist field. Scheduled as the first module of your English studies, the PET module has a strong focus on developing speaking skills, and thus gives you an excellent opportunity to get to know your fellow students while working in pairs and groups. The experiences of communication gained in class, mediated by critical reflection on the nature of language and intercultural communication, offer you the chance of extending your interpersonal and intercultural skills through the medium of English. In addition, the module helps you to direct your own learning, encouraging you to reflect upon which aspects of your English you would like to develop further during your studies, and upon developing strategies and techniques for effective language learning.
During PET, you will participate in simulated professional events such as a trade fair and factory tour, and give process/company presentations.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Contact lessons 24 h / Self-study assignments, including preparation of three short presentations 30 h

Target group:

Students in the engineering programmes (TTK and TST)

Prerequisites and co-requisites:

-

Recommended optional programme components:

This course is offered as the first module of your English studies.

Recommended or required reading:

Materials will be provided by the teacher. Learning resources for the module can also be found at the **PET web site** .

Assessment methods and criteria:

Assessment is based on continuous assessment of coursework, including active participation in class, successful completion of module assignments and class presentations. Self, peer and teacher assessment is used. The assessment criteria are based on the learning outcomes of the module.
Lue lisää opintosuoritusten arvostelusta yliopiston verkkosivulta.

Grading:

pass / fail

Person responsible:

Each engineering programme has its own Languages and Communication contact teacher for questions about English studies.

Working life cooperation:

-

Other information:

-

903024Y: Elementary Course in German 1, 3 - 4 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay903024Y Elementary Course in German 1 (OPEN UNI) 4.0 op

Proficiency level:

CEFR, A1.

Status:

The course is optional and it may be included in your faculty's Language, Cultural and Communication Studies (KieKuVi) or in other optional studies.

Required proficiency level:

Elementary Course in German 1 requires no previous German studies. This course unit is also intended for those students who have studied German before, in school or during secondary education, but a long time has passed since the previous studies.

ECTS Credits:

3 - 4 credits / 80 - 106 h of student's work

Language of instruction:

Finnish and German

Timing:

The course unit is held every semester. There are three teaching groups in the autumn semester and two in the spring.
The course lasts for one semester.

Learning outcomes:

Upon completion of the course unit the student should be able to communicate by using simple phrases in everyday language use situations both orally and in writing. The student should also know some basic information about German-speaking countries and their customs.

Contents:

The main body of the course unit consists of essential grammatical structures and vocabulary and various listening, reading, writing, discussion and pronunciation exercises. The course unit aims to help you develop your German communication skills and introduce you to the cultures of the German-speaking countries. Both everyday communication needs and professional life have been taken into account when choosing the topics to be discussed during the course unit.

Topics covered by the course unit include German-speaking countries, customs, holidays, talking about oneself, one's family and one's studies, standard professional vocabulary, one's own interests and hobbies, asking for and giving directions, making appointments, scheduling, inquiring about services, receiving services and restaurant and travelling situations.
Grammatical structures covered include verbs in the present tense, separable-prefix verbs, nominative and accusative forms of nouns, personal pronouns and possessive pronouns, accusative prepositions, conjunctions and word order in main clauses and interrogative sentences.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Contact teaching 2 times 90 min. / week , independent study
80 h of work for 3 credits
106 h of work for 4 credits

Target group:

Students of all faculties

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Fahrplan. Authors: Kauppi, Eva ja Simon, Heli (Tammi). Chapters 1- 7. A additional study material prepared by the teacher.

Assessment methods and criteria:

Continuous assesment, 2 exams. Regular and active participation, homework assignments and tests. Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5 scale

Person responsible:

Kaisu Jarde and Marja Pohjola-Effe

Working life cooperation:

-

Other information:

Registration in WebOodi. If the registration has closed the student can sign up by contacting the teacher by e-mail.

903025Y: Elementary Course in German 2, 3 - 4 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay903025Y	Elementary Course in German II (OPEN UNI)	4.0 op

Proficiency level:

CEFR levels A1 and A2.

Status:

The course is elective and it may be included in your faculty's Language, Cultural and Communication Studies (the KieKuVi module) or in other optional studies.

Required proficiency level:

Completion of Elementary Course in German 1 or A1 proficiency level (CEFR). This course unit is also intended for those students who have studied German before, in school or during secondary education, but a long time has passed since the previous studies.

ECTS Credits:

3 - 4 ECTS credits / 80 - 106 h of student's work.

Language of instruction:

Finnish and German

Timing:

The course unit is held every semester. There are two teaching groups in the autumn semester and three in the spring. The course unit lasts for one semester.

Learning outcomes:

Upon completion of the course unit the student should be able to communicate by using simple phrases in everyday language use situations both orally and in writing. The student should also know some basic information about German-speaking countries and their customs.

Contents:

The main body of the course unit consists of essential grammatical structures and vocabulary and various listening, reading, writing, discussion and pronunciation exercises. The course unit aims to help you develop your German communication skills and introduce you to the cultures of the German-speaking countries. During the course you will get continuous feed-back on your progress in language learning. Both everyday communication needs and professional life have been taken into account when choosing the topics to be discussed during the course unit. Topics covered by the course unit include housing, talking about one's home town, asking for and giving directions, telephone language, making a hotel reservation, visitations, holidays, travels and German-speaking countries and their cultures. Grammatical structures covered include present tense, perfect tense, dative forms of nouns, possessive pronouns, dative prepositions, the so called "dual" prepositions (accusative and dative forms), imperative form, conditional form, ordinal numerals, dates, units of time, conjunctions and word order of main clauses and subordinate clauses. The course unit allows the student to brush-up on the grammar learned during Elementary Course 1.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Contact teaching 2 times 90 min / week, independent study
80 h of work for 3 credits
106 h of work for 4 credits

Target group:

Students of all faculties

Prerequisites and co-requisites:

See Required Proficiency Level

Recommended optional programme components:

-

Recommended or required reading:

Fahrplan. Authors: Kauppi, Eva ja Simon, Heli (Tammi). Chapters 8 - 14. A additional study material prepared by the teacher.

Assessment methods and criteria:

Continuous assesment, 2 exams. Regular and active participation, homework assignments and tests
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1 - 5 / fail

Person responsible:

Kaisu Jarde and Marja Pohjola-Effe

Working life cooperation:

-

Other information:

Registration in WebOodi. If the registration has closed the student can sign up by contacting the teacher by e-mail.

903029Y: Intermediate Course in German 1, 3 - 4 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: German

Proficiency level:

CEFR level A2/B1

Status:

The course is optional. It can be approved as a partial completion of the course unit 903010P Technical German 1. This partial completion is worth 3 ECTS credits.

Required proficiency level:

3 years of German studies during secondary education or equivalent knowledge. 903024Y Elementary Course in German 1 & 903025Y Elementary Course in German 2.

ECTS Credits:

3 - 4 ECTS credits / 80 - 106 h of students's work.

Language of instruction:

German

Timing:

The course is held in autumn term. Please note: Intermediate Course in German 2 and Intermediate Course in German 1 can be studied in a way that first Course 2 can be taken in spring term and after that Course 1 in autumn term.

Learning outcomes:

The aim of the course is to develop the student's language skills in different areas. Upon completion of the course unit the student should be able to communicate in situations where familiar everyday topics are discussed. He/she should be able to understand relatively simple texts, express his/her opinions and manage in short dialogues. The student should be able to recognise some differences and similarities between Finnish and German-speaking cultures. He/she should be able to communicate in various everyday situations while taking into account the distinctive cultural features of the German-speaking country in question.

Contents:

Discussion exercises, grammar exercises and listening and reading comprehension exercises. Topics covered by the course include family, daily routines, free time, studies, working life and German-speaking countries and their cultures.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Contact teaching 2 times 90 min. / week , independent study
80 h of work for 3 credits
106 h of work for 4 credits

Target group:

Students of all faculties and exchange students

Prerequisites and co-requisites:

See Required proficiency requirement

Recommended optional programme components:

-

Recommended or required reading:

Material prepared by the teacher.

Assessment methods and criteria:

Regular and active participation, homework assignments and tests. Continuous assesment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Scale 1 - 5 or pass / fail

Person responsible:

Oliver Jarde

Working life cooperation:

-

Other information:

Registration in WebOodi. If the registration has closed the student can sign up by contacting the teacher by e-mail.

903030Y: Intermediate Course in German 2, 3 - 4 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: German

Proficiency level:

CEFR scale A2/ B1

Status:

The course is optional and it may be included in your faculty's Language, Cultural and Communication Studies (KieKuVi) or in Other Studies. It may also be included as a partial 3 credit course in the Technical German 1 or 3.

Required proficiency level:

5 years of German studies during secondary education or equivalent knowledge. 903029Y Intermediate Course in German 1.

ECTS Credits:

3 - 4 ECTS credits / 80 - 106 h of work for the student.

Language of instruction:

German

Timing:

The course is held in spring term. Please note: Intermediate Course in German 2 and Intermediate Course in German 1 can be studied in a way that first Course 2 can be taken in Spring term and after that Course 1 in Autumn term.

Learning outcomes:

The aim of the course is to develop the student's language skills in different areas: improve the student's oral and written capabilities, develop his/her listening comprehension and broaden his/her vocabulary. Upon completion of the course the student should be able to manage in everyday communication situations and express and justify his/her opinions. He/she should be able to understand texts about familiar topics written in standard language and produce coherent text on topics and themes interesting to him/her.

Contents:

Grammar exercises, reading and listening comprehension exercises and writing exercises relating to work and study-related situations, small talk, politeness and German-speaking countries.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Contact teaching 2 times 90 min. / week , independent study
80 h of work for 3 credits
106 h of work for 4 credits

Target group:

Students of all faculties and exchange students.

Prerequisites and co-requisites:

See Required proficiency level

Recommended optional programme components:

Other German course of more advanced level

Recommended or required reading:

Material prepared by the teacher.

Assessment methods and criteria:

Regular and active participation, homework assignments and tests. Continuous assesment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Scale 1 - 5 or pass / fail

Person responsible:

Oliver Jarde

Working life cooperation:

-

Other information:

Registration in WebOodi. If the registration has closed the student can sign up by contacting the teacher by e-mail.

Compulsory to all

521004P: Orientation to Electronics and Communications Engineering, 1 op

Voimassaolo: 01.08.2013 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Maritta Juvani
Opintokohteen kielet: Finnish

ECTS Credits:

1

Language of instruction:

Finnish, English when needed.

Timing:

Autumn, periods 1-2.

Learning outcomes:

1. After completing this course, students are familiar with academic studies and study-related services.

2. Students know how to plan and schedule their studies based on their program curriculum.

3. Students can use the necessary information and computer systems.

Contents:

Issues related to starting the studies. The university, student organizations, social services offered to students (such as financial aid, sports and health services). University of Oulu, Departments of electrical Engineering and Telecommunications Engineering, university administrat.

Mode of delivery:

Contact teaching.

Learning activities and teaching methods:

Student tutoring, teacher tutoring, information sessions offered by the Faculty and degree program, independent work; total of 30 hours.

Target group:

1st year electrical engineering BSc students

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Study guidebook, websites, new students' folder.

Assessment methods and criteria:

Participation in information sessions as well as student and teacher tutoring. Each student is required to submit a PSP for passing the course. Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass/fail.

Person responsible:

Maritta juvani

Working life cooperation:

None.

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ilkka Lusikka
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031010P	Calculus I (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn semester, periods 1-3.

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.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 55 h / Group work 22 h.

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

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).

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031078P: Matrix Algebra, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Matti Peltola
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031078P	Matrix Algebra (OPEN UNI)	5.0 op
031019P	Matrix Algebra	3.5 op

Ei opintojaksokuvauksia.

761111P: Basic mechanics, 5 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761118P	Mechanics 1	5.0 op
761118P-02	Mechanics 1, lab. exercises	0.0 op
761118P-01	Mechanics 1, lectures and exam	0.0 op
ay761111P	Basic mechanics (OPEN UNI)	5.0 op
761101P	Basic Mechanics	4.0 op

ECTS Credits:

5 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 is able to describe the basic concepts of mechanics and 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, including 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.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h, 7 exercises (14 h), 2 laboratory exercises (8 h), self-study 83 h

Target group:

For the students of the University of Oulu

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13th edition, 2012, chapters 1-14. Also older editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Course material availability can be checked here.

Assessment methods and criteria:

Three mini examinations and end examination or final examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/761111P/etusivu

521077P: Introduction to Electronics, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Hannu
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521077P Introduction to Electronics (OPEN UNI) 5.0 op
521209A Electronics Components and Materials 2.0 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the 2nd period. It is recommended to complete the course at the 1st autumn semester.

Learning outcomes:

1. Student understands the block structures of electronic devices and their signal processing paths.

2. Student can identify the interfaces of analog and digital electronics and the software operations.

3. Student is able to identify and classify electronics components and compare their properties.

4. Students can describe electric conductivity and apply the phenomenon on designing and choosing resistors

5. Student is able to estimate the difference between dielectric materials and how they affect the properties of a capacitor.

6. Student can compare properties of magnetic materials and how identify they effect on inductive components.

7. Student can identify semiconductivity and is able to list typical semiconductor components.

8. Student can classify different circuit board techniques and is able to choose proper coupling techniques.

9. Student can identify the future technologies of electronics materials.

Contents:

Structures and interfaces of electronic devices. Electromagnetic properties of materials (conductivity, dielectricity, magnetism and semiconductivity).Electronics components (resistors, capacitors, inductive components and semiconductors). Interconnection technologies and circuit board technologies. The future of electronic materials and application areas.

Mode of delivery:

Face-to-face teaching and independent work.

Learning activities and teaching methods:

The implementation methods of the course vary. The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 48 hours of guided teaching events and 84.5 hours of teaching without guidance either privately or in a group.

Target group:

First year electrical engineering students.

Prerequisites and co-requisites:

No prerequisites.

Recommended optional programme components:

-

Recommended or required reading:

Lecture material; Materials science and engineering: an introduction / Willam D. Callister, chapters 1, 18 and 20; Electronic components and technology / S. J. Sangwine. Chapters 1,2,3,5 and 7

Assessment methods and criteria:

This course utilizes continuous assessment. During the course, there are two intermediate exams. In addition students will make course work which are graded. The assessment of the course is based on the learning outcomes of the course. Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Jari Hannu

Working life cooperation:

No

521109A: Electrical Measurement Principles, 5 op

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

ECTS Credits:

5 ECTS credits / 136h

Language of instruction:

Course is lectured in Finnish. Lecture notes are available in English. Laboratory exercises and the exam can be done in English.

Timing:

Periods 1-2.

Learning outcomes:

1. is able to measure basic measurements with a multimeter,

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

3. is able to operate signal and function generators.

4. is able to estimate the validity of their measurements.

Contents:

Units of measures, standards of measures, analysis of errors, most commonly used analog and digital measuring methods, equipment and electrical safety regulations.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 20h, laboratory exercises 16 h and self-study 100h.

Target group:

Course is compulsory for electrical engineering, information engineering and wellness technology students. Course is open for all students in University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Course material is in English and Finnish and can be found in Optima.

Assessment methods and criteria:

Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Saarela

Working life cooperation:

None.

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Rautiainen, Mika Oja

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521141P Elementary Programming (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

Lectures and learning material are in Finnish. The course can be completed in English by self-studying from a book, completing assignments and exercises on the course learning environment, and delivering a final project.

Timing:

Fall, period 1. There is an option to extend the course to the 2nd period in cases where completing in one period doesn't fit the student's schedule.

Learning outcomes:

1. Is capable of solving problems in the computer's terms

2. Understands the basic concepts of programming

3. Knows the basics of the Python programming language

4. Is able to implement programs independently

5. Is able to use the internet to find information about programming

Contents:

Problem solving with programming, basic concepts of programming, writing Python code.

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

30h of exercise groups, 105h self-studying in the web.

Target group:

1 st year students of computer science and engineering, electrical engineering, medical and wellness technology and industrial and engineering management, 2nd year students of physics, and other students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course provides a basis for subsequent programming courses.

Recommended or required reading:

Web material in an online learning environment. Address will be announced at the beginning of the course.

Assessment methods and criteria:

The course is completed by passing all learning assignments, programming exercises and a final exercise project. Read more about assessment criteria at the University of Oulu webpage
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

031075P: Calculus II, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ilkka Lusikka
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031075P	Calculus II (OPEN UNI)	5.0 op
031011P	Calculus II	6.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring, period 3

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. After completing the course the student is able to examine the convergence of series and power series of real terms. Furthermore, the student can explain the use of power series e.g. in calculating limits and is able to solve problems related to differential and integral calculus of real and vector valued functions of several variables.

Contents:

Sequences, series, power series and Fourier series of real terms. Differential and integral calculus of real and vector valued functions of several variables.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 28 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the course Calculus I.

Recommended optional programme components:

-

Recommended or required reading:

Kreyszig, E.: Advanced Engineering Mathematics; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations.

Assessment methods and criteria:

Intermediate exams or a final exam.

Grading:

Numerical grading scale 1-5.

Person responsible:

Ilkka Lusikka

Working life cooperation:

-

Other information:

-

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031076P	Differential Equations (OPEN UNI)	5.0 op
800320A	Differential equations	5.0 op
031017P	Differential Equations	4.0 op

Ei opintojaksokuvauksia.

031021P: Probability and Mathematical Statistics, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Kemppainen
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031021P	Probability and Mathematical Statistics (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Spring semester, periods 4-6

Learning outcomes:

After completing the course the student knows the key concepts of probability and the most important random variables and is able to use them in calculating probabilities and parameters of probability distributions. In addition, the student is able to analyze statistical data by calculating interval and point estimates for the parameters. The student is also able to formulate statistical hypotheses and test them.

Contents:

The key concepts of probability, random variable, parameters of probability distributions, estimation of parameters, hypothesis testing.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 44 h/Exercises 22 h/Self-study 68 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisites are the course 031010P Calculus I and some parts of the course 031011P Calculus II.

Recommended optional programme components:

-

Recommended or required reading:

Milton, J.S., Arnold, J.C. (1992): Introduction to Probability and Statistics.

Assessment methods and criteria:

Intermediate exams or a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

Other information:

-

521301A: Digital Techniques 1, 8 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Antti Mäntyniemi
Opintokohteen kielet: Finnish
Leikkaavuudet:

521412A-02 Digital Techniques 1, Exercise Work 0.0 op
521412A Digital Techniques 1 6.0 op
521412A-01 Digital Techniques, Exam 0.0 op

ECTS Credits:

8

Language of instruction:

Finnish

Timing:

Periods 3-4

Learning outcomes:

1. 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.
2. 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.
3. Based on this knowledge, students are able to implement and analyze digital devices consisting of ordinary simple digital components.
4. 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:

The principles of digital devices, Boolean algebra, numeral systems, operating principle, analysis and synthesis of combinational logic, flip-flops, operating principle, analysis and synthesis of sequential logic (state machines), physical characteristics of CMOS technology, registers and register transfers, computer memory, instruction set architecture, computer design basics, interfaces and data transmission.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lessons 40 h, guidance of the project work 20 h.

Target group:

Primarily 1st year electrical engineering and computer science and engineering BSc students. The course can be taken by the students of the university of Oulu.

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

Text books, MIT OpenCourseWare and execise literature.

Assessment methods and criteria:

Project work, home assignment and exam. Partial exams are recommended.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Project work pass/fail. Numerical grading 1-5 for exam. Final grading is based on exam.

Person responsible:

Antti Mäntyniemi

Working life cooperation:

-

521302A: Circuit Theory 1, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

30h lectures, 22h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Kemppainen
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031077P	Complex analysis (OPEN UNI)	5.0 op
031018P	Complex Analysis	4.0 op

Ei opintojaksokuvauksia.

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Applied Mathematics and Computational Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Kotila, Vesa Iisakki
Opintokohteen kielet: Finnish
Leikkaavuudet:

031050A Signal Analysis 4.0 op

Ei opintojaksokuvauksia.

766319A: Electromagnetism, 7 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761119P Electromagnetism 1 5.0 op
761312A Electromagnetism 2 5.0 op
761119P-01 Electromagnetism 1, lectures and exam 0.0 op
761119P-02 Electromagnetism 1, lab. exercises 0.0 op
761113P Electricity and magnetism 5.0 op
761113P-01 Electricity and magnetism, lectures and exam 0.0 op
761113P-02 Electricity and magnetism, lab. exercises 0.0 op
761103P Electricity and Magnetism 4.0 op
766321A Electromagnetism I 4.0 op
766322A Electromagnetism II 4.0 op

ECTS Credits:

7 credits

Language of instruction:

Finnish

Timing:

2nd autumn

Learning outcomes:

The student identifies the basic concepts of electromagnetic theory and is able to derive the individual results of electromagnetic field theory and electric circuits. He can apply field theory in simple problems and can solve both direct and alternating current circuits.

Contents:

Electromagnetism is a physical theory which was developed mainly in the 1800's. A central concept in electromagnetism is field. Electromagnetism has joined the theories of electricity and magnetism into a unified theory and, finally, merged optics into the same framework. It also contains a clue to the theory of relativity and therefore it has had a great impact on the later development of physics. Our present society is largely affected by the applications of electromagnetism, since both electricity and magnetism have a profound role e.g. in the production and transport of energy, in domestic lightning, in telecommunications and in information technology.
Contents in brief: Mathematical tools, electric charge, Coulomb's law and electric field, potential and

potential energy, Gauss' law, dielectric media, volume polarisation and induced charges, conductors, capacitors, energy density of electric field, Laplace's and Poisson's equations magnetic field, Lorentz-force, the absence of magnetic monopoles Ampère's and Biot-Savart's laws, vector potential, magnetic moment, magnetic field vector, magnets, Faraday's law, inductance, magnetic energy, alternating currents, power in alternating current circuits, three-phase lines, linear circuits, Kirchhoff's laws, alternating current bridges, continuity equation, displacement current, Maxwell's equations.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 46 h, 12 exercises (24 h), self-study 117 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

Courses in mathematics. 763101P Mathematics for physics.

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

T. Nygrén: Sähkömagnetismi (in Finnish, available on web pages of the Department). English material are available on various textbooks like I.S. Grant ja W.R. Phillips: Electromagnetism (2nd edition, Wiley & Sons) or Cheng: Fundamentals of Engineering Electromagnetics (Addison-Wesley).

Assessment methods and criteria:

Two written intermediate examinations or final examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Anita Aikio

Working life cooperation:

No work placement period

Other information:

https://wiki.oulu.fi/display/766319A/

521329A: Hands-on Course in Wireless Communication, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Heikki Antero Kärkkäinen
Opintokohteen kielet: Finnish
Leikkaavuudet:

521316A	Broadband Communications Systems	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during first period. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

1. has become acquainted with wireless communication technologies with the aid of small laboratory measurement works, which do not require prior courses on telecommunication engineering.

2. has observed and learned the operation principles, properties and limitations of existing wireless communication systems.

3. has learned how to use measurement techniques and methods with the aid of modern measurement instruments in laboratory environment.

4. knows how to approach different kinds of wireless communication problems by utilizing hands-on engineering work practices.

Contents:

Students are introduced to the wireless communication systems and corresponding phenomena with the aid of guided laboratory exercises. The course utilizes within reasonable limits various existing wireless communication systems, in order to create simple connections between various equipments and modules in a laboratory environment.

Mode of delivery:

Face-to-face teaching and guided laboratory exercises. Self-studying at home between work themes. Writing of final report.

Learning activities and teaching methods:

Course consist of few small separate measurement problems dealing with wireless transmission. Before each work theme relevant theory and work instructions needed to complete the work are given. Students will participate in briefing lectures (appr. 2 h/theme) which introduce the theory needed to conduct each laboratory work problem. In addition, instructions to perform the work are given. After each lecture students will move to a measurement laboratory, and will study a given problem with the aid of measuring instruments in a laboratory environment under teacher's quidance. Work subjects are done within a group of several students, and measuremnt results are summarized in a written final report. Course contains face-to-face teaching and quided laboratory work among themes, and self-study between work themes. For the end, students perform discussion and reporting of results. Final exam is not arranged.

Target group:

Second year bachelor level electrical engineering students.

Prerequisites and co-requisites:

No prerequisities.

Recommended optional programme components:

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

Recommended or required reading:

No course book. Lecture slides, and problem assignments together with work instruction available. Materials will be placed into TTK-OPTIMA environment during the course.

Assessment methods and criteria:

All students of a group will participate in introductory face-to-face teaching and will prepare a final report according teacher’s instructions. Participation in all introductory lectures and laboratory exercises is mandatory for all members of a group. In addition, final report has to be in form required by a course teacher, and the content has to be satisying from acceptance standpoint.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Work grading accepted/rejected. No numerical grading.

Person responsible:

Kari Kärkkäinen

Working life cooperation:

No

521303A: Circuit Theory 2, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521306A Circuit Theory 2 4.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, period 2

Learning outcomes:

After the course the student can:
1. use Laplace transform for solving time and frequency response of electric circuits;
2. derive continuous-time transfer functions.;
3. solve their poles and zeros and understand the meaning of those;
4. draw the pole-zero map and Bode plots of any given transfer function;
5. construct 2-port parameter models of a given circuit

Contents:

Use of Laplace transform in network analysis. Properties of network functions, poles and zeros, Boden magnitude and phase plots. 2-port parameter models.

Mode of delivery:

Classroom

Learning activities and teaching methods:

30h lectures, 22 h exercises, and simulation excerices.

Target group:

Finnish BSc students

Prerequisites and co-requisites:

Basics of circuit theory, differential equations.

Recommended optional programme components:

Continuation for Circuit theory 1. Needed in most analog electronics courses.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 12-18.

Assessment methods and criteria:

Course is examined by a final exam. Obligatory simulation exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical 1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

766349A: Wave motion and optics, 7 op

Voimassaolo: 01.12.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field 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
766329A	Wave motion and optics	6.0 op

ECTS Credits:

7 credits

Language of instruction:

Finnish. The course material and exercises are available in English.

Timing:

First spring

Learning outcomes:

The student is able to treat different types of waves by methods of general theory of wave motion. The student is also able to solve problems related to basic optics and apply her/his knowledge to teaching and research in physics.

Contents:

General principles of wave motion, sound, electromagnetic waves, production and measurement of light, propagation of light, image formation in mirrors and lenses, matrix method in ray tracing, aberrations, optical instruments, interference, interferometry, polarization, Fraunhofer diffraction, diffraction grating, laser principles.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 46 h, exercises 24 h, self-study 117 h

Target group:

No specific target qroup

Prerequisites and co-requisites:

766101P Mathematics for physics

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

H. D. Young and R. A. Freedman, University Physics, Addison-Wesley, 2000 ja 2004, F. L. Pedrotti ja L. S. Pedrotti, Introduction to optics, Prentice-Hall, 2. ed., 1993 ja E. Hecht, Optics, (3rd ed.), Addison Wesley Longman, 1998.
Course material availability can be checked here.

Assessment methods and criteria:

Three written intermediate examinations or one final examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Seppo Alanko

Working life cooperation:

No work placement period

Other information:

Course website

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A Digital Filters (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is 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 f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Face-to-face teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Esa Rahtu

Working life cooperation:

None.

521330A: Telecommunication Engineering, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Heikki Antero Kärkkäinen
Opintokohteen kielet: Finnish
Leikkaavuudet:

521357A	Basics of Analog Communications	3.0 op
521361A	Basics of Digital Communications	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish. The course can be completed in other languages e.g. in English as a book examination.

Timing:

The course is held in the spring semester, during period IV. It is recommended to complete the course at the 2nd spring semester.

Learning outcomes:

1. can tell and explain the essential blocks and their operation in time & frequency domains for frequently used analog and digital carrier and pulse modulation methods.
2. understands essential differences both between linear and non-linear modulations, and between coherenr and non-coherent modulations.
3. understands in which system applications each analog or digital modulation is typically used.
4. can tell limitations on system performance caused by noise interference and various transmission channels, and can propose methods to suppress interference both in analog and digital transmission.
5. can perform system analysis, and can calculate performances of analog and digital modulations based on simple assumptions regarding channel models.
6. can compare modulations from the standpoints of resource use (transmitted power and bandwidth needed) and implementation complexity.
7. understands the meanings of various equalizing, diversity and coding methods from the standpoint of improvement for digital transmission reliability.
8. understands various standards and specifications of new digital transmission systems.
9. can apply gained knowledge in working life to design of systems and their sub-system units, and can also perform computer simulations.
10. understands the principles of information theory, source coding and error-control coding, and masters various most commonly used coding methods.

Contents:

Essential and optional blocks of coherent and non-coherent analog and digital transmission systems and their operation principles. Linear (amplitudemodulation) and non-linear (anglemodulation) modulation principles, and differences in their performance and operation. Carrier and pulse modulation principles and their differences. The most important analog (DSB, AM, SSB, VSB, PM, FM, PAM,PWM, PPM) and digital (ASK/MASK, PSK/MPSK, FSK/MFSK, DPSK, QPSK/OQPSK, MSK/GMSK, QAM, MCM/OFDM, TCM, DM, PCM) carrier and pulse modulation methods and their performance analysis (SNR, BEP) and comparison based on the AWGN channel model. Influence of single-tone carrier radiofrequency interference (RFI) in the case of analog modulations. The threshold effect in the case of non-linear modulations and non-linear

detectors. Mixing-principle and superheterodyne receiver. Phase-lock loop techniques, and FDM, TDM and QM-multiplexing methods. Matcher filter and correlation receiver principles. Characteristics and modelling of radio channels. Influence of band-limiting and multi-path propagation (inter-symbol interference ISI & fading) on system performance. Diversity, channel equalizing and MCM/OFDM methods for reducing channel interference. Spread-spectrum technique, and benefits & limitations & applications of that principle. Cellular system idea. Basics of information theory, source coding and error-control coding methods.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Face-to-face teaching 52 h. No separate times for class-ecercises. Exercises are integrated as part of face-to-face teaching event. Self-study 73 h. Total 125 h.

Target group:

Second year B.Sc.(Tech.) students in electrical engineering and computer engineering degree programmes.

Prerequisites and co-requisites:

031080A Signal analysis course.

Recommended optional programme components:

No connections to other courses.

Recommended or required reading:

Lecture slides in Finnsih are stored into the TTK-OPTIMA environment. The course and lecture slides are based on the book: R.E. Ziemer & W.H. Tranter: Principles of Communications: Systems, Modulation and Noise, 7th edition, 2015, John Wiley & Sons, Partially chapters: Ch 1 (ss. 1-16), Ch 3 (112-151), Ch 4 (ss. 156-184, 194-209), Ch 5 (ss. 215-216, 225-239), Ch 8 (ss. 349-361, 370-380, 384-390), Ch 9 (ss. 396-468), Ch 10 (ss. 477-516, 528-532, 540-546, 553-557), Ch 12 (ss. 615-647, 657-664, 668-670, 679-683).

Assessment methods and criteria:

Course can be passed either with several mini-exams during course, or with final exam.

Grading:

Course can be passed either with several mini-exams during course, or with final exam.
Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Kari Kärkkäinen

Working life cooperation:

No

Other information:

This course replaces the following candidate level courses: 521357A Telecommunication Engineering I (3 ECTS) and 521361A Telecommunication Engineering II (3 ECTS).

521104P: Introduction to Material Physics, 5 op

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

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish.

Timing:

Spring semester period 3

Learning outcomes:

1. is able to explain the principal solid state crystal structures

2. can explain how propagating waves and electrons in a crystal lattice can be presented

3. can explain the free electron model of metals and the formation of the energy band structure in crystals and their significance to the electrical properties of materials

4. is able to explain the basic phenomena related to semiconductors and is able to calculate the charge carrier concentrations in them

Contents:

Crystal structures, cohesion and defects. Reciprocal lattice and waves in crystals. Statistical mechanics and thermal vibration. Free electron model of metals. Energy bands in crystal. Basic phenomena of semiconductors.

Mode of delivery:

Will be notified in the beginning of lectures

Learning activities and teaching methods:

Will be notified in the beginning of lectures

Target group:

Second year electrical engineering students

Prerequisites and co-requisites:

Basic physics and mathematics.

Recommended optional programme components:

Basic course for 521071A Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes (in Finnish). English material for instance parts from books: H.M. Rosenberg: The Solid State, Clarendon Press, Oxford, 1988 and B. Streetman: Solid State Electronic Devices, Prentice Hall, New Jersey, 1995.

Assessment methods and criteria:

Will be notified in the beginning of lectures.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Will be notified in the beginning of lectures. Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Juha Hagberg

Working life cooperation:

No

521071A: Principles of Semiconductor Devices, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Hagberg
Opintokohteen kielet: Finnish
Leikkaavuudet:

521205A	Principles of Semiconductor Devices	4.5 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish

Timing:

Spring semester period 4

Learning outcomes:

1. will be able to explain physical phenomena in semiconductor materials and junctions; describe main types and characteristics of semiconductor diodes and transistors
2. will be able to explain physical principles of operation and to estimate ideal characteristics of the devices

Contents:

Junctions. Semiconductor diodes and lasers. Bipolar junction transistors. Field effect transistors. Switching devices.

Mode of delivery:

Will be notified in the beginning of lectures.

Learning activities and teaching methods:

Will be notified in the beginning of lectures.

Target group:

Second year electrical engineering students

Prerequisites and co-requisites:

521104P Introduction to materials physics.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes (in Finnish). Book: Streetman, B.: Solid state electronic devices, Prentice-Hall, New Jersey, 2000 (chapters 5 - 8, 11).

Assessment methods and criteria:

Will be notified in the beginning of lectures.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Hagberg

Working life cooperation:

No.

521431A: Principles of Electronics Design, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

1. should be able to analyze and design such electronic building blocks as rectifiers, clamping circuits, amplifiers and CMOS logic elements using diodes, operational amplifiers and MOS and bipolar junction transistors.

Contents:

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar and MOS transistor amplifiers, small signal modeling and analyzing ac properties of amplifiers, internal structures of digital circuits (mainly CMOS), MOS/CMOS switch.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h.

Target group:

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

Prerequisites and co-requisites:

Circuit Theory I

Recommended optional programme components:

Recommended course Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 1-8 and 15 partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 1-5 and 14.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Faculty of Technology
Arvostelu: 1 - 5, pass, fail
Opettajat: Ursula Heinikoski, Sassali, Jani Henrik
Opintokohteen kielet: Finnish
Leikkaavuudet:

030004P	Introduction to Information Retrieval	0.0 op

ECTS Credits:

1 ECTS credit

Language of instruction:

Finnish

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.

Mode of delivery:

Blended teaching: classroom training, web-based learning material and exercises in Optima environment, a final assignment on a topic of the student's own choice

Learning activities and teaching methods:

Training sessions 8h, group working 7h, self-study 12h

Target group:

Compulsory for all students of the Faculty of Technology, the Faculty of Information Technology and Electrical Engineering and the Faculty of Architecture. In the Faculty of Science compulsory for students of biology, physics, geosciences, chemistry and geography. Optional for students of biochemistry and mathematics.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Web learning material https://wiki.oulu.fi/display/030005P.

Assessment methods and criteria:

Passing the course requires participation in the training sessions and successful completion of the course assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail

Person responsible:

Science and Technology Library Tellus, tellustieto (at) oulu.fi

Working life cooperation:

-

Other information:

-

A451126: Module Preparing for the Option, Electrical Engineering, 40 - 47 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Module preparing for the option, electrical engineering 40 ECTS cr

521432A: Electronics Design I, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to recount the principles covering the design of multistage amplifiers

2. should be able to analyze and set the frequency response of a transistor amplifier

3. should be able to make use of feedback to improve the properties of an amplifier in the desired manner

4. should be able to analyze the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability

5. should be able to describe the principles governing the design of power amplifiers

6. should be able to make widespread use of operational amplifiers for realizing electronic circuits and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers

7. should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and tuned amplifiers

8. should be able to recount the basic principles governing the functions and properties of emitter-coupled logic

Contents:

Frequency response of a transistor amplifier, differential amplifier, feedback, stability and nonidealities of a feedback amplifier, comparator, output stages and power amplifiers, applications of operational amplifier, oscillators, tuned amplifiers and ECL logic.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h and exercises 20 h.

Target group:

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

Prerequisites and co-requisites:

Principles of electronic design

Recommended optional programme components:

This course is required when participating in Laboratory Exercises on Analogue Electronics.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 10-13-8 and 14, partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 7,8,9,13 and partially 11 and 12.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521404A: Digital Techniques 2, 5 op

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

ECTS Credits:

5

Language of instruction:

In Finnish. Exams can be arranged in English on demand.

Timing:

Autumn, period 2

Learning outcomes:

1. knows the common architectures of synchronous digital logic circuits, and the building blocks they consist of, and can design digital circuits that realize complex data and signal processing functions.
2. knows most common combinational and sequential logic based buildning blocks, and can use them to design and realize complex digital circuits.
3. knows digital logic design methods, such as use of hardware description languages, functional verification using simulation, realization of logic with a logic synthesis program, and functional and timing verification of gate-level models.

Contents:

1. Logical and physical properties of digital logic components. 2. Representation of digital designs. 3. Combination logic design. 4. Sequential logic design. 5. Digital artithmetics. 6. Semiconductor memories. 7. Register transfer level architecture design. 8. Register transfer level modeling and synthesis. 9. Timing design. 10. Digital interface design. 11. Design verification

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 24h/ exercises 30h (group work)/independent work 84h.

Target group:

Primarily electrical and computer science and engineering students. Also other student of University of Oulu can take the course.

Prerequisites and co-requisites:

Digital techniques 1

Recommended optional programme components:

No

Recommended or required reading:

Lecture textbook (in finnish) and literature announced during course.

Assessment methods and criteria:

Final exam and a design excercise, or weekly assignments consisting of theoretical and design exercises.
Read more about assessment criteria at the University of Oulu webpage.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5, The grade is the average of the exam and the design exercise.

Person responsible:

Jukka Lahti

Working life cooperation:

No

521384A: Basics in Radio Engineering, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, 1st period

Learning outcomes:

1. can define what radio engineering is and list its separate areas.

2. understands the meaning of Maxwell's equations and can solve the propagation of radio waves in a homogeneous medium

3. can solve EM-fields at an interface of two lossless media.

4. knows main properties of most common transmission line types and can solve EM-fields for coaxial lines and rectangular waveguides.

5. can utilize the methods based on the Smith chart for the impedance matching of microwave circuits and antennas.

6. understands the meaning of Y-, Z-, and S-matrix and can use S-parameters for solving charasteristics of microwave circuits.

7. can describe the operation of passive transmission line devices, resonators, filters and circuits based on the semiconductor devices.

8. knows the terms to describe antenna charasteristics and can define radiation patterns of simple antennas and antenna arrays.

9. knows different propagation phenomena and can evaluate, which phenomena are relevant in different radio systems in different frequency bands.

10. can describe the structure of a typical radio system and can calculate the S/N-ratio linkbudget for a radio system on a free-space radio link.

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.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 26 h and exercises 16 h including graded exercise problems.

Target group:

3 rd year bachelor's degree students.

Prerequisites and co-requisites:

Elementary knowledge of the electromagnetic theory.

Recommended optional programme components:

-

Recommended or required reading:

In Finnish: Antti Räisänen & Arto Lehto: Radiotekniikan perusteet. Otatieto, 2011; also older versions of the book can be used as a course book. 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.

Assessment methods and criteria:

The course is passed with a final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Erkki Salonen

Working life cooperation:

-

521070A: Introduction to Microfabrication Techniques, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teirikangas, Merja Elina
Opintokohteen kielet: Finnish
Leikkaavuudet:

521218A	Introduction to Microelectronics and Micromechanics	4.0 op
521218A-02	Introduction to Microelectronics and Micromechanics, demonstration	0.0 op
521218A-03	Introduction to Microelectronics and Micromechanics, exercise	0.0 op
521218A-01	Introduction to microelectronics and micromechanics, exam	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

2nd period

Learning outcomes:

1. Can present the process of source materials used to manufacture micro- and nanoelectronics /mechanics and analyse the required material properties depending of the application

2. Can explain the fabrication methods and discuss the characteristic features of each fabrication method, inculding their utilisation and restrictions.

3. Is capable of designing a fabrication process for a simple microelectronics application and is able to indetify the process steps also in complex application.

Contents:

The content of the course covers fabrication methods of micro-, nano- and optoelectronics as well as MEMS systems. 1. Fabrication methods for silicon based electronics and MEMS systems 2. Additive manufacturing methods 3. Nanomaterials and fabrication.

Mode of delivery:

Face-to face teaching

Learning activities and teaching methods:

Lectures (20 hours) and exercises (10 +10).

Target group:

Electrical engineering bachelor degree students.

Prerequisites and co-requisites:

Course content of 521104P Introduction to Materials Physics and 521071A Principles of Semiconductor Devices.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, Franssila Sami: Introduction to Microfabrication

Assessment methods and criteria:

Final written exam and passes laboratory exercises.

Grading:

Numerical grading 1-5.

Person responsible:

Lectures: Merja Teirikangas Exercise: Hanna Kähäri

Working life cooperation:

No

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A	Broadband Communications Systems	4.0 op
521433A	Laboratory Exercises on Analogue Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, periods 1-2

Learning outcomes:

1. is able to design basic electronic structural blocks and verify their functionality in a CAD simulation environment.

2. is able independently to realize and test a small-scale design object employing analogue circuit techniques.

Design exercises to deepen the understanding of the material presented in Principles of Electronics Design and Analogue Electronics I.

Contents:

Passive RC-circuits, diodes and their applications, bipolar transistor amplifiers, operational amplifiers and their applications, MOS-transistor, tuned circuit and amplifier, oscillator.

Mode of delivery:

Face-to-face teaching, partially independent work

Learning activities and teaching methods:

Independent design and simulating excercise 26 h and guided laboratory work 15 h. Group size is 1 - 2 students.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course.

Prerequisites and co-requisites:

Student must participate to courses Principles of Electronics Design and Electronics Design I, or he/she must have passed these courses earlier.

Recommended optional programme components:

Parallel to Electronics Design I.

Recommended or required reading:

Lecture notes of Principles of Ekectronic design and Electronics design 1.

Assessment methods and criteria:

Teacher accepts student’s design work and measurement results in laboratory.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes verbal grading scale pass or fail

Person responsible:

Kari Määttä

Working life cooperation:

No

521287A: Introduction to Computer Systems, 5 op

Voimassaolo: 01.08.2016 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teemu Leppänen
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521287A	Introduction to Computer Systems (OPEN UNI)	5.0 op
521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

Upon completing the course, the student understands the basics of computer architecture and CPU operation.Student knows number systems and data representations in computer.
Student is familiar of I/O operation with peripheral devices in general.
Student is able to implement small programs with the C programming language for general-purpose computers and for embedded systems.
Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Overview of computer architecture and CPU, data types and memory management, interrupts, registers and I/O, general computer and embedded systems programming, basics of the C programming language.

Mode of delivery:

Web-based teaching + face-to-face teaching.

Learning activities and teaching methods:

Lectures (20h), course exercises (10-20h), laboratory exercise (3h) and course project in a group.

Target group:

Students of the University of Oulu

Prerequisites and co-requisites:

Elementary programming 521141P

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Other material will be announced at the course start.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course project in a group. Assessment is based on the exercises and the course project. More detailed information on assessment can be found from the course Web pages in Noppa Portal.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

-

Other information:

521287A Introduction to Computer Systems replaces course 521142A Embedded systems programming for electrical engineering students.

521304A: Filters, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

Leikkaavuudet:

521331A Filters 4.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 3

Learning outcomes:

After the course the student can:
1. draw a pole-zero map for a given transfer function;
2. perform impedance and frequency scaling for component values;
3. choose an appropriate prototype filter and filter degree;
4. synthesize passive RLC filters;
5. synthesize active opamp based filters;
6. can compare various filter technologies;
7. understands the basics of scaling the dynamic range of active filters

Contents:

Filter types and prototypes, component scaling. Synthesis of active and passive filters. Sensitivity analysis and scaling of the dynamic range.

Mode of delivery:

Lectures, excercise and design excercise

Learning activities and teaching methods:

30 h lectures, 14 h exercises. A deign excercise.

Target group:

Finnish electrical engineering students

Prerequisites and co-requisites:

Basics of circuit theory, Bode plots and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

van Valkenburg: Analog Filter Design, 1982, chapters1-14, 18 ja 20 ; or year 2001 edition chapters 1-13.

Assessment methods and criteria:

Circuit is examined by a final exam. Also the obligatory design exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521092A: Electronic Measurement Techniques, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 136 h

Language of instruction:

Course is lectured in Finnish. Lecture notes are available in English. Calculation exercises, laboratory exercises and the exam can be done in English.

Timing:

Period 4

Learning outcomes:

1. can name the electrical measurement technique terminology associated to measurement systems, sensors and buses to candidate level.

2. can plan and implement complicated measurements with oscilloscopes

3. can plan and implement basic measurements with spectrum analyzers

4. can plan and implement basic measurements with light detectors

5. can name common sources of noise and interference

6. name means to control noise and interference

7. can name methods to realize electrical quantities

Contents:

Broad view to electronic measurements.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures and calculation exercises 30h, laboratory exercises 16 h and self-study 90h

Target group:

Course is compulsory for most electrical engineering students. Course is open for all students in University of Oulu.

Prerequisites and co-requisites:

Electrical Measurement Principles, Analogue Electronics I, Digital Techniques I.

Recommended optional programme components:

The course replaces previous courses with same name, but different credits and code.

Recommended or required reading:

Course material is in English and Finnish and can be found in Optima.

Assessment methods and criteria:

Exam and passed lab exercises.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Saarela

Working life cooperation:

None.

A451123: Module Preparing for the Option, Telecommunication Engineering, 20 - 40 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Telecommunications, 40 ECTS cr

521432A: Electronics Design I, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Autumn, period 1

Learning outcomes:

1. should be able to recount the principles covering the design of multistage amplifiers

2. should be able to analyze and set the frequency response of a transistor amplifier

3. should be able to make use of feedback to improve the properties of an amplifier in the desired manner

4. should be able to analyze the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability

5. should be able to describe the principles governing the design of power amplifiers

6. should be able to make widespread use of operational amplifiers for realizing electronic circuits and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers

7. should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and tuned amplifiers

8. should be able to recount the basic principles governing the functions and properties of emitter-coupled logic

Contents:

Frequency response of a transistor amplifier, differential amplifier, feedback, stability and nonidealities of a feedback amplifier, comparator, output stages and power amplifiers, applications of operational amplifier, oscillators, tuned amplifiers and ECL logic.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40 h and exercises 20 h.

Target group:

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

Prerequisites and co-requisites:

Principles of electronic design

Recommended optional programme components:

This course is required when participating in Laboratory Exercises on Analogue Electronics.

Recommended or required reading:

Lecture notes, Razavi: Fundamentals of Microelectronics (John Wiley & Sons 2008), chapters 10-13-8 and 14, partially or Sedra & Smith : Microelectronic Circuits (6th ed.), chapters 7,8,9,13 and partially 11 and 12.

Assessment methods and criteria:

Final or 2 mid-term exams.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 1-5.

Person responsible:

Juha Häkkinen

Working life cooperation:

-

521328A: Simulations and Tools for Telecommunications, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Risto Vuohtoniemi
Opintokohteen kielet: Finnish
Leikkaavuudet:

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

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Fall, period 2

Learning outcomes:

1. A student recognizes problems and limitations related to simulations.

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

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

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

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

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

7. A student knows basics of one or two fundamental simulation programs

Contents:

Simulation methods, modelling communication systems with simulations, confidence limits of simulation, noise generation and modelling of fading channel. A simple baseband simulation example. Basics of MATLAB and OPNET simulation software (these could vary depending on needs/availability).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h (including program introductions), and the compulsory assignment with a simulation program (40 h).

Target group:

3rd year bachelor's degree students

Prerequisites and co-requisites:

Telecommunication Engineering

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Selected parts (informed in the notes) of Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems, Modeling Methodology and Techniques, 2nd edition. Plenum Press, 2000. Additional reading: William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Risto Vuohtoniemi

Working life cooperation:

No

521384A: Basics in Radio Engineering, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, 1st period

Learning outcomes:

1. can define what radio engineering is and list its separate areas.

2. understands the meaning of Maxwell's equations and can solve the propagation of radio waves in a homogeneous medium

3. can solve EM-fields at an interface of two lossless media.

4. knows main properties of most common transmission line types and can solve EM-fields for coaxial lines and rectangular waveguides.

5. can utilize the methods based on the Smith chart for the impedance matching of microwave circuits and antennas.

6. understands the meaning of Y-, Z-, and S-matrix and can use S-parameters for solving charasteristics of microwave circuits.

7. can describe the operation of passive transmission line devices, resonators, filters and circuits based on the semiconductor devices.

8. knows the terms to describe antenna charasteristics and can define radiation patterns of simple antennas and antenna arrays.

9. knows different propagation phenomena and can evaluate, which phenomena are relevant in different radio systems in different frequency bands.

10. can describe the structure of a typical radio system and can calculate the S/N-ratio linkbudget for a radio system on a free-space radio link.

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.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 26 h and exercises 16 h including graded exercise problems.

Target group:

3 rd year bachelor’s degree students.

Prerequisites and co-requisites:

Elementary knowledge of the electromagnetic theory.

Recommended optional programme components:

-

Recommended or required reading:

In Finnish: Antti Räisänen & Arto Lehto: Radiotekniikan perusteet. Otatieto, 2011; also older versions of the book can be used as a course book. 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.

Assessment methods and criteria:

The course is passed with a final examination.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Erkki Salonen

Working life cooperation:

-

521370A: Laboratory Exercises in Telecommunication Engineering, 5 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha-Pekka Mäkelä
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Fall, period 2

Learning outcomes:

1. is able to use a spectrum analyzer for basic radio frequency measurements.
2. can operate a vector signal analyzer and analyze the obtained results.
3. has skills to measure and analyze basic properties of a radio frequency amplifier and other components used in radio systems.
4. is capable of 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. Radio channel measurements.

Mode of delivery:

Independent work in a laboratory.

Learning activities and teaching methods:

Exercises including measurements and documentation of results.

Target group:

3 rd year bachelor's degree students

Prerequisites and co-requisites:

Telecommunication Engineering (I-II), Basics of Radio Engineering

Recommended optional programme components:

-

Recommended or required reading:

Laboratory exercise manual(s)

Assessment methods and criteria:

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

Grading:

The course unit utilizes a numerical grading scale 1-5.
Read more about assessment criteria at the University of Oulu webpage.

Person responsible:

Juha Mäkelä/Risto Vuohtoniemi

Working life cooperation:

-

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A	Broadband Communications Systems	4.0 op
521433A	Laboratory Exercises on Analogue Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, periods 1-2

Learning outcomes:

1. is able to design basic electronic structural blocks and verify their functionality in a CAD simulation environment.

2. is able independently to realize and test a small-scale design object employing analogue circuit techniques.

Design exercises to deepen the understanding of the material presented in Principles of Electronics Design and Analogue Electronics I.

Contents:

Passive RC-circuits, diodes and their applications, bipolar transistor amplifiers, operational amplifiers and their applications, MOS-transistor, tuned circuit and amplifier, oscillator.

Mode of delivery:

Face-to-face teaching, partially independent work

Learning activities and teaching methods:

Independent design and simulating excercise 26 h and guided laboratory work 15 h. Group size is 1 - 2 students.

Target group:

Primarily in electrical engineering students. Other University of Oulu students can complete the course.

Prerequisites and co-requisites:

Student must participate to courses Principles of Electronics Design and Electronics Design I, or he/she must have passed these courses earlier.

Recommended optional programme components:

Parallel to Electronics Design I.

Recommended or required reading:

Lecture notes of Principles of Ekectronic design and Electronics design 1.

Assessment methods and criteria:

Teacher accepts student’s design work and measurement results in laboratory.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course unit utilizes verbal grading scale pass or fail

Person responsible:

Kari Määttä

Working life cooperation:

No

521287A: Introduction to Computer Systems, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521287A	Introduction to Computer Systems (OPEN UNI)	5.0 op
521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

Upon completing the course, the student understands the basics of computer architecture and CPU operation.Student knows number systems and data representations in computer.
Student is familiar of I/O operation with peripheral devices in general.
Student is able to implement small programs with the C programming language for general-purpose computers and for embedded systems.
Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Overview of computer architecture and CPU, data types and memory management, interrupts, registers and I/O, general computer and embedded systems programming, basics of the C programming language.

Mode of delivery:

Web-based teaching + face-to-face teaching.

Learning activities and teaching methods:

Lectures (20h), course exercises (10-20h), laboratory exercise (3h) and course project in a group.

Target group:

Students of the University of Oulu

Prerequisites and co-requisites:

Elementary programming 521141P

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Other material will be announced at the course start.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course project in a group. Assessment is based on the exercises and the course project. More detailed information on assessment can be found from the course Web pages in Noppa Portal.

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

Grading:

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

Person responsible:

Teemu Leppänen, Mika Rautiainen.

Working life cooperation:

-

Other information:

521287A Introduction to Computer Systems replaces course 521142A Embedded systems programming for electrical engineering students.

521304A: Filters, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521331A Filters 4.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 3

Learning outcomes:

After the course the student can:
1. draw a pole-zero map for a given transfer function;
2. perform impedance and frequency scaling for component values;
3. choose an appropriate prototype filter and filter degree;
4. synthesize passive RLC filters;
5. synthesize active opamp based filters;
6. can compare various filter technologies;
7. understands the basics of scaling the dynamic range of active filters

Contents:

Filter types and prototypes, component scaling. Synthesis of active and passive filters. Sensitivity analysis and scaling of the dynamic range.

Mode of delivery:

Lectures, excercise and design excercise

Learning activities and teaching methods:

30 h lectures, 14 h exercises. A deign excercise.

Target group:

Finnish electrical engineering students

Prerequisites and co-requisites:

Basics of circuit theory, Bode plots and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

van Valkenburg: Analog Filter Design, 1982, chapters1-14, 18 ja 20 ; or year 2001 edition chapters 1-13.

Assessment methods and criteria:

Circuit is examined by a final exam. Also the obligatory design exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S	Statistical Signal Processing 1	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

1. is able to utilize the generic linear model as a representation for parameter estimation

2. can apply typical deterministic and random parameter estimation methods for different estimation problems

3. is able to determine statistical properties of estimators and make comparisons between them

4. can form a basic state-variable model and utilize Kalman filtering for state estimation

5. is able to apply basic methods of detection theory for solving simple detection problems

6. can implement the learned methods and assess their statistical properties with the Matlab software

Contents:

This course provides basic knowledge of statistical signal processing, in particular, estimation theory and its applications in signal processing. Topics: 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.

Mode of delivery:

Face-to-face teaching and homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab homework assignments (20 h).

Target group:

Computer Science and Engineering students and other Students of the University of Oulu.

Prerequisites and co-requisites:

031078P Matrix Algebra, 031021P Probability and Mathematical Statistics

Recommended optional programme components:

521337A Digital Filters, 031050A Signal Analysis. These courses provide complementary information on digital signal processing and stochastic signals. The courses are recommended to be studied either in advance or simultaneously.

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.

Assessment methods and criteria:

The course is passed with intermediate exams or final exam and accepted Matlab exercise.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

A451124: Module Preparing for the Option, Prerequisite for Physics Teacher Education (obligatory), 20 - 31 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

The module includes 30 cr compulsory courses

802357A: Euclidean Spaces, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opettajat: Ville Suomala
Opintokohteen kielet: Finnish
Leikkaavuudet:

802352A Euclidean Topology 4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

Subject teachers: 2. year 2. period

Learning outcomes:

After passing the course the student
- will be able to define basic topological concepts
- will be able to handle sequences
- will be able to justify basic properties of continuous vector valued functions

Contents:

Sequences, continuity and limit of a vector valued function, basic topological concepts

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

28 hours of lectures, 14 hours of excercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802151P Introduction to mathematical deduction,
802161P Introduction to real functions,
802162P Continuity and limits

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

Fail, 1-5

Person responsible:

Maarit Järvenpää

Working life cooperation:

-

Other information:

-

802164P: Series and Integral, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

800318A	Integral	5.0 op
802353A	Series and Integrals	6.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

1st year, 4th period

Learning outcomes:

After completing the course, the student is able to
- operate with series
- define and calculate Riemann integrals
- formulate the Fundamental Theorem of Calculus and apply it to evaluate integrals

Contents:

The course is continuation for the courses Continuity and Limit and Derivative. The goal is the same as in the prerequisite courses, that is, to develop mathematical thinking and extend the knowledge of mathematical analysis. The contents of the course are series and Riemann integral. A central result is the Fundamental Theorem of Calculus that connects the Riemann integral to antiderivative.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h exercises, 14h exercises, 91h independent study

Target group:

Mathematics major and minor students

Prerequisites and co-requisites:

802162P Continuity and Limit
802163P Derivative

Recommended optional programme components:

-

Recommended or required reading:

lecture notes

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Mahmoud Filali

Working life cooperation:

No

Other information:

-

802151P: Introduction to mathematical deduction, 5 op

Voimassaolo: 01.08.2009 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay802151P	Introduction to mathematical deduction (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

Finnish

Timing:

First period at the first semester.

Learning outcomes:

After completing the course, student

- is able to use different methods proving techniques
- is able to use basic set theoretic concepts and definitions
- is able to define and apply basic definitions related to functions

Contents:

The course in an introduction to mathematical deduction and introduces different types of proof techniques. The course covers the concepts familiar from upper secondary school studies more profound way. Main concepts in this course are basic set theory and functions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30h, exercises 18h

Target group:

Major and minor students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

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

Grading:

Pass/Fail

Person responsible:

Maarit Järvenpää

Working life cooperation:

-

Other information:

Course homepage: https://noppa.oulu.fi/noppa/kurssi/802151p/etusivu

806113P: Introduction to Statistics, 5 op

Voimassaolo: 01.01.2011 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Hanna Heikkinen

Opintokohteen oppimateriaali:

Wild, Christopher J. , , 2000
Grönroos, Matti (2) , , 2003

Opintokohteen kielet: Finnish

Leikkaavuudet:

806118P Introduction to Statistics 5.0 op
806119P A Second Course in Statistics 5.0 op
806116P Statistics for Economic Sciences 5.0 op

ECTS Credits:

5 cr

Language of instruction:

Finnish

Timing:

3rd period. It is recommended to complete the course at the 1st spring semester.

Learning outcomes:

Upon completion of the course, student will be
- able to identify and define the main principles of statistical research, collection of the data and analysis
- able to apply basic methods of descriptive statistics and statistical inference in simple quantitative research using a statistical software
- able to critically evaluate results of the statistical research presented in media
- prepared for teaching statistics in secondary school and high school
- prepared for participating in a group.

Contents:

- the nature and the meaning of statistics
- data and the acquisition of them: observations, variables, measuring and designs of a study
- the descriptive statistics of empirical distributions: tables, graphical presentations and descriptive measures of center, variation and dependence
- the principles and the basic methods of statistical inference: random sample, sample statistics, point estimation, confidence intervals and statistical testing of hypotheses

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 16 h (partly compulsory) / instructed group work (28 h) / independent work 80 h. Group works will be returned. Additional independently implemented learning diary tasks. Independent work contains also preparation for group work and peer assessment.

Target group:

Students of mathematical sciences and other interested students.

Prerequisites and co-requisites:

The recommended prerequisite prior to enrolling for the course is the completion of the courses: 802151P Introduction to mathematical deduction, 802154P Elementary functions, 802155P Continuity and limit ja 801195P Introduction to Probability Theory.

Recommended optional programme components:

After the course, student is able to continue other statistics courses.

Recommended or required reading:

Lecture notes.

Assessment methods and criteria:

This course utilizes continuous assessment. Practical works and learning diaries are assessed weekly. The assessment of the course is based on the learning outcomes of the course. The more detailed assessment criteria is available in the beginning of the course. In addition one compulsory lecture and peer assessment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Hanna Heikkinen

Working life cooperation:

No

802328A: Basics in Number Theory, 5 op

Voimassaolo: 01.06.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapani Matala-aho

Opintokohteen oppimateriaali:
Hardy, G. H., , 1979
Rosen, Kenneth H., , 1993

Opintokohteen kielet: Finnish

ECTS Credits:

5 cr

Language of instruction:

Finnish/English

Timing:

2.-3. year of studies. Timing varies.

Learning outcomes:

As usual in my mathematical studies I shall be able to solve problems arising from the subject and to prove essential theorems starting from the given definitions using the tools applied in the course. More detailed; For example, when I pass the course with the grade 1/5, I shall recognize most definitions and I am able to solve closely related problems. Also I am able to rewrite short proofs with some understanding. When I pass the course with the grade 5/5, then I shall understand well the given definitions with the proofs of the theorems deduced from them. Further, I am able to solve challenging problems which demand independent deductions with several stages and applications of appropriate tools.

Contents:

In our lectures we consider arithmetical properties of the common numbers involved in studing mathematics and in particular number theory. Also the methods will get a special interest. Examples of the numbers under the research will be binomials, continued fractions, sums of powers and some numbers sharing a name with the mathematicians Bernoulli, Euler, Fermat, Fibonacci, Heron, Lucas, Mersenne, Neper, Pythagoras, Stirling, Wilson and Wolstenholme. From the tools we mention congruences of rational numbers and polynomials, difference operators, generating series, irrationality considerations, matrix presentations, recurrences and telescopes.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36h lectures, 18h exercises

Target group:

Major and minor students

Prerequisites and co-requisites:

802354A Lukuteoria ja ryhmät,
802355A Rings, fields and polynomials
802118P Linear algebra I
802119P Linear algebra II
802352A Euclidean topology
802353A Series and integrals

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes,
G.H. Hardy ja E.M. Wright: An Introduction to the Theory of Numbers;
Kenneth H. Rosen: Elementary number theory and its applications.

Assessment methods and criteria:

Mid-term exams or final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Tapani Matala-aho

Working life cooperation:

-

766344A: Nuclear and particle physics, 5 op

Voimassaolo: 01.12.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

766330A-01	Structure of matter, part 1: Solid state physics	0.0 op
766330A-02	Structure of matter, part 2: Nuclear and particle physics	0.0 op
766334A	Nuclear and particle physics	2.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

2nd spring

Learning outcomes:

The student can explain the basic principles of nuclear and particle physics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.

Contents:

This course deals with the structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of fundamental particles, and unified theories of fundamental interactions.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30 h, 8 exercises (16 h), self-study 87 h

Target group:

Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766322A/766348A).

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part). Additioanl material available from the web pages of the course.
Course material availability can be checked here.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Juhani Lounila

Working life cooperation:

No work placement period

Other information:

Course website

A451125: Module Preparing for the Option, Prerequisite for Physics Teacher Education (optional), 9 - 30 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Choose mathematics and physics courses 10 ECTS cr to your degree.

802320A: Linear Algebra, 5 op

Voimassaolo: 01.06.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Mathematics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

802119P Linear Algebra II 5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd year, 1st period

Learning outcomes:

On successful completion of this course, the student will be able to

- apply the definition of linear space and concepts associated with linear spaces such as basis
- work with linear mappings and their matrix representations
- apply the definition of inner product space and concepts associated with inner product spaces such as orthogonality
- prove results related to linear spaces

Contents:

The aim of the course is to provide the student with the knowledge needed in almost all later courses in mathematics: abstract vector spaces and subspaces, linear independence and bases, inner product spaces, linear mappings and concepts associated with linear mappings such as kernel, eigenvalues and eigenvectors.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

28h lectures, 14h exercises, 91h independent study

Target group:

Mathematics majors and minors students

Prerequisites and co-requisites:

802120P Introduction to Matrices

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Final exam

Grading:

1-5, fail

Person responsible:

Pekka Salmi

Working life cooperation:

No

Other information:

-

523990A: Bachelor's Thesis / Electrical Engineering, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:
8
Language of instruction:
Finnish, can be written in English if needed.
Timing:
Periods 1-6
Learning outcomes:
The student is able to set objectives for a given assignment. He/she is able to analyze the theme coherently, with emphasis on the key issues. The student is able to use sources of information critically. The student is able to present the planned and implemented solution clearly and to justify the choices he/she took, and to assess the functionality of the solution using relevant testing and evaluation methods. In addition, he/she is able to compare the

results against the set objectives. The student is able to produce impeccable, clear and finalized text, in line with technical and scientific writing practices.
Contents:
The student chooses the theme for the thesis in cooperation with his/her supervisor.
Mode of delivery:
The thesis is written towards the end of the BSc studies, typically during the third year.
Learning activities and teaching methods:
Independent work.
Target group:
Students of Electrical Engineering.
Prerequisites and co-requisites:
Basic studies.
Recommended optional programme components:
BSc preparatory module, Technical communication.
Recommended or required reading:
-
Assessment methods and criteria:
BSc thesis and related maturity essay.
Grading:
Grading: pass/fail.
Person responsible:
Professors and researchers in the Departments of Electrocal Engineering and Communications Engineering.
Working life cooperation:
Yes.
Other information:
-

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

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

Proficiency level:
-
Status:
This course unit is compulsory for students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.
Required proficiency level:
-
ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
1st year: Process and Environmental Engineering
3rd year: Mechanical Engineering; Electrical Engineering, Computer Science and Engineering and Communications Technologies

Mode of delivery:
Multimodal teaching
Learning activities and teaching methods:
Contact hours ca. 20 h and independent group work or self-study ca. 34 h.

Target group:
Bachelors students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-
Recommended or required reading:
Kauppinen, Anneli & Nummi, Jyrki & Savola, Tea: Tekniikan viestintä: kirjoittamisen ja puhumisen käsikirja (EDITA); Nykänen, Olli: Toimivaa tekstiä: Opas tekniikasta kirjoittaville (TEK) and material in Optima study environment.
Assessment methods and criteria:
Active participation in contact teaching, independent study and completion of given assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass / fail
Person responsible:
Kaija Oikarainen
Toropainen, Outi
Working life cooperation:
-
Other information:
All students are required to attend the first meeting of the course unit so the work groups can be formed and work started in a timely and efficient manner. When signing up for the course unit, you should keep in mind that completing it requires a responsible attitude and a strong commitment to the work because the teamwork-based exercises rely heavily on the participation and activity of the students.
If the student is involved in the University's student associations or functions in a position of trust in university government, student union administration or Oulun Teekkariyhdistys ry (or in its subordinate guilds), he/she may be relieved of some of the group communication exercises. These compensatory actions must always be agreed upon separately with the course unit's teacher. The student must present an official statement from a person in charge of the governing body or association, which details the student's tasks and involvement with that body or association. Participation that took place over five years ago does not entitle the student to any compensation.

523993A: Bachelor's Thesis / Telecommunication Engineering, 8 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Required proficiency level:
8
ECTS Credits:
8
Language of instruction:
Finnish; English if needed.
Timing:
Periods 1-6
Learning outcomes:
The student is able to set objectives for a given assignment. He/she is able to analyze the theme coherently, with emphasis on the key issues. The student is able to use sources of information critically. The student is able to present the planned and implemented solution clearly and to justify the choices he/she took, and to assess the functionality of the solution using relevant testing and evaluation methods. In addition, he/she is able to compare the results against the set objectives. The student is able to produce impeccable, clear and finalized text, in line with technical and scientific writing practices.
Contents:
The student chooses the theme for the thesis in cooperation with his/her supervisor.
Mode of delivery:
The thesis is written towards the end of the BSc studies, typically during the third year.
Learning activities and teaching methods:

Independent work.
Target group:
Students of Electrical Engineering.
Prerequisites and co-requisites:
Basic studies.
Recommended optional programme components:
BSc preparatory module, Technical communication.
Recommended or required reading:
-
Assessment methods and criteria:
BSc thesis and related maturity essay.
Grading:
Grading: pass/fail.
Person responsible:
Professors and researchers in the Departments of Electrocal Engineering and Communications Engineering.
Working life cooperation:
Yes.
Other information:
-

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

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

Proficiency level:
-
Status:
This course unit is compulsory for students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.
Required proficiency level:
-
ECTS Credits:
2 credits
Language of instruction:
Finnish
Timing:
1st year: Process and Environmental Engineering
3rd year: Mechanical Engineering; Electrical Engineering, Computer Science and Engineering and Communications Technologies

Mode of delivery:
Multimodal teaching
Learning activities and teaching methods:
Contact hours ca. 20 h and independent group work or self-study ca. 34 h.
Target group:
Bachelors students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.
Prerequisites and co-requisites:
-
Recommended optional programme components:
-

Recommended or required reading:
Kauppinen, Anneli & Nummi, Jyrki & Savola, Tea: Tekniikan viestintä: kirjoittamisen ja puhumisen käsikirja (EDITA); Nykänen, Olli: Toimivaa tekstiä: Opas tekniikasta kirjoittaville (TEK) and material in Optima study environment.
Assessment methods and criteria:
Active participation in contact teaching, independent study and completion of given assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass / fail
Person responsible:
Kaija Oikarainen
Toropainen, Outi
Working life cooperation:
-
Other information:
All students are required to attend the first meeting of the course unit so the work groups can be formed and work started in a timely and efficient manner. When signing up for the course unit, you should keep in mind that completing it requires a responsible attitude and a strong commitment to the work because the teamwork-based exercises rely heavily on the participation and activity of the students.
If the student is involved in the University's student associations or functions in a position of trust in university government, student union administration or Oulun Teekkariyhdistys ry (or in its subordinate guilds), he/she may be relieved of some of the group communication exercises. These compensatory actions must always be agreed upon separately with the course unit's teacher. The student must present an official statement from a person in charge of the governing body or association, which details the student's tasks and involvement with that body or association. Participation that took place over five years ago does not entitle the student to any compensation.

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

801389A: Basic Geometry, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

801399A Geometry 5.0 op

ECTS Credits:
6 cr
Language of instruction:
Finnish
Timing:
After the second year at the earliest
Learning outcomes:
After completing the course, a student
- understands the fundamental concepts and results of Euclidean geometry
- can construct basic geometric proofs
- can perform compass-and-straightedge constructions
- can solve basic geometric problems related to applications

Contents:
The course focuses on basic geometric concepts and results familiar from school from an axiomatic angle. We construct geometric theory starting from a set of basic axioms systematically with theorems and their proofs. Most results in the course are familiar to students from junior high and high school, but the course offers a deeper understanding to the founding mathematics behind geometry curriculum in schools, and the birth of axiomatic mathematics.
The majority of the course is dedicated to planar geometry. We also learn to perform classical compass-and-straightedge constructions. Towards the end of the course we extend our examination to three dimensions. In

solid geometry we focus on the relations between lines and planes in space and properties of three-dimensional solids. At the end of the course we briefly look into non-Euclidean geometries.
Learning activities and teaching methods:
Summer course
36 hours of face-to-face teaching
Independent studying in groups
In addition an optional research project
Prerequisites and co-requisites:
Mandatory first year courses.
Recommended or required reading:
Lecture notes of Matti Lehtinen and extra material.
Assessment methods and criteria:
Final exam and an optional research project.
If a student only attends (and passes) the final exam, the course is completed as a 6 ECTS A-course (intermediate). Students can also choose to do an additional research project. After passing the final exam and writing a short research project about some topic in geometry, the course is completed as a 6 ECTS S-course (advanced). If the student already has the course completed, it is possible to write the research project as a separate 3 ECTS S-course (advanced).
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5, fail
Person responsible:
Emma Leppälä
Other information:
Course website in Noppa.

780109P: Basic Principles in Chemistry, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Chemistry

Arvostelu: 1 - 5, pass, fail

Opettajat: Minna Tiainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

780120P	Basic Principles in Chemistry	5.0 op
ay780117P	General and Inorganic Chemistry A (OPEN UNI)	5.0 op
780117P	General and Inorganic Chemistry A	5.0 op
780115P	General and Inorganic Chemistry II	6.0 op
780114P	General and Inorganic Chemistry I	6.0 op
780113P	Introduction to Chemistry	12.0 op
780101P	Introduction to Physical Chemistry	7.0 op
780101P2	Physical Chemistry I	4.0 op
780107P	Basic Course in Inorganic and Physical Chemistry	7.5 op
780152P	Inorganic and Physical Chemistry I	7.5 op
780153P	General and Inorganic Chemistry	7.5 op
780154P	Basic Inorganic Chemistry	7.5 op

ECTS Credits:
4 credits/107 hours of work
Learning outcomes:

Learning activities and teaching methods:
The course is not lectured any more. There are final examinations of the course during the academic years 2015-2016 and 2016-2017.
Person responsible:

Lecturer Minna Tiainen

761668S: Computational physics and chemistry, 6 op

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

ECTS Credits:
6 credits
Language of instruction:
English
Timing:
Not lectured every year.
Learning outcomes:
After successful completion, student has a basic knowledge of computer simulation methods to study the microscopic systems (atoms, molecules and solids) in physics, chemistry, bio- and materials sciences. Student understands the application possibilities and restrictions of the methods and has versatile capabilities to use them in solving of various problems.
Contents:
The course builds a foundation for further studies of computational physics and chemistry and the use of these methods in research.
Subjects: electronic structure of finite systems, solid-state electronic structure, Monte Carlo and molecular dynamics simulations, quantum simulations, least-squares method, neural networks and genetic algorithms.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 35 h, 4 practical works, self-study 125 h
Target group:
Advanced undergraduate students in physics, chemistry and materials sciences and graduate students.
Prerequisites and co-requisites:
Atomic Physics 1 (766326A), Thermophysics (766328A), and Molecular Quantum Mechanics (761661S) courses or comparable knowledge. Basic programming and computer abilities.
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Lecture notes based on: Leach: Molecular Modelling: Principles and Applications, 2nd ed. (Prentice Hall, 2001). Jensen: Introduction to Computational Chemistry (Wiley, 1999). Allen and Tildesley: Computer Simulation of Liquids (Oxford, 1987) .Atkins and Friedman: Molecular Quantum Mechanics, 4th ed. (Oxford, 2005). Thijssen: Computational Physics (Cambridge, 1999). Giordano and Nakanishi: Computational Physics, 2nd ed. (Pearson, 2006). Pang: An Introduction to Computational Physics, 2nd ed. (Cambridge, 2006). Hill, Subramanian, and Maiti: Molecular Modeling Techniques in Material Sciences, (CRC, Taylor&Francis, 2005).
Course material availability can be checked here.
Assessment methods and criteria:
One written examination.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Perttu Lantto
Working life cooperation:
No work placement period
Other information:
https://wiki.oulu.fi/display/761668S/

763628S: Condensed matter physics, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

763636S Condensed matter physics 5.0 op

ECTS Credits:
10 credits
Language of instruction:
English
Timing:
3th -5th year
Learning outcomes:
To learn to apply quantum mechanics and statistical physics to solid state, in particular to crystal structure and scattering from it, electronic structure and transport properties in noninteracting electron model, interacting electron gas and lattice vibrations.
Contents:
Modern technology is largely based on the understanding of condensed matter. Condensed matter has many interesting physical properties that are consequences of large number of particles and their interactions. The course starts with crystal structure of solids and its studies by scattering experiments. Surfaces and more complicated structures are discussed briefly. The electronic structure is first studied using free electron picture. The effect of crystal lattice is studied as small perturbation as well as starting from localized atomic states. The Coulomb interaction between electrons is studied using Hartree-Fock equations. Lattice vibrations are studied using simple models and the lattice specific heat is calculated. Electron dynamics is studied using semiclassical equations. Electrical and thermal conduction is solved using Boltzmann equation.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 50 h, 12 exercise sessions (24 h), self-study 193 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
763333A Solid state physics, 763312A Quantum mechanics I, 766328A Thermophysics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Michael P. Marder: Condensed Matter Physics. N.W. Ashcroft & N.D. Mermin: Solid state Physics.
Course material availability can be checked here.
Assessment methods and criteria:
One written examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:
Matti Alatalo
Working life cooperation:
No work placement period
Other information:
Course website

477622A: Control System Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477603A Control System Design 4.0 op

ECTS Credits:
5 ECTS / 133 hours of work
Language of instruction:
Finnish
Timing:
Period 3 (spring term)
Learning outcomes:
After completing the course the students can apply mathematical and graphical methods to the dynamics of process characterisation and control design. The student can form PID controllers for the process, and tune them and evaluate the closed-loop requirements.
Contents:
Laplace-level vs, time level, poles of the system, closed loop and its design specifications, PID control and tuning, Matlab control designer tool, control design in frequency domain
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures and exercises
Target group:
B.Sc. students in process and environmental engineering
Prerequisites and co-requisites:
The courses 477011P Introduction to process and environmental engineering I, 488010P Introduction to process and environmental engineering and 477602A Control system analysis recommended beforehand
Recommended optional programme components:
None
Recommended or required reading:
Lecture and exercise handouts. Åström, K & Murray, R. (2009) Feedback Systems, An Introduction for Scientists and Engineers. Princeton University Press, New Jersey, 396 s. Additional literature: Dorf, R (2010) Modern Control Systems. Prentice-Hall, New York, 1104 s., DiStefano, J (1990) Schaum's Outline of Feedback and Control Systems. 2nd ed, McGraw-Hill, 512 s. ja Ylen, J-P (1994) Säätötekniikan harjoitustehtäviä. Hakapaino Oy, 252 s.
Assessment methods and criteria:
Exam
Grading:
Numerical grading scale 1-5 or fail
Person responsible:
Professor Enso Ikonen and university teacher Seppo Honkanen
Working life cooperation:
No
Other information:
-

521223S: Electronic and Optoelectronic Materials, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521275A: Embedded Software Project, 8 op

Voimassaolo: 01.08.2007 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning, Teemu Tokola
Opintokohteen kielet: English

ECTS Credits:
8
Language of instruction:
Material in English, lectures and guidance of individual groups available in English.
Timing:
Autumn and Spirng, periods 2-4.
Learning outcomes:
1. Can work independently on a non-trivial problem

2. Knows how to write a thesis and has gained lot of experience on refining text

3. Can make a scientific background study on a topic

4. Has increased experience on implementing an embedded software

5. Has improved group work and project skills
Contents:
This course familairizes the student with modern embedded system development with modern methods and tools. Topics: Development tools, practical application program for an embedded system. The students additionally work on the application topic through scientific papers and use their application program to produce a scientific work of their own.
Mode of delivery:
Face-to-face teaching, independent project work in groups.
Learning activities and teaching methods:
Pair project with monitoring meetings and a compulsory exercise. Lectures 30 h, design exercise in period 4-6 180 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
521457A Software Engineering, 521286A Computer Systems or 521142A Embedded Systems Programming. In addition, 521453A Operating Systems be beneficial.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Course website, hardware data sheets and manuals, scientific publications.
Assessment methods and criteria:
Project report and a demonstrated implementation.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Juha Röning, Teemu Tokola
Working life cooperation:
The topics of the course are relevant research topics with applications in the industry, and visiting lecturers are occasionally arranged to shed light on how the course topics are applied in the industry.
Other information:
The 521275A course offers the possibility to complete your Bachelor thesis in a structured course environment. The course is suitable also for students who do not use the course for their Bachelor Thesis.

902144Y: Environmental Issues, 2 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:
CEFR B2 - C1 (All Levels)
Status:
This module can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK), Faculty of Information Technology and Electrical Engineering (TST), and Oulu Mining School (KaTk).
Required proficiency level:
English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.
ECTS Credits:
2 ECTS credits. The workload is 53 hours.
Language of instruction:
English
Timing:
spring semester
Learning outcomes:
By the end of the module, you are expected to
- have demonstrated the use of a good vocabulary related to environmental matters
- be able to discuss environmental issues with a reasonable degree of fluency
- be able to present clear, detailed descriptions and viewpoints on topics related to the environment.

Contents:
This integrated language course focuses on the four language skills of speaking, listening, reading and writing. An important aim of the course is to help you to develop your vocabulary on environmental topics.
The subject matter for the course will draw on interdisciplinary materials, and you will increase your knowledge of up-to-date environmental topics. You will be required to consider controversial issues and be prepared to contribute your own opinions in debate within the class.
Mode of delivery:
Contact teaching and independent study
Learning activities and teaching methods:
The course meets regularly for two hours per week for most of the term. Active participation is essential. Homework consists of some reading, one piece of written work, and the preparation of three short presentations, which will be given in class to small groups of students.
Target group:
Students in the engineering programmes (TTK and TST)
Prerequisites and co-requisites:
-
Recommended optional programme components:
This module is an elective course which follows PET for students in the engineering programmes (TTK and TST).
Recommended or required reading:
Course materials will be provided by the teacher.
Assessment methods and criteria:
Participation in lectures and tutorials is required. Course assignments must be completed, and continuous assessment will be used.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
See contact teachers
Working life cooperation:
-
Other information:
-

521150A: Introduction to Internet, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Timo Koskela
Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
All materials are in English, lectures are given in Finnish.
Timing:
Spring, period 4.
Learning outcomes:
1. is able to explain the design principles, architecture, functionality and challenges of the public internet

2. understands data link layer's role and most important access network technologies

3. is able to explain the structure and most important protocols of the TCP/IP protocol stack

4. knows most important internet applications and their protocols

5. understands the principles of internet security and multimedia applications

6. is able to solve simple internet related problems

7. is able to program a small internet application
Contents:
Internet’s design principles and architecture, data link layer and most important access network technologies, TCP /IP protocol stack and its most important protocols, most important Internet applications, principles of Internet security and multimedia, internet's challenges and Future Internet.
Mode of delivery:
Face-to-face teaching.
Learning activities and teaching methods:
Lectures 32 h / problem solving exercises 14 h / laboratory exercises 12 h / course work 25 h / self-study 52 h. Problem solving exercises, laboratory exercises and course work are completed as group work.
Target group:
Computer Science and Engineering students, Information Processing Science students, other students of the University of Oulu.
Prerequisites and co-requisites:
None.
Recommended optional programme components:
-
Recommended or required reading:
Announced at the beginning of the course.
Assessment methods and criteria:
The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory course work.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course uses numerical grading scale 1-5.
Person responsible:
Dr. Timo Koskela.
Working life cooperation:
-

802119P: Linear Algebra II, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

802320A Linear Algebra 5.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish
Timing:
First year, 4. period
Learning outcomes:
On successful completion of this course, the student will be able to
- basic properties of inner product spaces
- linear mappings, their matrix representation, and eigen values
- determinants and apply them to problems relating to matrices and linear mappings
Contents:
The aim of the course is to provide the student with the knowledge needed in almost all later courses in mathematics: Abstract vector spaces and subspaces, Linear independence and bases, Inner product spaces, Linear mappings, Determinants, Eigenvalues and Eigenvectors, Hermitian matrices and quadratic forms.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
35 h lectures, 21 h exercises
Target group:
Major and minor students
Prerequisites and co-requisites:
802119P Linear algebra I
Recommended optional programme components:
-
Recommended or required reading:
Lecture notes
Assessment methods and criteria:
Midterm exam or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Esa Järvenpää
Working life cooperation:
-

521216S: Microelectronics Packaging Technology and Reliability, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

ECTS Credits:
7
Language of instruction:
In Finnish.
Timing:

4-6

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 mechanisms 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. Methods of environmental testing, screening, and quality control.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

Lectures 28h / group work 30h / working with research machines 12h / self-study 119h.

Target group:

Major students.

Prerequisites and co-requisites:

Recommended Introduction to Microelectronics and Micromechanics

Recommended optional programme components:

Advanced course Micromodules

Recommended or required reading:

Rao R. Tummala(edit): Fundamentals of microsystems packaging, New York, McGraw-Hill, 2001. Parts of Ken Gilleo: Area Array Packaging Handbook: Manufacturing and Assembly, McGraw-Hill, 2002 and J.J. Licari, L.R. Enlow: Hybrid Microcircuit Technology Handbook: Materials, processes, Design, Testing and Production, Noyes Publications, 1998. William D. Brown (edit.): Advanced Electronic Packaging. With Emphasis on Multichip Modules. IEEE, Inc., 1999, chapters 11 and 16. Patrick D.T. O'Connor: Practical Reliability Engineering, John Wiley&Sons, 2002 chapters 8 and 9.

Assessment methods and criteria:

This course unit utilizes continuous assessment. The course can also be completed with the final exam. The assessment of the course unit is based on the learning outcomes of the course unit. Passed exam and practice work are needed for the course completion.

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

Grading:

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

Person responsible:

Jari Hannu

Working life cooperation:

-

Other information:

-

A451224: Module of the Option, Telecommunication Engineering, 40 - 41 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Module of the Option

Laji: Study module

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

800322A: Multidimensional analysis, 8 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

800328A	Calculus of several variables	5.0 op
802351A	Vector Calculus	5.0 op

ECTS Credits:
8 cr
Language of instruction:
Finnish
Timing:
Second year, periods 1-2
Learning outcomes:
On successful completion of this course, the student will be able to
- differentiate multivariate functions
- apply the derivative to minimization problems
- define and use multidimensional integrals
Contents:
The course deals with multidimensional real calculus.
The course provides an introduction to vector-valued functions of one variable, their derivatives and path integrals.
The central notion of the course is the derivative of vector-valued function of several variables (including the gradient of a real-valued function of several variables). In the course we develop the Riemann integral of a real-valued function of two variables. The course provides basic tools for advanced courses in analysis and for applications (such as physics).
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
56 h lectures, 28 h exercises, 129 h self-study.
Target group:
Major and minor students in mathematics.
Prerequisites and co-requisites:
Linear algebra I
Linear algebra II
Euclidean topology
Series and integrals

Recommended optional programme components:
-
Recommended or required reading:
- Baxandall, Liebeck: Vector calculus, Oxford University Press, 1986.
- lecture notes.
Assessment methods and criteria:
Midterm exams or final exam
Read more about assessment criteria at the University of Oulu webpage.
Grading:
0-5
Person responsible:
Pekka Salmi.
Working life cooperation:
No

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Nyländen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S DSP Laboratory Work 5.0 op

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

902148Y: Negotiations and Meeting Skills, 2 op

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:
CEFR Level: B2 - C1 (All levels)
Status:

This module can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK), Faculty of Information Technology and Electrical Engineering (TST), and Oulu Mining School (KaTk). Groups may also include students from other faculties.
Required proficiency level:
English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.
ECTS Credits:
2 credits. The workload is 53 hours
Language of instruction:
English
Timing:
autumn semester
Learning outcomes:
By the end of the module, you are expected to

- have used communication skills and strategies for effective participation in meeting and negotiation situations
- have demonstrated sensitivity to social and cultural aspects of meetings and negotiations
- be able to initiate, maintain and end topics in discussion with effective turn-taking
- have used appropriate technical vocabulary for meetings and negotiations.

Contents:
This course is designed to allow you to learn the language of meetings and negotiations. The course focuses on business situations and includes pre-reading in preparation for simulated meeting and negotiation situations. Active participation in the activities is required. The simulations chosen reflect typical situations in the working world. They include choosing locations for future facilities, diversifying a product range, business and the environment, industrial relations, financial negotiations, and acquiring a bank loan for a business.
Mode of delivery:
Contact teaching
Learning activities and teaching methods:
Lessons 26 hours / independent work 27 hours.
Target group:
Students in the engineering programmes (TTK and TST)
Prerequisites and co-requisites:
-
Recommended optional programme components:
This module is an elective course which follows PET for students in the engineering programmes (TTK and TST).
Recommended or required reading:
Course materials will be provided by the teacher.
Assessment methods and criteria:
This is based on a continuous evaluation of the student's active participation in class, pre-reading assignments, in-class written tasks, and overall progress. The student is also expected to pass a test on meetings vocabulary. Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
See contact teachers
Working life cooperation:
-
Other information:
-

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:

5
Language of instruction:
Finnish
Timing:
Spring semester, periods 4-5
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 linear algebra. Numerical methods for systems of equations, Basics of the approximation theory. Numerical quadratures. Numerical methods for ordinary and partial differential equations.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 44 h / Group work 22 h.
Target group:
-
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations and Matrix algebra.
Recommended optional programme components:
-
Recommended or required reading:
J. Douglas Faires and Richar L. Burden, Numerical methods; Alfio Quarteroni, Riccardo Sacco, Fausto Saleri, Numerical mathematics
Assessment methods and criteria:
Intermediate exams or a final exam.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5.
Person responsible:
Marko Huhtanen
Working life cooperation:
-
Other information:
-

031051S: Numerical Matrix Analysis, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:
5
Language of instruction:
Finnish (English if necessary).
Timing:
1-2
Learning outcomes:
After completing the course the student knows the most efficient and numerically stable methods to solve the basic problems in linear algebra. The student has the capability to solve very large systems with the iterative solutions methods and understands the concept of preconditioning.
Contents:

The theory of matrix decompositions, SVD-decomposition, LU-decomposition, QR-decomposition, Schur-decomposition, FFT, eigenvalue- and generalized eigenvalue problems, matrix functions, GMRES, MINRES, Preconditioning.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 40 h / Group work 20 h.
Target group:
-
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra, Numerical Methods.
Recommended optional programme components:
-
Recommended or required reading:
M. Huhtanen, Matrix Computations (opintomoniste), G. Golub and C. van Loan, Matrix Computations.
Assessment methods and criteria:
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Marko Huhtanen
Working life cooperation:
-
Other information:
-

521015A: Practical Training, 3 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Maritta Juvani

Opintokohteen kielet: Finnish

ECTS Credits:
3
Language of instruction:
Finnish/English
Timing:
1-6
Learning outcomes:
After the practical training the student can describe one possible future job and its working environment from the point of view of his or her studies. The student can identify problems in the work and suggest improvements. The student can find connections between work and studies.The technical goal of the training is to give a student a general insight into the field on which he or she will work after graduation, as well as support and promote theoretical studying. Likewise the training has to acquaint the trainee with the social aspects of industrial production and with industrial safety.
Contents:
2 month work experience in a suitable organisation, written report.
Mode of delivery:
The students find their training jobs themselves. It is recommended to participate University tuition sessions on training, career planning and employment issues, when available.
Learning activities and teaching methods:
Independent work.
Target group:
BSc students
Prerequisites and co-requisites:
-

Recommended optional programme components:
-
Recommended or required reading:
-
Assessment methods and criteria:
Students submit a training report to the person responsible. More detailed instructions for the training report are available on the WWW pages of the degree program.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Maritta Juvani
Working life cooperation:
Yes
Other information:
Practical training is compulsory in the BSc. Tech (Electrical Engineering) degree for students who started in 2010 or earlier. For students starting 2011 or later, Practical Training is optional.

902146Y: Presentation Skills, 2 op

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:
CEFR B2 - C1 (All Levels)
Status:
This module can be chosen in partial completion of the English language requirement for students in the engineering programmes (TTS and TST). Groups may also include students from other faculties.
Required proficiency level:
English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.
ECTS Credits:
2 credits. The workload is 53 hours.
Language of instruction:
English
Timing:
autumn semester
Learning outcomes:
Learning Outcomes:
After the course, students are expected to be able to:
- use principles of good presentation structuring for optimal clarity
- establish and maintain audience rapport in the presentation setting
- speak to the audience without relying on pre-written material
- use principles of good slideshow design to complement preparation, subject knowledge and English language skills
- use observation of self and others to continue developing and fine-tuning presentation skills

Contents:
The aim of the course is to help students at all levels to better conceptualise what constitutes a good presentation, and to develop their confidence in speaking to and interacting with an audience.
In the early weeks of the course **,** an emphasis on oral exercises in small groups, including short impromptu speeches, supports development in oral fluency. Students are introduced to and discuss key concepts in presentation giving, for example getting started, topic research, organisation of content, clear articulation, use of visual aids, and audience interaction. Thus, students gain confidence through practice in taking the floor, debating points, and giving peer feedback. In the second half of the course, students prepare, rehearse and give their final presentation, which is a longer, more developed academic speech. After the event, using feedback received from teacher and classmates, students write a self-assessment of their own performance.
Mode of delivery:

Contact teaching and independent study
Learning activities and teaching methods:
Lessons 28 hours. Active participation is essential.
Independent work 25 hours.
Target group:
Students in the engineering programmes (TTK and TST)
Prerequisites and co-requisites:
-
Recommended optional programme components:
This module is an elective course which follows PET for students in the engineering programmes (TTK and TST).
Recommended or required reading:
Course materials will be provided by the teacher.
Assessment methods and criteria:
Continuous assessment will pay attention to classroom participation and the quality of completed smaller coursework tasks as well as that of the final presentation.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/Fail
Person responsible:
See contact teachers
Working life cooperation:
-
Other information:
-

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

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: Finnish

Leikkaavuudet:

521362S	Electonics and Communications Engineering Seminar	0.0 op

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

2. Student has experience on presenting her/his topic

3. Student has experience on evaluating other students' presentations

4. Student has a general view of completed diploma theses
Contents:
The content is determined by the diploma work topics and other current research topics.
Mode of delivery:
Seminar presentations
Learning activities and teaching methods:
Seminar sessions when necessary during the whole year.
Target group:
2nd year M.Sc. (after bachelor degree) and WCE students
Prerequisites and co-requisites:
-

Recommended optional programme components:
-
Recommended or required reading:
Instructions for preparing a diploma work in the degree program.
Assessment methods and criteria:
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.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes grading passed.
Person responsible:
Jari Iinatti
Working life cooperation:
-
Other information:
Objective: The aim is to familiarize the students to the diploma work requirements. The students get practice in preparing and giving an oral presentation. At the same time they learn about current research and development projects going on in the university and in the industry.

521486S: Signal Processing Systems, 4 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

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.

766330A: Structure of matter, 6 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

763343A	Solid state physics	5.0 op
763333A	Structure of matter I	4.0 op
766334A	Nuclear and particle physics	2.0 op

ECTS Credits:
6 credits *(Part 1, Solid state physics 4 credits and part 2, Nuclear and particle physics 2 credits)*
Language of instruction:
Finnish
Timing:
Lectured in the spring of 2016.
Learning outcomes:
Part 1, Solid state physics: To learn to explain the basics of solid state physics such as lattice structure, binding interactions, lattice vibrations, band structure and its effect on conductivity, conductivity of semiconductors, the interaction between light and matter, magnetism and superconductivity, and to apply these to different materials.
Part 2, Nuclear and particle physics: The student can explain the basic principles of nuclear and particle physics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
Contents:
Part 1, Solid state physics: The rapid development of technology is largely based on understanding the properties of the solid state. There are many interesting phenomena in solid state physics, which are consequences of very large number of particles and their interactions. The course starts with symmetry of crystal lattices and their experimental determination. Different binding forces of solids are discussed. Lattice vibrations and their contribution to specific heat are studied. Especial emphasis is put on electronic structure, and it is used to explain the electric conduction in metals, insulators and semiconductors. Also experimental methods, magnetism and superconductivity are discussed.
Part 2, Nuclear and particle physics: This part deals with the structure and properties of nuclei, nuclear forces, nuclear models, radioactivity, nuclear reactions, properties and interactions of fundamental particles, and unified theories of fundamental interactions.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Part 1: Lectures 30 h, exercises 16 h, self-study 61 h
Part 2: Lectures 20 h, exercises 10 h, self-study 23 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
Atomic physics 1 (766326A), Electromagnetism (766319A). An important supporting course is Thermophysics (766322A).
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Part 1: C. Kittel: Introduction to solid state physics.
Part 2: Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley,

2012, or earlier editions (in part), R. Eisberg and R. Resnick: Quantum physics of atoms, molecules, solids, nuclei, and particles, John Wiley & Sons (in part). Additioanl material available from the web pages of the course. Course material availability can be checked here.

Assessment methods and criteria:

Both parts of the course have their own separate examinations. The final grade of the course is the weighted average of the grades of part 1 (4 cp) and part 2 (2 cp).

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

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Part 1: Erkki Thuneberg

Part 2: Juhani Lounila

Working life cooperation:

No work placement period

Other information:

https://noppa.oulu.fi/noppa/kurssi/766330A/etusivu

464061A: Techniques of Creative Working, 3 op

Voimassaolo: - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mechanical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Niskanen, Juhani

Opintokohteen kielet: Finnish

Leikkaavuudet:

464104A	Product innovations	5.0 op

ECTS Credits:

3 ects

Language of instruction:

Finnish

Timing:

Lectures during period 1.

Learning outcomes:

The objective of the course for the student to learn to find problems in a familiar environment, analyze them and implement mechanical engineering to solve the problems.

Learning outcomes: Upon completion of the course, the student is able to convert a familiar condition to a problem requiring a technical solution and question existing solutions. The student is able to apply the most important methods of systematic creative working.

Contents:

Analyzing and abstracting of a problem; Connecting a problem to a larger context or its division to minor problems; Applying systematic methods to a defined problem

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course includes an introductory lesson and guided exercises during lessons. The course also includes a separate group work from a topic that has come up during lessons. This course will have an exam and group work. The final grade is the average of exam and group work. Those who have done the exercises during the lessons are required to answer only half of the questions in the exam.

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Jorma Tuomaala: Luovan työn tekniikka.

Assessment methods and criteria:

Final exam and practical work.
Read more about assessment criteria at the University of Oulu webpage.
Person responsible:
prof. Juhani Niskanen
Working life cooperation:
-
Other information:
-

766348A: Thermophysics, 7 op

Voimassaolo: 01.12.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Field of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761314A	Thermophysics	5.0 op
761102P	Basic Thermodynamics	2.0 op
766328A	Thermophysics	6.0 op

ECTS Credits:
7 credits
Language of instruction:
Finnish
Timing:
Third autumn semester
Learning outcomes:
The student can explain the basic principles of thermophysics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
Contents:
The goal of the course is to explain how the macroscopic thermophysical properties of a system (e.g., equation of state) can be derived from its fundamental microscopic properties (e.g., from the behavior of the molecules). For this purpose, the students are given a physically clear understanding of the basic principles of thermophysics, recognizing the fundamental role of its statistical nature. Topics will include: Basic concepts, The first law, Thermal expansion, heat transfer, and diffusion, The second law, The combined law, Heat engines and refrigerators, Thermodynamic potentials, Phases of matter, Classical ideal gas, Classical and open systems, Quantal ideal gas.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h, 12 exercises (24 h), self-study 117 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2015.
Course material availability can be checked here.
Assessment methods and criteria:
Two written intermediate examinations or one final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:

Numerical grading scale 0-5, where 0 = fail
Person responsible:
Juhani Lounila
Working life cooperation:
No work placement period
Other information:
Due to the partial overlap of the subject matters of the courses 761102P Basic Thermodynamics (2 cp) and 766348A Thermophysics (7 cp), exceptionally only 6 cp (not 7 cp) are given for the latter course in the special case that the student has previously completed the course Basic Thermodynamics and has got 2 cp for that.
Course website

766328A: Thermophysics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761314A	Thermophysics	5.0 op
766348A	Thermophysics	7.0 op
761102P	Basic Thermodynamics	2.0 op

ECTS Credits:
6 credits
Language of instruction:
Finnish
Timing:
Third autumn semester
Learning outcomes:
The student can explain the basic principles of thermophysics and can derive their consequences in the extent and level of the lectures (see Contents). In addition, he/she can solve problems which require profound understanding of the essential contents of the course.
Contents:
The goal of the course is to explain how the macroscopic thermophysical properties of a system (e.g., equation of state) can be derived from its fundamental microscopic properties (e.g., from the behavior of the molecules). For this purpose, the students are given a physically clear understanding of the basic principles of thermophysics, recognizing the fundamental role of its statistical nature. Topics will include: Basic concepts, The first law, Thermal expansion, heat transfer, and diffusion, The second law, The combined law, Heat engines and refrigerators, Thermodynamic potentials, Phases of matter, Classical ideal gas, Classical and open systems, Quantal ideal gas.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h, 12 exercises (24 h), self-study 90 h
Target group:
Primarily for the students of the degree programme in physics. Also for the other students of the University of Oulu.
Prerequisites and co-requisites:
No specific prerequisites
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
Textbooks: H. D. Young and R. A. Freedman: University Physics, 13th edition, Pearson Addison-Wesley, 2012, or earlier editions (in part), F. Mandl: Statistical Physics, second edition, John Wiley & Sons Ltd., 1988 (in part).
Lecture notes: Juhani Lounila: 766328A Termofysiikka, Oulun yliopisto, 2014.
Course material availability can be checked here.
Assessment methods and criteria:
Two written intermediate examinations or one final examination
Read more about assessment criteria at the University of Oulu webpage.

Grading:
Numerical grading scale 0-5, where 0 = fail
Person responsible:
Juhani Lounila
Working life cooperation:
No work placement period
Other information:
Due to the partial overlap of the subject matters of the courses 761102P Basic Thermodynamics (2 cp) and 766328A Thermophysics (6 cp), exceptionally only 5 cp (not 6 cp) are given for the latter course in the special case that the student has previously completed the course Basic Thermodynamics and has got 2 cp for that.
https://wiki.oulu.fi/display/766328A/

766329A: Wave motion and optics, 6 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field 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
766349A	Wave motion and optics	7.0 op

ECTS Credits:
6 credits
Language of instruction:
Finnish. The course material and exercises are available in English.
Timing:
Firts spring
Learning outcomes:
The student is able to treat different types of waves by methods of general theory of wave motion. The student is also able to solve problems related to basic optics and apply her/his knowledge to teaching and research in physics.
Contents:
General principles of wave motion, sound, electromagnetic waves, production and measurement of light, propagation of light, image formation in mirrors and lenses, matrix method in ray tracing, aberrations, optical instruments, interference, interferometry, polarization, Fraunhofer diffraction, diffraction grating, laser principles.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 46 h, exercises 24 h, self-study 90 h
Target group:
No specific target qroup
Prerequisites and co-requisites:
763101P Mathematics for physics
Recommended optional programme components:
No alternative course units or course units that should be completed simultaneously
Recommended or required reading:
H. D. Young and R. A. Freedman, University Physics, Addison-Wesley, 2000 ja 2004, F. L. Pedrotti ja L. S. Pedrotti, Introduction to optics, Prentice-Hall, 2. ed., 1993 ja E. Hecht, Optics, (3rd ed.), Addison Wesley Longman, 1998.
Course material availability can be checked here.
Assessment methods and criteria:
Three written intermediate examinations or one final examination
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 0 – 5, where 0 = fail
Person responsible:

Seppo Alanko
Working life cooperation:
No work placement period
Other information:
https://noppa.oulu.fi/noppa/kurssi/766329a/etusivu