# Opasraportti

## Courses in English for Exchange Students CSE DCE EE (2014 - 2015)

This Weboodi Course Catalogue lists courses taught in English for exchange students during the academic year 2014-2015 at the Departments of

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

When planning your exchange studies and the required learning agreement, please use the information provided under the **Courses** tab in this Study Guide. Please read carefully the information of each course you wish to take (language of instruction, target group, course content, timing, preceding studies, additional information etc.).

All exchange students must submit their exchange application through SoleMOVE.

Accepted exchange students are required to register to all courses. Course registration takes place once you have arrived in Oulu and received your University of Oulu login information. More information on registration will be provided during orientation. When registering you will be able to find detailed information on teaching and schedule under **Instruction** tab.

Individual course codes include information on the level of course.
xxxxxxP = basic, introductory level courses
xxxxxxA = for 2-3 year students, mostly Bachelor level courses
xxxxxxS = for 4-5 year students, Master level courses

Departmental information: http://www.oulu.fi/eeng/node/12575

Further information on application process for incoming exchange students:
http://www.oulu.fi/english/studentexchange
international.office(at)oulu.fi

Any general questions about courses in English at the above departments should be addressed to:

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## Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

521095S: Advanced Course of Printed Electronics, 3 op
521380S: Antennas, 4 op

521281S: Application Specific Signal Processors, 5 op
521107S: Biomedical Instrumentation, 6 op
521373S: Communication Signal Processing I, 6 op
521340S: Communications Networks I, 5 op
521377S: Communications Networks II, 7 op
521493S: Computer Graphics, 7 op
521280S: DSP Laboratory Work, 5 op
521266S: Distributed Systems, 6 op
521172S: EMC Design, 4 op
521443S: Electronics Design II, 5 op
521321S: Elements of Information Theory and Coding, 5 op
521145A: Human-Computer Interaction, 5 op
521264S: Human-Computer Interaction Techniques, 5 op
031025A: Introduction to Optimization, 5 op
521110S: Measuring and Testing Systems, 6 op
521224S: Microelectronics and Micromechanics, 6 op
521173S: Mixed-signal Testing, 4 op
521147S: Mobile and Social Computing, 5 op
521318S: Modern Topics in Telecommunications and Radio Engineering, 3 - 7 op
521217S: Printed Electronics, 4 op
521260S: Programmable Web Project, 5 op
521225S: RF Components and Measurements, 5 op
521335S: Radio Engineering 1, 6 op
521375S: Radio Engineering II, 5 op
521146S: Research Methods in Computer Science, 5 op
521201S: Research methods of Materials for Electronics, 3,5 op
521149S: Special Course in Information Technology, 5 - 8 op
521148S: Ubiquitous Computing Fundamentals, 5 op
521114S: Wireless Measurements, 4 op

# Opintojaksojen kuvaukset

## Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

### 521095S: Advanced Course of Printed Electronics, 3 op

**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Department of Electrical Engineering
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Tapio Fabritius
**Opintokohteen kielet:** Finnish
**Leikkaavuudet:**

| | | |
|---|---|---|
| 521089S | Printed Electronics | 5.0 op |

**ECTS Credits:**
3
**Language of instruction:**
Finnish/English
**Timing:**
2
**Learning outcomes:**

After passing this course, student understands physical principle of organic photovoltaic (OPV) and organic light emetting diodes (OLED) and the utilized different component structures. In addition, he/she understands the materials of OPV and OLED layer structure and utilized fabrications methods.
**Contents:**
OPV- and OLED-structures, materials and farication methods
**Mode of delivery:**
Face-to-face teaching
**Learning activities and teaching methods:**
Intensive course.
**Target group:**
Course is optional in some advanced modules in electrical engineering
**Prerequisites and co-requisites:**
Printed electronics.
**Recommended optional programme components:**
-
**Recommended or required reading:**
Lecture handout.
**Assessment methods and criteria:**
Exam.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Numeric scale 1-5.
**Person responsible:**
Tapio Fabritius
**Working life cooperation:**
-
**Other information:**
-

## 521380S: Antennas, 4 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Markus Berg

**Opintokohteen kielet:** English

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521388S | Antennas | 5.0 op |

**ECTS Credits:**
4
**Language of instruction:**
English
**Timing:**
Spring, periods 4-6
**Learning outcomes:**
After completing the course the student can apply antenna terminology and calculate the antenna characteristics of different kind of radio systems. He/she can apply electromagnetic theory to calculate the properties of the fields radiated by wire antennas, micro strip antennas and antenna arrays. The student is also able to design wire antennas, micro strip antennas and antenna arrays for different radio systems. In addition, the student can use electromagnetic simulators to analyze and design antennas.
**Contents:**
ntroduction to different antenna types. Antenna parameters. Antennas as a part of a radio system. Radiation of an antenna from the Maxwell's equations. Typical linear wire antennas: infinitesimal dipole, small dipole, finite length dipole, half-wavelength dipole. Antennas near the conducting plane. Loop antennas. Microstrip antennas. Antenna arrays.
**Mode of delivery:**
Face-to-face teaching
**Learning activities and teaching methods:**

Lectures 24 h, exercises 16 h and the compulsory antenna design work with an electromagnetic simulation program (14 h).
**Target group:**
1 st and 2 nd year M.Sc. and WCE students
**Prerequisites and co-requisites:**
Basics of Radio Engineering
**Recommended optional programme components:**
-
**Recommended or required reading:**
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 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:**
Markus Berg
**Working life cooperation:**
-
**Other information:**
Course will be given every second year in even years. Objective: After having passed the course the student knows antenna terminology, understands the role of antennas as a part of different radio systems and is familiar with the theories explaining the electromagnetic radiation of usual antenna types and antenna arrays. In addition, the student masters the preliminary design of various antenna types and arrays, as well as, knows the feasibility of electromagnetic simulators in the antenna design.

## 521281S: Application Specific Signal Processors, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Boutellier, Jani Joosefi

**Opintokohteen kielet:** English

**ECTS Credits:**
5
**Language of instruction:**
In English.
**Timing:**
Spring, periods 4-5.
**Learning outcomes:**
**Objective:** The course introduces the main types of processors used in digital signal processing. Practical skills are learned by processor construction exercises.
**Learning outcomes:** After completing the course the student can distinguish the main types of signal processors and design a couple of transport triggered architecture processors. The student is able to assemble a signal processor out of basic entities and match the processor performance and the application requirements. The student applies the TTA codesign environment and Altera's FPGA tools to synthesize a system.
**Contents:**
Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.
**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 pro-cessing.
**Prerequisites and co-requisites:**
521267A Computer engineering, 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.

## 521107S: Biomedical Instrumentation, 6 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521093S | Biomedical Instrumentation | 5.0 op |

**ECTS Credits:**
6
**Language of instruction:**
English
**Timing:**
5-6
**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 54 h and self-study 100 h.
**Target group:**
Students interested in biomedical measurements.
**Prerequisites and co-requisites:**
None
**Recommended optional programme components:**
Course replaces course 521126S Biomedical measurements
**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:**
None
**Other information:**
None.

## 521373S: Communication Signal Processing I, 6 op

**Voimassaolo:** 01.08.2004 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juntti, Markku Johannes

**Opintokohteen kielet:** English

**Leikkaavuudet:**

521324S Statistical Signal Processing II 5.0 op

**ECTS Credits:**
6
**Language of instruction:**
English
**Timing:**
Spring, periods 4-5
**Learning outcomes:**
Upon completing the required coursework, the student is able to use the methodology of signal processing to design communication systems and their receivers. He or she will be able to design and implement various equalizer algorithms. The student can estimate the complexity of various equalizer algorithms.
**Contents:**
Communication receiver as a statistical optimization problem, optimal linear filters, matrix algorithms, adaptive algorithms, linear and nonlinear equalizers, multi-antenna signal processing.
**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:**
Statistical signal processing, Telecommunication Engineering II, Wireless Communications I
**Recommended optional programme components:**
-
**Recommended or required reading:**
Parts from books: Jinho Choi: Adaptive and Iterative Signal Processing in Communications, Cambridge University Press, 2006 (318 pages) ISBN-13 978-0-521-86486-2 and Simon Haykin: Adaptive Filter Theory, 3rd ed. Prentice Hall, 1996. (989 pages) ISBN: 0-13-322760-X. Lecture notes and other literature.
**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:**

Markku Juntti
**Working life cooperation:**
-
**Other information:**
Objective: Statistical signal processing methods are applied to design the key functionalities of a communication receiver and in particular its equalizer. In addition, the expertise on statistical and adaptive signal processing is deepened and enlarged regarding linear estimation, adaptive signal processing and multi-antenna signal processing.

## 521340S: Communications Networks I, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Savo Glisic

**Opintokohteen kielet:** English

**ECTS Credits:**
5
**Language of instruction:**
English
**Timing:**
Fall, periods 1-3
**Learning outcomes:**
Upon completing the required coursework, the student is able to list the functionalities of different layers of OSI and TCP/IP protocol models. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE, LTE and IEEE802.11 systems. The student is able to describe the basic protocol model of the UMTS radio interface and radio access network. The student knows the basic properties of routing protocols in ad hoc networks. The student will achieve skills to describe the main principles of mobility control, network security, cross-layer optimization. The course also gives the student the ability to explain the essential features of sensor networks.
**Contents:**
Communications architecture and protocols, adaptive network and transportation layers, mobility management, network security, network management, ad hoc and sensor networks, cross-layer optimization, examples of wireless communication networks.
**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:**
1 st year M.Sc. and WCE students
**Prerequisites and co-requisites:**
-
**Recommended optional programme components:**
-
**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
**Working life cooperation:**
-
**Other information:**

Objective: The aim 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.

## 521377S: Communications Networks II, 7 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Savo Glisic

**Opintokohteen kielet:** English

**ECTS Credits:**
7
**Language of instruction:**
English
**Timing:**
Spring, periods 4-6
**Learning outcomes:**
Upon completing the required coursework, the student is able to construct simple theoretical queuing theory models and analyze the simulation results of these models. The student achieves skills to explain simple Markovian birth-death process and apply that model in queuing systems. The course gives skills for the student to describe functionalities of a communication network with game theoretic models. The student knows the decomposition methods of network utility function and is capable of using that knowledge for network optimization.
**Contents:**
Introduction to concepts in queuing theory, birth-death process, 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.
**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:**
-
**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
**Working life cooperation:**
-
**Other information:**
Objective: The aim is to help the student to understand the basic principles of networking by providing a balance between the description of existing networks and the development of analytical tools. The descriptive material is used to illustrate the underlying concepts, and the analytical material is used to generate a deeper and more precise understanding of the concepts. The course presents the basic principles of queuing theory giving mathematical tools to apply the theory to practical communication systems.

## 521493S: Computer Graphics, 7 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Guoying Zhao

**Opintokohteen kielet:** English

**Leikkaavuudet:**

521140S Computer Graphics 5.0 op

**ECTS Credits:**
7
**Language of instruction:**
In English.
**Timing:**
Spring, periods 5-6.
**Learning outcomes:**
Upon completing the required coursework, student is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clipping, and 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling. Moreover, student is able to explain the relationship between the 2D and 3D versions of such algorithms, and also has the necessary basic skills to use these basic algorithms available in OpenGL.
**Contents:**
The history and evolution of computer graphics; 2D graphics including: line 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 (40 hours) and self-study (50 h). In addition student will independently solve programming assignments (100 hours).
**Target group:**
Computer Science and Engineering students and other Students of the University of Oulu.
**Prerequisites and co-requisites:**
Pro-gramming 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.
**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: Interactive Computer Graphics, 5th, Addison-Wesley 2008
2) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
3) Lecture notes (in English)
4) 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 a fail.
**Person responsible:**
Guoying Zhao, Jie Chen, Jukka Holappa
**Working life cooperation:**
-

## 521280S: DSP Laboratory Work, 5 op

**Voimassaolo:** 01.08.2012 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Department of Computer Science and Engineering
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Teemu Nyländen, Miguel Bordallo Lopez
**Opintokohteen kielet:** English

**ECTS Credits:**
5
**Language of instruction:**
In English.
**Timing:**
Periods 2-6 (it can be done from November to May).
Autumn and Spring.
**Learning outcomes:**
After the course the student is able to use integrated design environments of digital signal processors for designing, implementing and testing signal processing algorithms.
**Contents:**
Algorithm design, Sampling, quantization noise, signal generation, decimation and interpolation, FIR and IIR filter implementations, FFT implementations, DSP-assembly coding and optimization, Multi-rate signal processing, LMS adaptive filters implementations, CIC filtering.
**Mode of delivery:**
Starting lectures and independent exercises.
**Learning activities and teaching methods:**
The course is based on a starting lecture and exercises that are done using development boards of modern 32-bit digital signal processors, and the respective software development tools. The course is passed by accepted and documented exercises.
**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:**
521337A Digital filters, 521267A Computer Engineering, programming skills.
**Recommended optional programme components:**
521279S Signal processing systems. This course provides complementary information on the DSP-laboratory Work course.
**Recommended or required reading:**
Exercise instruction booklet, processor handbooks and develop-ment 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:**
Miguel Bordallo López
**Working life cooperation:**
No.

## 521266S: Distributed Systems, 6 op

**Voimassaolo:** 01.08.2005 -
**Opiskelumuoto:** Advanced Studies
**Laji:** Course
**Vastuuyksikkö:** Department of Computer Science and Engineering
**Arvostelu:** 1 - 5, pass, fail
**Opettajat:** Ojala, Timo Kullervo
**Opintokohteen kielet:** English

**Leikkaavuudet:**

521290S Distributed Systems 5.0 op

**Language of instruction:**
In English.
**Timing:**
Spring, periods 4-5.
**Learning outcomes:**
Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and implement a small distributed system.
**Contents:**
Architectures, processes, 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.

## 521172S: EMC Design, 4 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521115S EMC Design 5.0 op

**ECTS Credits:**
4
**Language of instruction:**
English.
**Timing:**
Period 6.
**Learning outcomes:**

After completing the course the student is able to name common EMC standards, and is able to use EMC testing equipment and methods. The student can explain the noise coupling mechanisms, and is able to use good design practices related to analogue and digital electronics design, grounding, cabling, filtering and shielding.
**Contents:**
EMC standards for emission and susceptibility, interference coupling, circuit design and grounding, connections, filtering, shielding, EMC testing laboratories, EMC tests and their background.
**Mode of delivery:**
Face-to-face teaching
**Learning activities and teaching methods:**
Lectures 24h/Exercises 12h/Laboratory work 12h.
**Target group:**
-
**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:**
Electronics Design I, Digital Techniques I, Electronic Measurement Techniques, Measuring and Testing Systems, RF Components and Measurements.
**Recommended or required reading:**
Tim Williams: EMC for Product Designers, 4th edition, Oxford: Newnes, 2007. Lecture slides.
**Assessment methods and criteria:**
Final exam and passed laboratory 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:**
Hannu Sorvoja
Teemu Myllylä
**Working life cooperation:**
-
**Other information:**
-

## 521443S: Electronics Design II, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**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 semester, periods 1-2
**Learning outcomes:**

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

**Contents:**

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

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

**Voimassaolo:** 14.11.2005 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Timo Kokkonen, Juntti, Markku Johannes

**Opintokohteen kielet:** English

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521323S | Wireless Communications I | 5.0 op |

**ECTS Credits:**
5
**Language of instruction:**
In English.
**Timing:**
Fall, periods 1-3
**Learning outcomes:**
Upon completing the required coursework, the student is able to use the basic methodology of information theory to calculate the capacity bounds of communication and data compression systems. He can estimate the feasibility of given design tasks before the execution of the detailed design. What is more, she can independently search for information and knowledge related to communication engineering, system design and signal processing. The student understands the operating principles of block codes, cyclic codes and convolutional codes. He 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. She can represent the operating idea of a convolutional encoder as a state machine, the student is able to apply the Viterbi algorithm to decoding of convolutional codes, and is capable of specifying principles of turbo coding and coded modulation. Moreover, he 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:**
Lectures 40 h, exercises 20 h

**Target group:**
1 st year M.Sc. and WCE students

**Prerequisites and co-requisites:**
Signal Analysis, Telecommunication Engineering II

**Recommended optional programme components:**
Wireless Communications I

**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.

**Grading:**
The course unit utilizes a numerical grading scale 1-5.
Read more about assessment criteria at the University of Oulu webpage.

**Person responsible:**
Markku Juntti / Timo Kokkonen

**Working life cooperation:**
-

**Other information:**
-

## 521145A: Human-Computer Interaction, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** English

**Timing:**
Autumn, periods 2-3

**Learning outcomes:**
Upon completing the course the student is able to explain the Human Computer Interaction (HCI) fundamentals, explain evaluation and prototyping techniques, explain 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:**
None. No prior courses are required.

**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 three group-based activities throughout the semester: design & prototyping (40%), conduct an evaluation (40%), and complete a report of the activities (20%). Passing criteria: all 3 elements (designs, evaluation, report) 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:**
Vassilis Kostakos

## 521264S: Human-Computer Interaction Techniques, 5 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5
**Language of instruction:**
In English.
**Timing:**
Autumn, periods 2-3.
**Learning outcomes:**
Upon completing the course the student is able to explain the HCI fundamentals, explain evaluation and prototyping techniques, explain 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, 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:**
No prior courses are required.
**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 three group-based activities throughout the semester: design & prototyping (40%), conduct an evaluation (40%), and complete a report of the activities (20%). Passing criteria: all 3 elements (designs, evaluation, report) 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:**
Vassilis Kostakos
**Working life cooperation:**
-

## 031025A: Introduction to Optimization, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**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:**
-

## 521110S: Measuring and Testing Systems, 6 op

**Voimassaolo:** 01.08.2013 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Juha Saarela, Tuomas Happonen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521096S | Measurement Systems | 5.0 op |

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

Period 4.
**Learning outcomes:**
The goal of this course is to teach measurement and testing systems generally. Constructions, connections, software, data acquisition as well as widely used interfaces are included in this course. Also methods to analyze measured signals especially to take care of eliminating disturbances are considered.
Learning outcomes: After completing the course the student is able to explain the principles of measuring and testing systems, and is able to compare the properties and performance of different communication techniques used in measurement systems. The student is able to design an application which controls a measurement system and stores the measurement data. Additionally, the student is able to realize essential multisensor systems and large systems which utilize data networks, and can give examples of practical measurement systems found in the industry and in medicine.
**Contents:**
Basics of measurement and testing systems, data transmission in measurement systems, software and data acquisition, design of measurement system, examples of measurement systems in industry and medicine, wide measurement systems using data networks, test system applications.
**Learning activities and teaching methods:**
Lectures and laboratory exercises. Final exam and passed laboratory exercises.
**Recommended optional programme components:**
Electronic Measurement Techniques .
**Recommended or required reading:**
Handout. Lab-View material

## 521224S: Microelectronics and Micromechanics, 6 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Krisztian Kordas

**Opintokohteen kielet:** English

**Leikkaavuudet:**

521074S Microelectronics and Micromechanics 5.0 op

**ECTS Credits:**
6
**Language of instruction:**
English
**Timing:**
Periods 4-6
**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:**

-

**Prerequisites and co-requisites:**

Passing the basic course “521218A Introduction to Microelectronics and Micromechanics” before the advanced course may be helpful, however it is not a must.

**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:**

1-5

**Person responsible:**

Krisztian Kordas

**Working life cooperation:**

-

**Other information:**

-

## 521173S: Mixed-signal Testing, 4 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Matti Kinnunen

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

4

**Language of instruction:**

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

**Timing:**

Period 5

**Learning outcomes:**

After completing the course the student can compare different testing techniques of analogue and digital electronics, which have been implemented using either embedded testing methods or external automatic testing equipment. Additionally, the student is able to analyze tests made using an automatic test instrument, compare different test interfaces and data busses, and use principles of design of a high-quality printed test circuit board.

**Contents:**

Design for testability, DC- and parametric measurements, dynamic tests, constructions of testers, test signal generation and measurement, mixed-signal test buses, converter tests, data analysis, diagnostics, DSP-based tests, embedded testing.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24h/Exercises 12h, independent work 75h.

**Target group:**

Course is compulsory to elecrical engineering students in measuring and testing techniques module.

**Prerequisites and co-requisites:**

The recommended prerequisite is the completion of the following courses prior to enrolling for the course unit: Electronics Design I, Measuring and Testing systems

**Recommended optional programme components:**

-

**Recommended or required reading:**
M. Burns, G. W. Roberts: An Introduction to Mixed-Signal IC Test and Measurement. Lecture slides.
**Assessment methods and criteria:**
Final exam
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
**Person responsible:**
Matti Kinnunen
**Working life cooperation:**
-
**Other information:**
-

## 521147S: Mobile and Social Computing, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521046A | Mobile Computing | 5.0 op |
| 521045S | Mobile Computing | 5.0 op |

**Language of instruction:**
In English.
**Timing:**
Spring, periods 4-5
**Learning outcomes:**
Upon completing the course the student is able to implement mobile user interfaces, implement online social network applications, explain the fundamental concepts of context awareness and 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.
**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:**
No prior courses are required.
**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 two group-based activities throughout the semester: build a mobile application (50%), build an online social application (50%). Passing criteria: both elements (mobile application, social application) 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.

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

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Opettajat:** Matti Latva-aho

**Opintokohteen kielet:** English

**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**
3-7
**Language of instruction:**
English
**Timing:**
Fall&Spring, periods 1-6
**Learning outcomes:**
After completing the course the student can prepare a presentation of predetermined length of her/his thesis and have experience on presenting the topic. In addition, she/he has experience on evaluating other students' presentations and has a general view of completed diploma theses.
**Contents:**
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:**
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.

## 521217S: Printed Electronics, 4 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Tapio Fabritius

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521089S Printed Electronics 5.0 op

**ECTS Credits:**
4
**Language of instruction:**
Finnish. English if more than two international students in the course.
**Timing:**
4-6
**Learning outcomes:**
After passing this course, student understands the basics of the materials and printing/deposition methods used in printed electronics. In addition, he/she understands operational principles passive/active components and the utilized in fabrication techniques of optoelectronic components
**Contents:**
Materials; conductive and semiconductive polymers, conductive particular inks, insulator materials, photo active polymers. Printing methods: gravure, flexo, screen, inkjet and nanoimprinting. Components; Organic solar cells, organic light emitting diodes, organic transistors, passive components
**Mode of delivery:**
Classroom.
**Learning activities and teaching methods:**
Lectures 24 h, supervised exercises 6 h and self-study 70 h.
**Target group:**
Course is mandatory in some advanced studies of module of electrical engineering
**Prerequisites and co-requisites:**
Not defined.
**Recommended optional programme components:**
None.
**Recommended or required reading:**
D.R. Gamota, P. Brazis, K. Kalyanasundaram ja J. Zhang, "Printed organic and molecular electronics", lecture handout.
**Assessment methods and criteria:**
Exam and accepted exercises (e.g. seminar presentation)
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
1-5
**Person responsible:**
Tapio Fabritius
**Working life cooperation:**
-
**Other information:**
-

## 521260S: Programmable Web Project, 5 op

**Voimassaolo:** 01.08.2006 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Mika Rautiainen

**Opintokohteen kielet:** English

**Leikkaavuudet:**

ay521260S Programmable Web Project (OPEN UNI) 5.0 op

**ECTS Credits:**
5
**Language of instruction:**
In English.
**Timing:**
Spring, periods 4-6.
**Learning outcomes:**

Objective: The objective of the course is to supply the student with basic understanding of RESTful Web Services and related technologies.
Learning outcomes: Upon completing the required coursework, the student is able to design and implement different components of a RESTful Web Service including the Web client. The student becomes familiar with basic technologies to store data on the server, serialize data in the Web and to create Web based clients.
**Contents:**
RESTful Web Services, serialization languages (XML, JSON), data storage, HTML5 and AJAX.
**Mode of delivery:**
Web-based teaching and face-to-face teaching.
**Learning activities and teaching methods:**
Lectures 4 h, guided laboratory work 10 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 space in the classes.
**Prerequisites and co-requisites:**
Elementary 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:**
Will be announced at the first lecture.
**Assessment methods and criteria:**
This course unit utilizes continuous assessment. The students return each chapter of the project report separately and get from the teachers feedback to each chapter.
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:**
Mika Rautiainen
**Working life cooperation:**
None.
**Other information:**
This course replaces the course “521260S Representing structured information”.

## 521225S: RF Components and Measurements, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Matti Kinnunen, Jari Hannu

**Opintokohteen kielet:** Finnish

**ECTS Credits:**
5
**Language of instruction:**
Finnish. English, if there are at least 3 international students in class.
**Timing:**
Period 1-3.
**Learning outcomes:**
After completing the course the student has knowledge of the behavior of passive components at RF frequencies, knows the fabrication methods of components and is also able to apply the knowledge to practical applications. The student also knows the operating principles of transfer lines, antennas and filters and of their design. The student can apply the fundamentals of RF and microwave techniques to measurements, is able to make the measurements of RF components, has knowledge of the operating principles of RF region measurement equipment and is able to compare the usability of different measurement techniques in different measurement situations. In addition the student knows how to perform typical measurements of RF region magnitudes (power, frequency, impedance and noise).
**Contents:**

Fundamentals of RF and microwave techniques, components in microwave circuits, measurement instruments, measuring of power, frequency, impedance and noise, time-domain and active circuit measurements.
**Mode of delivery:**
Face-to-face teaching,, independent design exercises
**Learning activities and teaching methods:**
Lectures 24h/calculation exercises 12h/laboratory exercises 12h/design exercises 12h
**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:**
-
**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 and 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:**
Jari Hannu and Matti Kinnunen
**Working life cooperation:**
-
**Other information:**
Kurssissa käydään läpi tavallisimmat RF-komponentit ja -mittausmenetelmät, jotka ovat käytössä RF- ja mikroaaltoalueilla. Kurssi antaa valmiudet komponenttien toiminnan ja valintaperusteiden ymmärtämiseen sekä sähkömagneettisten kenttien ja suurtaajuuspiirien mittauksiin.

## 521335S: Radio Engineering 1, 6 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Risto Vuohtoniemi

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521326S | Radio Engineering 1 | 5.0 op |

**ECTS Credits:**
6
**Language of instruction:**
English
**Timing:**
Fall, periods 1-3
**Learning outcomes:**
After completing the course the student recognizes different kind of impedance matching methods and can design the impedance matching network using discrete components and microstrip lines. She/he can also explain factors, which are limiting the bandwidth of impedance matching networks. The student can design the impedance matching for a low noise amplifier. In the impedance matching the noise figure is minimized or the gain is maximized. The impedance matching can also be made for the constant gain. The student can explain the principle of a single ended, balanced and double balanced mixer and the advantages and the disadvantages of these mixers. She/he can design a power divider and a directional coupler. The student can also explain the principle of an automatic gain control (AGC). The student can classify power amplifiers and can in the basic case design the matching network for a power amplifier.
**Contents:**

Impedance matching using discrete 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 30 h, exercises 24 h and the compulsory RF design work with ADS simulation software (18 h).

**Target group:**
1 st year M.Sc. and WCE students

**Prerequisites and co-requisites:**
Basics of Radio Engineering

**Recommended optional programme components:**
-

**Recommended or required reading:**
Lecture notes. Parts from D.M. Pozar: Microwave Engineering, 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:**
-

**Other information:**
After having passed the course the student is familiar with the basic theory and techniques of designing radio frequency circuits used in radio transceivers.

## 521375S: Radio Engineering II, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Risto Vuohtoniemi

**Opintokohteen kielet:** English

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521327S | Radio Engineering II | 6.0 op |

**ECTS Credits:**
5

**Language of instruction:**
English

**Timing:**
Spring, periods 4-6

**Learning outcomes:**
After completing the course the student recognizes the blocks of a transceiver and can explain the operating principle of a transceiver. She/he can classify different architectures used in a single and a multi-antenna transceiver and understand the basis for them. 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. She/he can explain nonlinear distortion and can design the automatic gain control in the system level. 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. 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:**
Two hours of lectures in a week, 30 h in total. The compulsory design exercise with ADS simulation software, 30 h during periods 5 and 6.
**Target group:**
1 st year M.Sc. and WCE students
**Prerequisites and co-requisites:**
Radio Engineering I
**Recommended optional programme components:**
-
**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.
**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:**
-
**Other information:**
The aim is to understand the basic theory and techniques of a transceiver system level design. After passing the course the student knows, what should be taken into account when functional blocks of a transceiver are connected so that the performance requirements are achieved.

## 521146S: Research Methods in Computer Science, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Vasileios Kostakos

**Opintokohteen kielet:** English

**Leikkaavuudet:**

813621S Research Methods 5.0 op

**Timing:**
Autumn, periods 2-3.
**Learning outcomes:**
Upon completing the course the student is able to explain the scientific method, create a research plan, design and conduct experimental studies for computer science, write in academic style, and give presentations.
**Contents:**
Scientific method, research planning, statistics, research tools, research methods, studying humans, academic writing, presentation skills.
**Mode of delivery:**
Face to face teaching.
**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:**
No prior courses are required.
**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 four individual activities throughout the semester: develop a research plan (20%), complete statistics tests (20%), generate graphs and figures (20%), conduct a mini experiment (40%). Passing criteria: all four elements (research plan, statistics tests, graphs and figures, mini experiment) 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:**
Vassilis Kostakos

## 521201S: Research methods of Materials for Electronics, 3,5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Marina Tjunina

**Opintokohteen kielet:** English

**ECTS Credits:**
3,5
**Language of instruction:**
In English.
**Timing:**
Periods 4 -6
**Learning outcomes:**
Student will be able to describe experimental methods of materials characterization, to explain their physical principles and limitations, and meaning of measurement results. Student will be able to properly select and apply the characterization methods.
**Contents:**
Optical methods (microscopy, interferometry, ellipsometry; absorption, photoelectron, Raman, and infrared spectroscopies). X-ray methods (scattering, diffraction, fluorescence, spectroscopies). Electron microscopies (scanning, transmission, electron diffraction, and spectrosco-pies). Scanning tunneling and atomic force microscopies. Ion-beam methods.
**Mode of delivery:**
Blended teaching
**Learning activities and teaching methods:**
Lectures 20 h/ Exercises as group work 20 h/ Self-study as online work 55 h.
**Target group:**
Not defined.
**Prerequisites and co-requisites:**
766326A Atom physics; 766329A Waves and optics; 521104P Introduction to materials physics.
**Recommended optional programme components:**
None.
**Recommended or required reading:**
Lectures.
**Assessment methods and criteria:**
Final written exam.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
Numerical grading 1 – 5.
**Person responsible:**
Marina Tyunina
**Working life cooperation:**
Yes. Demonstrations at Center of Microscopy and Nanotechnology.
**Other information:**

The course gives an overview of experimental methods of characterization of morphology, crystal, surface, and electronic structure, atomic composition, and basic properties of materials. Emphasis is on materials and nanostructures for electronics.

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

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Ojala, Timo Kullervo

**Opintokohteen kielet:** English

**Voidaan suorittaa useasti:** Kyllä

**ECTS Credits:**
5-8
**Language of instruction:**
English; Finnish when only Finnish-speaking students.
**Timing:**
Autumn and Spring, periods 1-6.
**Learning outcomes:**
The learning outcomes are defined based on the course topic.
**Contents:**
Varies yearly.
**Mode of delivery:**
Face-to-face teaching, also web-based teaching can be used.
**Learning activities and teaching methods:**
Lectures, exercises, design exercise, project work and seminars depending on the topic of the year. The implementation of the course will be informed separately. The course can be given several times with different contents during the academic year and it can be included into the degree several times.
**Target group:**
M.Sc. level students of Computer Science and Engineering; other students are accepted if there is space in the classes.
**Prerequisites and co-requisites:**
Will be defined based on the contents.
**Recommended optional programme components:**
No.
**Recommended or required reading:**
Will be announced at the first lecture
**Assessment methods and criteria:**
Depends on the working methods.
Read more about assessment criteria at the University of Oulu webpage.
**Grading:**
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
**Person responsible:**
CSE dept. professors
**Working life cooperation:**
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## 521148S: Ubiquitous Computing Fundamentals, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Computer Science and Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opintokohteen kielet:** Finnish

**Language of instruction:**
In English.
**Timing:**
Autumn, periods 2-3.
**Learning outcomes:**
Upon completing the course the student is able to apply the knowledge and methods provided in the course in the design, implementation and evaluation of ubiquitous computing systems.
**Contents:**
Ubiquitous computing systems, privacy, field studies, ethnography, interfaces, location, context-aware computing, processing sequential sensor data.
**Mode of delivery:**
Face-to-face.
**Learning activities and teaching methods:**
Lectures 18 h, exercises 18 h, project work 50 h, self-study 47 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 passed with an approved 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.

## 521114S: Wireless Measurements, 4 op

**Voimassaolo:** 01.08.2005 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Department of Electrical Engineering

**Arvostelu:** 1 - 5, pass, fail

**Opettajat:** Esko Alasaarela

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

| | | |
|---|---|---|
| 521097S | Wireless Measurements | 5.0 op |

**ECTS Credits:**
4
**Language of instruction:**
In Finnish or in English if two or more foreign students participate.
**Timing:**
Period 4
**Learning outcomes:**
Upon completing the course, the student can apply wireless technologies in industrial, traffic, environmental and healthcare measurements. He/she can tell and argument the benefits and challenges of using wireless measurement solutions and is able to apply the most important standards in his/her engineering work. In addition, he/she can use a representing set of industrial and scientific applications of wireless measurements to develop his /her own solutions.
**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

25 h lectures and seminars. The course is lectured intensively within one period. At the end of the period the students prepare presentations about contemporary themes selected by them or proposed by the teacher and give 15-20 minutes presentation to other students in the seminars.

**Target group:**

Last phase students

**Prerequisites and co-requisites:**

Basics of measurement technology and electronic measurement technology or equivalent basic knowledge.

**Recommended optional programme components:**

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**Recommended or required reading:**

Lecture notes (in English) prepared by the teacher and contemporary seminar presentations with their source material.

**Assessment methods and criteria:**

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

**Grading:**

1-5

**Person responsible:**

Esko Alasaarela

**Working life cooperation:**

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**Other information:**

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