

Opasraportti

Computer Science and Engineering (2015 - 2016)

Tutkintorakenteet

International Master's Programme in Biomedical Engineering: Signal and Image Processing (BME-SIP)

Tutkintorakenteen tila: published

Lukuvuosi: 2015-16

Lukuvuoden alkamispäivämäärä: 01.08.2015

Basic Module, Compulsory Courses (57 op)

- 521285S: Affective Computing, 5 op
- 041201A: Basics in eHealth, 5 op
- 521284S: Biomedical Engineering Project, 5 op
- 580402S: Biomedical Imaging Methods, 1 - 5 op
- 521093S: Biomedical Instrumentation, 5 op
- 521273S: Biosignal Processing I, 5 op
- 521282S: Biosignal Processing II, 5 op
- 521289S: Machine Learning, 5 op
- 764634S: Medical physics and imaging, 5 op
- 521003P: Orientation Course for International CSE Students, 1 op
- 813621S: Research Methods, 5 op
- 521149S: Special Course in Information Technology, 5 - 8 op

Recommended Optional Studies (30 op)

- 764664S: Analysis and simulation of biosystems, 6 op
- 521495A: Artificial Intelligence, 5 op
- 900013Y: Beginners' Finnish Course 1, 3 op
- 900053Y: Beginners' Finnish Course 2, 5 op
- 521283S: Big Data Processing and Applications, 5 op
- 080916S: Biomechanics of Human Movement, 5 op
- 521493S: Computer Graphics, 7 op
- 521337A: Digital Filters, 5 op
- 521259S: Digital Video Processing, 5 op
- 031025A: Introduction to Optimization, 5 op
- 521466S: Machine Vision, 5 op
- 521288S: Multiprocessor Programming, 5 op
- 521124S: Sensors and Measuring Techniques, 5 op
- 521279S: Signal Processing Systems, 5 op
- 521149S: Special Course in Information Technology, 5 - 8 op
- 521484A: Statistical Signal Processing, 5 op

900017Y: Survival Finnish Course, 2 op

521097S: Wireless Measurements, 5 op

Compulsory

521097S-02: Wireless Measurements, exercise work, 0 op

521097S-01: Wireless Measurements, exam, 0 op

Common Compulsory (33 op)

The Master's Thesis requires a written maturity test.

521013A: Advanced Practical Training, 3 op

522987S: Master's Thesis in Biomedical Engineering, 30 op

521009S: The Maturity Test for Master's Degree, 0 op

International Master's Programme in Computer Science and Engineering 2015-

Tutkintorakenteen tila: published

Lukuvuosi: 2015-16

Lukuvuoden alkamispäivämäärä: 01.08.2015

Basic Module (21 op)

900013Y: Beginners' Finnish Course 1, 3 op

521145A: Human-Computer Interaction, 5 op

521003P: Orientation Course for International CSE Students, 1 op

521260S: Programmable Web Project, 5 op

813621S: Research Methods, 5 op

900017Y: Survival Finnish Course, 2 op

Specialisation Options, Compulsory Courses (40 - 57 op)

Computer Vision and Signal Processing

521285S: Affective Computing, 5 op

521281S: Application Specific Signal Processors, 5 op

521273S: Biosignal Processing I, 5 op

521493S: Computer Graphics, 7 op

521259S: Digital Video Processing, 5 op

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

031025A: Introduction to Optimization, 5 op

521289S: Machine Learning, 5 op

521466S: Machine Vision, 5 op

521288S: Multiprocessor Programming, 5 op

521279S: Signal Processing Systems, 5 op

Ubiquitous Computing

521151A: Applied Computing Project I, 10 op

521152S: Applied Computing Project II, 10 op

521290S: Distributed Systems, 5 op

812331A: Interaction Design, 5 op

521147S: Mobile and Social Computing, 5 op

521148S: Ubiquitous Computing Fundamentals, 5 op

Specialisation Options, Recommended Optional Studies (9 - 26 op)

Computer Vision and Signal Processing

- 521495A: Artificial Intelligence, 5 op
- 521283S: Big Data Processing and Applications, 5 op
- 521337A: Digital Filters, 5 op
- 521467A: Digital Image Processing, 5 op
- 521147S: Mobile and Social Computing, 5 op
- 521489S: Research Work on Information Processing, 8 op
- 521484A: Statistical Signal Processing, 5 op
- 521148S: Ubiquitous Computing Fundamentals, 5 op

Ubiquitous Computing

- 521283S: Big Data Processing and Applications, 5 op
- 813625S: Information Systems Theory, 5 op
- 812331A: Interaction Design, 5 op
- 815657S: Open Source Software Development, 5 op
- 815305A: Real Time Distributed Software Development, 5 op
- 521489S: Research Work on Information Processing, 8 op
- 521479S: Software Project, 7 op
- 521149S: Special Course in Information Technology, 5 - 8 op
- 817603S: System Design Methods for Information Systems, 5 op
- 521428S: UBI summer school, 5 op

Common Compulsory (33 op)

- 521013A: Advanced Practical Training, 3 op
- 521993S: Master's Thesis in Computer Engineering, 30 op

Degree Programme in Information Engineering, B.Sc.

Tutkintorakenteen tila: published

Lukuvuosi: 2015-16

Lukuvuoden alkamispäivämäärä: 01.08.2015

Basic and Intermediate Studies (130 op)

A452120: Basic and Intermediate Studies, Information Engineering, 120 - 150 op

Second official language, select 2

- 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

Compulsory studies

- 521002P: Orientation to Computer Science and Engineering, 5 op
- 031010P: Calculus I, 5 op
- 031078P: Matrix Algebra, 5 op
- 521141P: Elementary Programming, 5 op
- 031075P: Calculus II, 5 op
- 031021P: Probability and Mathematical Statistics, 5 op
- 902011P: Technical English 3, 6 op
- 031077P: Complex analysis, 5 op
- 031023P: Mathematical Structures for Computer Science, 5 op
- 030005P: Information Skills, 1 op

031076P: Differential Equations, 5 op

761113P: Electricity and magnetism, 5 op

Compulsory

761113P-01: Electricity and magnetism, lectures and exam, 0 op

761113P-02: Electricity and magnetism, lab. exercises, 0 op

Compulsory Intermediate Studies

521109A: Electrical Measurement Principles, 5 op

521301A: Digital Techniques 1, 8 op

521150A: Introduction to Internet, 5 op

521286A: Computer Systems, 8 op

521457A: Software Engineering, 5 op

521145A: Human-Computer Interaction, 5 op

811312A: Data Structures and Algorithms, 5 op

031080A: Signal Analysis, 5 op

521453A: Operating Systems, 5 op

521495A: Artificial Intelligence, 5 op

521337A: Digital Filters, 5 op

521467A: Digital Image Processing, 5 op

521330A: Telecommunication Engineering, 5 op

Compulsory Bachelor's Thesis

523991A: Bachelor's Thesis / Information Engineering, 8 op

900060A: Technical Communication, 2 op

Module preparing for the option (10 op)

Information Technology

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op

Compulsory studies

521484S: Statistical Signal Processing, 5 op

031022P: Numerical Analysis, 5 op

Applied computing

A452149: Module Preparing for the Option, Applied computing, 10 - 30 op

Obligatory studies

521151A: Applied Computing Project I, 10 op

Embedded Systems

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op

Compulsory studies

521302A: Circuit Theory 1, 5 op

521431A: Principles of Electronics Design, 5 op

Students can choose optional courses to complete the 15 credit. Practical training, 3 credits, can also be included. (521012A Practical Training)

521012A: Practical Training, 3 op

Supplementary modules

Recommended modules in the Finnish language study guide.

H452229: Other Supplementary Module (Computer Science and Engineering), 15 op

Supplementary module primarily consists of a preparatory module of another orientation (Information Processing Engineering, Applied Computing or Embedded Systems). In this case one additional course of 5 ECTS cr from the same field should be selected to complement the module. Another alternative is to select the supplementary module from the fields of Electrical Engineering, Information Processing Science, Industrial Engineering and Management, Working life & Entrepreneurship, or Economics and Management. In all cases the extent of the supplementary module is 15 ECTS cr.

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op

Compulsory studies

521484S: Statistical Signal Processing, 5 op

031022P: Numerical Analysis, 5 op

A452149: Module Preparing for the Option, Applied computing, 10 - 30 op

Obligatory studies

521151A: Applied Computing Project I, 10 op

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op

Compulsory studies

521302A: Circuit Theory 1, 5 op

521431A: Principles of Electronics Design, 5 op

Supplementary Module: Electrical Engineering (15 ECTS cr)

521302A: Circuit Theory 1, 5 op

521431A: Principles of Electronics Design, 5 op

521077P: Introduction to Electronics, 5 op

521329A: Hands-on Course in Wireless Communication, 5 op

521104P: Introduction to Material Physics, 5 op

521071A: Principles of Semiconductor Devices, 5 op

521303A: Circuit Theory 2, 5 op

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

Compulsory

521070A-01: Introduction to Microfabrication Techniques, 0 op

521070A-02: Introduction to Microfabrication Techniques, exercise work, 0 op

521304A: Filters, 5 op

Compulsory

521304A-02: Filters, exercise work, 0 op

521304A-01: Filters, exam, 0 op

521092A: Electronic Measurement Techniques, 5 op

521307A: Laboratory Exercises on Analogue Electronics, 5 op

521484A: Statistical Signal Processing, 5 op

Supplementary Module: Information Processing Science. (15 ECTS cr)

810136P: Introduction to Information Processing Sciences, 5 op

811122P: Introduction to Programming, 5 op

813316A: Business Process Modeling, 5 op

811177P: Humans as Users and Developers of Information Technology, 5 op

811375A: User Interface Programming, 5 op

811379A: Basics of Human Computer Interaction, 5 op

815345A: Software Architectures, 5 op

811174P: Introduction to Software Business, 5 op

811346A: Software Engineering, 5 op

812341A: Object-Oriented Programming, 5 op

Compulsory

812341A-01: Object-oriented programming, exercise work, 0 op

812341A-02: Object-oriented programming, exam, 0 op

812342A: Object Oriented Analysis and Design, 5 op

812305A: Information Systems in Organisations, 5 op

811167P: Introduction to Information Systems Design, 5 op

Compulsory

811167P-01: Introduction to Information Systems Design, exercise work, 0 op

811167P-02: Introduction to Information Systems Design, exam, 0 op

812332A: Information Systems Design, 5 op

811394A: Database systems, 5 op

811395A: Basics of Databases, 5 op

810122P: Computer Architecture, 5 op

811168P: Information Security, 5 op

811391A: Requirements Engineering, 5 op

Supplementary Module: Industrial Engineering and Management (15 ECTS cr)

555225P: Basics of industrial engineering and management, 5 op

555285A: Project management, 5 op

555242A: Product development, 5 op

555286A: Process and quality management, 5 op

555264P: Managing well-being and quality of working life, 5 op
Supplementary Module: Working life & Entrepreneurship (15 ECTS cr)
 910001S: Working Life and Studies, 5 op
 910002S: Toward Entrepreneurial Mindsets, 5 op
 910003S: Building Business through Creativity and Collaboration, 5 op
 910004S: Turning Opportunities to Business, 5 op
 910005S: Entrepreneurial Field Project, 5 op
Supplementary Module: Economics and Management (15 ECTS cr)
 724103P: Strategic Management, 5 op
 724105P: Management Accounting, 5 op
 724106P: Principles of Marketing, 5 op
 724109P: Investment Decisions, 5 op
 724110P: Introductory Economics, 5 op

MSc. Engineering, Computer Science and Engineering

Tutkintorakenteen tila: published

Lukuvuosi: 2015-16

Lukuvuoden alkamispäivämäärä: 01.08.2015

Module of the option (60 - 80 op)

Compulsory, choose one of the options (32 -37 ECTS cr). Advanced modules are approximately 35 ECTS cr in total.

Information Technology

A452221: Module of the Option, Information Technology, 34 - 35 op

All compulsory

031025A: Introduction to Optimization, 5 op
 813621S: Research Methods, 5 op
 521466S: Machine Vision, 5 op
 521289S: Machine Learning, 5 op
 521279S: Signal Processing Systems, 5 op
 521288S: Multiprocessor Programming, 5 op
 521260S: Programmable Web Project, 5 op

Applied computing

A452224: Module of the Option, Applied computing, 35 - 62 op

Obligatory courses

521148S: Ubiquitous Computing Fundamentals, 5 op
 813621S: Research Methods, 5 op
 811395A: Basics of Databases, 5 op
 521290S: Distributed Systems, 5 op
 521147S: Mobile and Social Computing, 5 op
 521260S: Programmable Web Project, 5 op
 521479S: Software Project, 7 op

Embedded Systems

A452223: Module of the Option, Embedded Systems, 30,5 - 32 op

All compulsory

521404A: Digital Techniques 2, 5 op
 521340S: Communications Networks I, 5 op
 521479S: Software Project, 7 op
 521423S: Embedded System Project, 5 op
 521279S: Signal Processing Systems, 5 op

521288S: Multiprocessor Programming, 5 op

Advanced module, Information Processing Engineering (35 op)

Information technology, Advanced Module: 1. Signal processing

A452271: Advanced Module/Information Technology, Signal Processing (obligatory), 13,5 - 20 op

Obligatory courses

- 521404A: Digital Techniques 2, 5 op
- 521288S: Multiprocessor Programming, 5 op
- 521281S: Application Specific Signal Processors, 5 op
- 521321S: Elements of Information Theory and Coding, 5 op

A452272: Advanced Module/Information Technology, Signal Processing (optional), 15 - 22 op

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

- 521323S: Wireless Communications I, 5 op
- Compulsory*
- 521323S-01: Wireless Communications I, Exam, 0 op
- 521323S-02: Wireless Communications I, Exercise, 0 op

- 521273S: Biosignal Processing I, 5 op
- 477607S: Advanced Control and Systems Engineering, 5 op
- 521489S: Research Work on Information Processing, 8 op
- 521324S: Communication Signal Processing I, 5 op
- 521493S: Computer Graphics, 7 op
- 521445S: Digital Techniques 3, 6 op
- 521325S: Communication Signal Processing, 5 op

Information technology, Advanced Module: 2. Intelligent Systems

A452273: Advanced Module/Information Technology, Intelligent Systems (obligatory), 14 - 17 op

Obligatory courses

- 521493S: Computer Graphics, 7 op
- 521285S: Affective Computing, 5 op
- 521290S: Distributed Systems, 5 op

A452274: Advanced Module/Information Technology, Intelligent Systems (optional), 18 - 25 op

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

- 477624S: Control System Methods, 5 op
- 521489S: Research Work on Information Processing, 8 op
- 521273S: Biosignal Processing I, 5 op
- 477607S: Advanced Control and Systems Engineering, 5 op
- 802633S: Statistical Pattern Recognition, 10 op
- 521283S: Big Data Processing and Applications, 5 op
- 477525S: Computational intelligence in automation, 5 op

Information technology, Advanced Module: 3. Biomedical Information Engineering

A452275: Advanced Module/Information Technology, Biomedical Information Engineering (obligatory), 11 - 20 op

Obligatory courses

- 521273S: Biosignal Processing I, 5 op
- 521282S: Biosignal Processing II, 5 op
- 521149S: Special Course in Information Technology, 5 - 8 op

A452276: Advanced Module/Information Technology, Biomedical Information Engineering (optional), 20 - 24 op

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

- 580402S: Biomedical Imaging Methods, 1 - 5 op
- 764634S: Medical physics and imaging, 5 op
- 757314A: Basics of bioinformatics, 5 op
- 521285S: Affective Computing, 5 op
- 521284S: Biomedical Engineering Project, 5 op
- 521093S: Biomedical Instrumentation, 5 op

Advanced Module, Applied Computing

Advanced Module: Applied Computing

A452286: Advanced module/Applied computing technology (optional), 25 - 40 op

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

521489S: Research Work on Information Processing, 8 op

812342A: Object Oriented Analysis and Design, 5 op

812341A: Object-Oriented Programming, 5 op

Compulsory

812341A-01: Object-oriented programming, exercise work, 0 op

812341A-02: Object-oriented programming, exam, 0 op

812331A: Interaction Design, 5 op

815657S: Open Source Software Development, 5 op

815305A: Real Time Distributed Software Development, 5 op

817603S: System Design Methods for Information Systems, 5 op

813625S: Information Systems Theory, 5 op

521283S: Big Data Processing and Applications, 5 op

521493S: Computer Graphics, 7 op

521285S: Affective Computing, 5 op

A452285: Advanced module/applied computing technology (obligatory), 10 - 40 op

Obligatory courses

521152S: Applied Computing Project II, 10 op

Applied Computing, Advanced Module: 2. Applied Computing Business

A452287: Advanced module/Applied computing economy (obligatory), 10 - 40 op

Obligatory courses

724206A: Strategic Marketing Management, 5 op

724201A: Internationalization, 5 op

A452288: Advanced module/Applied computing economy (optional), 20 - 40 op

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

806118P: Introduction to Statistics, 5 op

806119P: A Second Course in Statistics, 5 op

521489S: Research Work on Information Processing, 8 op

555314S: Management Information Systems, 5 op

724050A: Bachelor's Thesis in Economics and Business Administration, 10 op

724202A: Managing Multinationals, 5 op

724203A: Financial Statement Analysis, 5 op

724204A: Management Control, 5 op

724207A: Financial Decisions, 5 op

724208A: Portfolio Theory, 5 op

724209A: Monetary Economics, 5 op

724210A: Global Economics, 5 op

724205A: Distribution and Retail Management, 5 op

Advanced Module, Embedded Systems

Embedded Systems, Advanced Module: 1. Embedded Systems Electronics

A452281: Advanced Module/Embedded Systems, Embedded Systems Electronics (obligatory), 16 - 21 op

Obligatory courses

521281S: Application Specific Signal Processors, 5 op

521306A: Circuit Theory 2, 4 op

521432A: Electronics Design I, 5 op

521445S: Digital Techniques 3, 6 op

A452282: Advanced Module/Embedded Systems, Embedded Systems Electronics (optional), 14 - 39 op

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

813621S: Research Methods, 5 op

521405A: Electronic System Design, 5 op

521323S: Wireless Communications I, 5 op

Compulsory

521323S-01: Wireless Communications I, Exam, 0 op

521323S-02: Wireless Communications I, Exercise, 0 op

521443S: Electronics Design II, 5 op
 521088S: Optoelectronics, 5 op
 521489S: Research Work on Information Processing, 8 op
 521484A: Statistical Signal Processing, 5 op
 521385S: Mobile Telecommunication Systems, 5 op
 521304A: Filters, 5 op

Compulsory

521304A-02: Filters, exercise work, 0 op
 521304A-01: Filters, exam, 0 op
 521328A: Simulations and Tools for Telecommunications, 5 op

Embedded Systems, Advanced Module: 2. Embedded Systems Software

A452283: Advanced Module/Embedded Systems, Embedded Systems Software (obligatory), 10 - 20 op

Obligatory courses

521266S: Distributed Systems, 6 op
 521260S: Programmable Web Project, 5 op

A452284: Advanced Module/Embedded Systems, Embedded Systems Software (optional), 23 - 35 op

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

813621S: Research Methods, 5 op
 812342A: Object Oriented Analysis and Design, 5 op
 812341A: Object-Oriented Programming, 5 op

Compulsory

812341A-01: Object-oriented programming, exercise work, 0 op
 812341A-02: Object-oriented programming, exam, 0 op
 521323S: Wireless Communications I, 5 op

Compulsory

521323S-01: Wireless Communications I, Exam, 0 op
 521323S-02: Wireless Communications I, Exercise, 0 op
 521489S: Research Work on Information Processing, 8 op
 521281S: Application Specific Signal Processors, 5 op
 521328A: Simulations and Tools for Telecommunications, 5 op

Supplementary module (15 - 30 op)

Choose optional courses so that your degree is the minimum of 120 cr.

Advanced practical training (3 op)

521013A: Advanced Practical Training, 3 op

Master's Thesis (30 op)

The Master's Thesis requires a written maturity test.

521993S: Master's Thesis in Computer Engineering, 30 op
 521009S: The Maturity Test for Master's Degree, 0 op

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

721704P: Business Logistics, 5 op
 721462S: Business Networks, 6 op
 721419P: Consumer Behavior, 5 op

721672S: Economics of Network Industries, 6 op
 521275A: Embedded Software Project, 8 op
 521014S: Expert Training, 0 - 5 op
 721412P: Product and Market Strategies, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

Upon completing the required coursework, student is able to explain the emotion theory and modeling, implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities, use the basic tools to synthesize facial expressions and speech as well as has the ideas of wide applications of affective computing.

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

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

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Guoying Zhao

Working life cooperation:

-

041201A: Basics in eHealth, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Medicine

Arvostelu: 1 - 5, pass, fail

Opettajat: Jarmo Reponen

Opintokohteen kielet: English

Leikkaavuudet:

ay041201A Basics in eHealth (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credit points / 135 hours of work

Language of instruction:

English

Timing:2nd year autumn**Learning outcomes:**

The student can define central information and communication technological terms and solutions in healthcare, and can list respective applications in healthcare services and training.

The student can evaluate the societal and economic significance of information and communication technology in healthcare

Contents:

- terms and concepts
- societal dimensions
- delivery of health services
- electronic patient records
- data transfer within the health care system
- data transfer between the health care professionals and the patients
- remote consultations, radiology/psychiatry, teleradiology, telepsychiatry
- economical and functional assessment
- remote education
- future visions of health care information systems

Mode of delivery:

Web-based teaching

Learning activities and teaching methods:

Interactivity takes place in virtual learning environment Optima. The course consists of video-taped lectures, power point-presentations and links to other material available in the web. Performance of duties includes an essay, exam, participating in discussions on the grounds of the lectures.

Web lectures 15h / Web exam 40h / Written essay 40h / Self-study and participation to web discussion 40h

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineering, biophysics, other degree programs), Students of Health Sciences and information technology and everyone who is interested

Recommended or required reading:

All recommended or required reading are offered in Optima virtual learning environment

Assessment methods and criteria:

Web tasks, an essay and final exam

Grading:

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

Person responsible:

Professor Jarmo Reponen

Working life cooperation:

No

Other information:

Recommended literature:

Graig J Wootton R, Patterson V (Eds): An introduction to

Telemedicine, RSM Press 2006

Hämäläinen P, Reponen J, Winblad I, Kärki J, Laaksonen M, Hyppönen H, Kangas M (2013) eHealth and eWelfare of Finland, Check point 2011. THL Report 5/ 2013.

(https://www.julkari.fi/bitstream/handle/10024/104368/URN_ISBN_978-952-245-835-3.pdf?sequence=1)

Saranto K, Korpela M (toim) Tietotekniikka ja tiedonhallinta sosiaali- ja terveydenhuollossa, WSOY, Porvoo-Helsinki-Juva 1999

Winblad I, Reponen J, Hämäläinen P (2012) Tieto- ja viestintäteknologian käyttö terveydenhuollossa vuonna 2011. Tilanne ja kehityksen suunta. [English summary] THL Raportteja 3/2012.

(<http://www.julkari.fi/bitstream/handle/10024/80372/825d0af8-f97c-4192-bf5b-ba5e1bf773aa.pdf?sequence=1>)

Journals:

Journal of Telemedicine and Telecare

Telemedicine and e-Health

In addition: eLibrary in the Optima comprising updating of the topics of the lectures and some selected essays (by permission of the author)

521284S: Biomedical Engineering Project, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish or English, depending on the student.

Timing:

As part of the master level studie, in any period suitable to the student.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The topics are from biomedical engineering and depend on the student's interest.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for biomedical data processing. Often the work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study under supervision.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, and documentation. Task assignments can be applied at any time all year round.

Target group:

Master-level students of the Department of Computer Science and Engineering that are interested in biomedical engineering.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Courses such as Biosignal processing I and II, Biomedical image processing and Machine learning are recommended. Programming skills, especially the Matlab.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Tapio Seppänen

Working life cooperation:

No

580402S: Biomedical Imaging Methods, 1 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Saarakkala

Opintokohteen kielet: English

ECTS Credits:

1-5 ECTS credit points / 27-135 hours of work.

Language of instruction:

English

Timing:

Master studies, spring. The course is not organized every year.

Learning outcomes:

The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.

Contents:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Target group:

Master Students of Medical and Wellness technology and Biomedical Engineering and all other who are interested in methods of biomedical imaging

Recommended or required reading:

Required literature is given in the lectures.

Assessment methods and criteria:

Participation in the lectures and demonstrations, study diary. Exercises. Written exam. The course can be taken as 1, 2, 3 or 5 ECTS.

1 ECTS # participation in the lectures

2 ECTS # participation in the lectures and demonstrations

3 ECTS # participation in the lectures and demonstrations + practical assignment

5 ECTS # participation in the lectures and demonstrations + practical assignment and final exam

Grading:

The 1, 2 or 3 ECTS courses utilize verbal grading: pass or fail. The 5 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Associate Professor Simo Saarakkala

Working life cooperation:

No

Other information:

This course is a part of specialization of Biomedical Technology and Medical imaging.

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Igor Meglinski

Opintokohteen kielet: Finnish

Leikkaavuudet:

521107S Biomedical Instrumentation 6.0 op

ECTS Credits:

5

Language of instruction:

English.

Timing:

Period 3.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

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

Target group:

Students interested in biomedical measurements.

Prerequisites and co-requisites:

None

Recommended optional programme components:

Course replaces earlier courses Biomedical measurements and Biomedical instrumentation.

Recommended or required reading:

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

Assessment methods and criteria:

The course is passed by the final exam or optionally with the assignments/test agreed at the first lecture.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1 - 5.

Person responsible:

Igor Meglinski

Working life cooperation:

No.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

After passing the course, student knows special characteristics of the biosignals and typical signal processing methods. Student can solve small-scale problems related to biosignal analysis.

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, preferably at their master's level studies.

Computer Science and Engineering students and other 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, A Case-Study Approach", R.M Rangayyan. 516 pages. + Lecture transparencies + 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.

Grading:

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

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kortelainen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

Lectures and laboratory works are given in English. The examination can be taken in Finnish or English.

Timing:

Periods 4

Learning outcomes:

The course focuses on advanced digital signal processing techniques generally used with biosignals of neural origin. Hands-on guided laboratory working is arranged in parallel to the lectures.

After passing the course, students know the special characteristics of neural signals and the typical signal processing methods related to them. Students can solve advanced problems related to the neural signal analysis.

Contents:

Introduction to EEG, fundamentals of EEG signal processing, event-related potentials, seizure signal analysis, EEG source localization, sleep EEG, brain-computer interfacing.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (10 h) and laboratory work (20 h), written exam.

Target group:

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

Prerequisites and co-requisites:

The basic engineering math courses, digital filtering, programming skills, Biosignal Processing I.

Recommended optional programme components:

-

Recommended or required reading:

The course is based on the book "EEG Signal Processing", S. Sanei and J. A. Chambers, 289 pages, lecture slides and task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by the assistants who will also check that the task assignments are completed properly. The course ends with a written exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading of the accepted exam is in the range 1-5.

Person responsible:

Jukka Kortelainen

Working life cooperation:

No

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01 Pattern Recognition and Neural Networks, Exam 0.0 op

521497S-02 Pattern Recognition and Neural Networks; Exercise Work 0.0 op

521497S Pattern Recognition and Neural Networks 5.0 op

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

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

Learning outcomes:

After completing the course the student can design simple optimal classifiers from the basic theory and assess their performance. The student can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers. The student can apply the basics of gradient search method to design a linear discriminant function. The student can apply regression techniques to practical machine learning problems.

Contents:

Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

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

Target group:

Computer Science and Engineering students and other students of the University of Oulu who are interested in data analysis technology.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The independent task assignment is graded. The course ends with a written exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.

Person responsible:

Tapio Seppänen

Working life cooperation:

No

764634S: Medical physics and imaging, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

English

Timing:

4th-5th Autumn

Learning outcomes:

The student is able to define the physical principles on which various medical diagnostic and therapeutic devices are based upon.

Contents:

The course acquaints the students to the basic physics related to imaging modalities and therapeutic systems used in hospitals. Covered topics include e.g. x-ray imaging, computed tomography, magnetic resonance imaging, nuclear medicine, radiation therapy and methods of clinical neurophysiology.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, calculus assignments 4 h, demonstrations 6 h, reporting 25 h, self-study 112 h

Target group:

Physics MSc students with biophysics major or/and medical physics minor, biomedical engineering students. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Recommended: physics basic courses and Radiation physics, biology and safety (766116P, 761116P, 764117P or 764317A).

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

Dowsett, Kenny, Johnston: The Physics of Diagnostic Imaging, 2nd ed., Hodder Arnold, 2006.

Webster: Medical instrumentation: application and design, 4th ed, John Wiley & Sons, 2010.

Podgorsak: Radiation Oncology Physics – A handbook for teachers and students, IAEA, 2005 (http://www-pub.iaea.org/mtcd/publications/pdf/pub1196_web.pdf).

Additional literature depending on the lecturers.

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:

Miika Nieminen

Working life cooperation:

No work placement period

Other information:

<https://wiki.oulu.fi/display/764634S/>

521003P: Orientation Course for International CSE Students, 1 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Vili-Petteri Kellokumpu

Opintokohteen kielet: English

Leikkaavuudet:

521005P Orientation Course for New CSE Students 1.0 op

ECTS Credits:

1 ECTS / 30 hours of Work

Language of instruction:

English

Timing:

Autumn, periods 1-2

Learning outcomes:

After completing this course, students are familiar with academic studies and study-related services. Students know how to plan and schedule their studies based on their program curriculum. Students can use the necessary information and computer systems.

Contents:

Issues related to starting the studies. The university, Department of Computer Science and Engineering, student organizations, social services offered to students (sports and health services). Introduction to the library and data services (Oula database). Noppa, Lukkari and other information systems and tools, introduction to Linux. Personal study plan (PSP).

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Student tutoring, teacher tutoring, laboratory exercises on Introduction to Linux, information sessions offered by the Faculty of Information Technology and Electrical Engineering and degree program, independent work, total of 30 hours.

Target group:

First year international MSc students in computer science and engineering

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Websites

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.

Grading:

Pass/Fail

Person responsible:

Vili Kellokumpu

Working life cooperation:

None.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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/134 hours of work

Language of instruction:

English

Timing:

The course starts in autumn and continues to spring semester (periods 2 and 3). It is recommended that the course is completed during the first year of Master's studies.

Learning outcomes:

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

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:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail

Person responsible:

Arto Lanamäki

Working life cooperation:

No

Other information:

-

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

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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 1-4.

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:

-

764664S: Analysis and simulation of biosystems, 6 op

Voimassaolo: 01.01.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764364A Analysis and simulation of biosystems 6.0 op

ECTS Credits:

6 credits

Language of instruction:

Finnish (or English)

Timing:

4th spring

Learning outcomes:

The student is able to use modelling in the analysis of simple biosystems, with the utilization of the concept of analogies between different types of systems. Further, with those skills the student will be able to build simulations of relatively simple biosystems and analyze their properties.

Contents:

See [764364A](#) Analysis and simulation of biosystems

Person responsible:

Matti Weckström, likka Salmela

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Pietikäinen, Matti

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A Artificial Intellig (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

In Finnish. The exam and coursework can be passed in English.

Timing:

Periods 3-4.

Learning outcomes:

After taking the course, the student is able to identify the types of problems that can be solved using methods of artificial intelligence. The student knows the basic concepts of intelligent agents, the common search methods used in artificial intelligence, logic based reasoning and applying planning techniques to problems of artificial intelligence. The student can also apply simple methods to reasoning under uncertainty and machine learning from observation. In addition the student will be able to implement the most common search methods.

Contents:

1. Introduction, 2. Intelligent agents, 3. Solving problems by searching, 4. Informed search and exploration, 5. Constraint satisfaction problems, 6. Games, 7. Logical agents, 8. First-order logic, 9. Inference in first-order logic, 10. Planning, 11. Uncertainty, 12. Bayesian Networks, 13. Learning from observation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures and a programming exercise (approximately 25 hours) during periods 3-4, the rest as independent work.

Target group:

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

Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

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

Recommended or required reading:

Primary text book and slides (in English): Russel S., Norvig P.: Artificial Intelligence, A Modern Approach (AIMA), Second Edition, Prentice Hall, 2003. Lecture notes (in Finnish): Syrjänen, M.: Tietämystekniikan peruskurssin luentomoniste, Teknillinen korkeakoulu, 2004. More details on the course WWW page <http://www.ee.oulu.fi/research/imag/courses/ai/>.

Assessment methods and criteria:

The course is passed with a final exam and a passed programming exercise.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1-5 / fail.

Person responsible:

Professor Matti Pietikäinen

Working life cooperation:

-

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

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: Negotiated Education

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.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

After completing the course, the student can explain the big data phenomena and the possibilities it has in data processing and exploitation. The student can analyse concrete technologies for big data management and processing. The student can explain the most common solutions available for cloud services, and understand the benefits, risks and restrictions of them. The course offers viewpoints for big data exploitation and applications. One aim is to learn to apply methods of data preprocessing, knowledge extraction, data analysis and statistics on big data platforms. The focus will be on open data. In the exercises, the student will learn the principles of the current new technologies and utilize them on a basic level.

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying

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:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise with a report. The reports will be evaluated in seminar work through student opponents.

Grading:

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

Person responsible:

Susanna Pirttikangas, Mika Rautiainen

Working life cooperation:

None

080916S: Biomechanics of Human Movement, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credit points / 135 hours of work.

Language of instruction:

English

Timing:

Master studies, Spring

Learning outcomes:

The student can describe the main challenges of movement biomechanics and principles for motion analysis. The student knows basics of biomechanical measurement and modeling of movement. The student can perform practical biomechanical experiments, analyze measurement data, interpret results, and report them using good scientific reporting practice.

Contents:

Musculoskeletal biomechanics. Motion analysis. Biomechanical modeling of the body. Exercise biomechanics and measurement of physical activity. Biomechanical measurements.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 12h / Assignment 54h / Self-study 69h. Final exam.

Target group:

Students of Medical Technology (medical and wellness technology, biomedical engineers, biophysics, other degree programs) and all other who are interested

Prerequisites and co-requisites:

It is recommended to have basic knowledge on anatomy and physiology, sensors and measurement techniques and signal processing.

Recommended or required reading:

Material given during lectures.

Assessment methods and criteria:

Accepted home exercises and assignments, written exam. The exam includes definition and explanation assignments and problems.

Grading:

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

Person responsible:

University lecturer Riikka Ahola

Working life cooperation:

No

Other information:

This course is a part of the specialization of Health Technology.

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

Upon completing the required coursework, the 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, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line 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, self-study: 50 hours. Student independently solves programming assignments: 100 hours

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.

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 fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

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:

Upon completing the required coursework, the student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods. He is also able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the filters. Moreover, the student is able to explain the impacts of finite word length in filter design. After the course the student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. 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:

031018P Complex Analysis, 031050A 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:

Olli Silvén

Working life cooperation:

None.

521259S: Digital Video Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 2.

Learning outcomes:

In this course students become familiar with basics of video processing and communications. The emphasis is in video representation and coding.

After completing the course the student is able to explain the basic formats and representations of digital video signals. He can analyze the frequency properties of video signals as well as the effects of sampling of multi-dimensional signals, and he can specify digital filters for video sampling rate conversions. He is able to model video content by using simple two- and three-dimensional models, and apply certain well-known methods for video motion estimation. The student can explain the essential parts of the techniques used in video coding and the most important properties of common video coding standards. He can also describe the general principles of scalable video coding and error resilient video coding.

Contents:

1. Video formation, 2. Fourier analysis of video signals, 3. Sampling of multi-dimensional signals, 4. Video sampling rate conversion, 5. Video modeling, 6. Motion estimation, 7. Foundations of video coding, 8. Waveform-based coding, 9. Scalable video coding, 10. Video compression standards, 11. Error control in video communications.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures (20 h), exercises (10 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:

Digital Image Processing, Digital Filters.

Recommended optional programme components:

521466S Machine Vision. This course provide complementary information on analysis and processing of digital video. The course is recommended to be studied either in advance or simultaneously.

Recommended or required reading:

Y. Wang, J. Ostermann, Y. Zhang: Video processing and communications, Prentice-Hall, 2002, chapters 1-6, 8, 9, 11, 13, 14. Additional material about H.264/AVC and HEVC standards. Lecture notes and exercise material.

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:

Esa Rahtu

Working life cooperation:

No.

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:

-

521466S: Machine Vision, 5 op**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Esa Rahtu**Opintokohteen kielet:** Finnish**ECTS Credits:**

5

Language of instruction:

In English

Timing:

Spring, periods 3.

Learning outcomes:

This 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. Upon completion of the course, the student can utilize common machine vision methods for various image analysis problems. He is able to detect and recognize objects using features computed from images. He can use motion information in image analysis and model matching in image registration and object recognition. The student can explain the basics of geometric computer vision and is able to calibrate cameras as well as to obtain 3D coordinate measurements from the scene using for example stereo imaging. After the course the student has the rudimentary skills to use the Matlab environment and its tools for implementing machine vision methods and analyzing the results.

Contents:

1. Introduction, 2. Imaging and image representation, 3. 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.

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:

521467A Digital Image Processing and Machine Learning. These courses provide complementary information on pattern recognition and classification applied in machine vision. It is recommended to be studied simultaneously.

Recommended or required reading:

Shapiro L.G., Stockham G.C.: Computer vision, Prentice Hall, 2001. Szeliski R: Computer Vision: Algorithms and Applications, Springer, 2011. Lecture notes, exercise material.

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:

Esa Rahtu

Working life cooperation:

No.

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

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:

-

521124S: Sensors and Measuring Techniques, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Myllylä, Risto Antero, Matti Kinnunen

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.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

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 (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

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silvén

Working life cooperation:

No.

521149S: Special Course in Information Technology, 5 - 8 op**Voimassaolo:** 01.08.2012 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**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 1-4.

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:

-

521484A: Statistical Signal Processing, 5 op**Voimassaolo:** 01.08.2012 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Esa Rahtu**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

521348S Statistical Signal Processing 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.

Contents:

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.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab design exercise (10 h). The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031019P 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:

Esa Rahtu

Working life cooperation:

None.

900017Y: Survival Finnish Course, 2 op**Voimassaolo:** 01.08.1995 -**Opiskelumuoto:** Language and Communication Studies**Laji:** Course**Vastuuyksikkö:** Negotiated Education**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.

521097S: Wireless Measurements, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esko Alasaarela

Opintokohteen kielet: English

Leikkaavuudet:

521114S Wireless Measurements 4.0 op

521114S-01 Wireless Measurements, exam 0.0 op

ECTS Credits:

5

Language of instruction:

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

Timing:

Period 3.

Learning outcomes:

Upon completing the course, the student can apply wireless technologies in industrial, traffic, environmental and healthcare measurements. He/she can tell and argue 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 representative 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 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:

28 h lectures and seminars. The course is lectured in one period. At the end of the period the students prepare presentations about contemporary themes selected by themselves 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:

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

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

*Compulsory***521097S-02: Wireless Measurements, exercise work, 0 op****Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Advanced Studies**Laji:** Partial credit**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Esko Alasaarela**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

521097S-01: Wireless Measurements, exam, 0 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Advanced Studies**Laji:** Partial credit**Arvostelu:** 1 - 5, pass, fail

Opettajat: Esko Alasaarela

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Arvostelu: 1 - 5, pass, fail

Opettajat: Kontinen, Jukka Pekka

Opintokohteen kielet: Finnish

Leikkaavuudet:

521027S Advanced practical training 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

3

Language of instruction:

Finnish/English

Timing:

Whole academic year. Periods 1-4.

Learning outcomes:

After the 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 study. 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 gives 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:

Students find their training jobs themselves.

Target group:

Computer Science and Engineering MSc students.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

-

Recommended or required reading:

None.

Assessment methods and criteria:

For the compulsory MSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. A more exact compilation instruction of the training report is on the WWW pages of the degree programs.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail.

Person responsible:

Jukka Kontinen

Working life cooperation:

Yes.

522987S: Master's Thesis in Biomedical Engineering, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

30

Language of instruction:

English

Timing:

Second year of MSc

Learning outcomes:

The student knows the background and methods for the research field of his/her thesis, and is able to perform relatively large research project as well as to handle reporting of the results.

Contents:

Research project in the field of biomedical engineering and writing of the thesis.

Mode of delivery:

Face-to-face (supervision meetings) and independent work.

Learning activities and teaching methods:

Thesis can be made at different research groups of the university or in industry or health care system. The student writes the thesis independently supported by the supervisor. The topic and contents should be discussed with the professor beforehand.

Target group:

Second year MSc students (International Master's Degree Programme in Biomedical Engineering).

Prerequisites and co-requisites:

-

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

-

Assessment methods and criteria:

Writing the thesis. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale: 1 – 5

Person responsible:

Professor Tapio Seppänen

Working life cooperation:

Yes

Other information:

Detailed instructions:

<http://www oulu.fi/cse/studying/masters-thesis>

521009S: The Maturity Test for Master`s Degree, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

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.

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, periods 2

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

Working life cooperation:

-

521003P: Orientation Course for International CSE Students, 1 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Vili-Petteri Kellokumpu

Opintokohteen kielet: English

Leikkaavuudet:

521005P Orientation Course for New CSE Students 1.0 op

ECTS Credits:

1 ECTS / 30 hours of Work

Language of instruction:

English

Timing:

Autumn, periods 1-2

Learning outcomes:

After completing this course, students are familiar with academic studies and study-related services. Students know how to plan and schedule their studies based on their program curriculum. Students can use the necessary information and computer systems.

Contents:

Issues related to starting the studies. The university, Department of Computer Science and Engineering, student organizations, social services offered to students (sports and health services). Introduction to the library and data services (Oula database). Noppa, Lukkari and other information systems and tools, introduction to Linux. Personal study plan (PSP).

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Student tutoring, teacher tutoring, laboratory exercises on Introduction to Linux, information sessions offered by the Faculty of Information Technology and Electrical Engineering and degree program, independent work, total of 30 hours.

Target group:

First year international MSc students in computer science and engineering

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Websites

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.

Grading:

Pass/Fail

Person responsible:

Vili Kellokumpu

Working life cooperation:

None.

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara, 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 3-4.

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 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 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".

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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/134 hours of work

Language of instruction:

English

Timing:

The course starts in autumn and continues to spring semester (periods 2 and 3). It is recommended that the course is completed during the first year of Master's studies.

Learning outcomes:

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

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:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail

Person responsible:

Arto Lanamäki

Working life cooperation:

No

Other information:

-

900017Y: Survival Finnish Course, 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

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.

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

Upon completing the required coursework, student is able to explain the emotion theory and modeling, implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities, use the basic tools to synthesize facial expressions and speech as well as has the ideas of wide applications of affective computing.

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

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

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Guoying Zhao

Working life cooperation:

-

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

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 processing.

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.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

After passing the course, student knows special characteristics of the biosignals and typical signal processing methods. Student can solve small-scale problems related to biosignal analysis.

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, preferably at their master's level studies.

Computer Science and Engineering students and other 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, A Case-Study Approach", R.M Rangayyan. 516 pages. + Lecture transparencies + 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.

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.

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

Upon completing the required coursework, the 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, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line 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, self-study: 50 hours. Student independently solves programming assignments: 100 hours

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.

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 fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521259S: Digital Video Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 2.

Learning outcomes:

In this course students become familiar with basics of video processing and communications. The emphasis is in video representation and coding.

After completing the course the student is able to explain the basic formats and representations of digital video signals. He can analyze the frequency properties of video signals as well as the effects of sampling of multi-dimensional signals, and he can specify digital filters for video sampling rate conversions. He is able to model video content by using simple two- and three-dimensional models, and apply certain well-known methods for video motion estimation. The student can explain the essential parts of the techniques used in video coding and the most important properties of common video coding standards. He can also describe the general principles of scalable video coding and error resilient video coding.

Contents:

1. Video formation, 2. Fourier analysis of video signals, 3. Sampling of multi-dimensional signals, 4. Video sampling rate conversion, 5. Video modeling, 6. Motion estimation, 7. Foundations of video coding, 8. Waveform-based coding, 9. Scalable video coding, 10. Video compression standards, 11. Error control in video communications.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures (20 h), exercises (10 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:

Digital Image Processing, Digital Filters.

Recommended optional programme components:

521466S Machine Vision. This course provide complementary information on analysis and processing of digital video. The course is recommended to be studied either in advance or simultaneously.

Recommended or required reading:

Y. Wang, J. Ostermann, Y. Zhang: Video processing and communications, Prentice-Hall, 2002, chapters 1-6, 8, 9, 11, 13, 14. Additional material about H.264/AVC and HEVC standards. Lecture notes and exercise material.

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:

Esa Rahtu

Working life cooperation:

No.

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

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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, period 2

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.

The Objective of the course is to learn the information theory as a discipline and its most important applications in information technology in general and in communications engineering in particular as well as the basics of forward error control coding.

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:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

Signal Analysis, Telecommunication Engineering

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:

-

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:

-

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01 Pattern Recognition and Neural Networks, Exam 0.0 op

521497S-02 Pattern Recognition and Neural Networks; Exercise Work 0.0 op

521497S Pattern Recognition and Neural Networks 5.0 op

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

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

Learning outcomes:

After completing the course the student can design simple optimal classifiers from the basic theory and assess their performance. The student can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers. The student can apply the basics of gradient search method to design a linear discriminant function. The student can apply regression techniques to practical machine learning problems.

Contents:

Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

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

Target group:

Computer Science and Engineering students and other students of the University of Oulu who are interested in data analysis technology.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also check that the task assignments are completed properly. The independent task assignment is graded. The course ends with a written exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.

Person responsible:

Tapio Seppänen

Working life cooperation:

No

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In English

Timing:

Spring, periods 3.

Learning outcomes:

This 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.

Upon completion of the course, the student can utilize common machine vision methods for various image analysis problems. He is able to detect and recognize objects using features computed from images. He can use motion information in image analysis and model matching in image registration and object recognition. The student can explain the basics of geometric computer vision and is able to calibrate cameras as well as to obtain 3D coordinate measurements from the scene using for example stereo imaging. After the course the student has the rudimentary skills to use the Matlab environment and its tools for implementing machine vision methods and analyzing the results.

Contents:

1. Introduction, 2. Imaging and image representation, 3. 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.

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:

521467A Digital Image Processing and Machine Learning. These courses provide complementary information on pattern recognition and classification applied in machine vision. It is recommended to be studied simultaneously.

Recommended or required reading:

Shapiro L.G., Stockham G.C.: Computer vision, Prentice Hall, 2001. Szeliski R: Computer Vision: Algorithms and Applications, Springer, 2011. Lecture notes, exercise material.

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:

Esa Rahtu

Working life cooperation:

No.

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

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:

-

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

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 (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

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silvén

Working life cooperation:

No.

521151A: Applied Computing Project I, 10 op**Voimassaolo:** 01.08.2013 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Vasileios Kostakos, Ojala, Timo Kullervo, Simo Hosio**Opintokohteen kielet:** English**Leikkaavuudet:**

521041A Applied Computing Project I 8.0 op

ECTS Credits:

10

Language of instruction:

In English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

Upon completing the course the student is able to complete a full cycle of interactive systems development, including requirements elicitation, system design, prototyping, testing, and evaluation. In this work, the student is able apply skills obtained in B.Sc. courses.

Contents:

Project work.

Mode of delivery:

Face to face teaching, project work as collaborative team work.

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully English.

Target group:

3rd year Computer Science and Engineering B.Sc. 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:

Dix, Finlay, Abowd & Beale: Human-Computer Interaction (<http://www.hcibook.com>); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (<http://www.id-book.com>).

Assessment methods and criteria:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Vassilis Kostakos, Timo Ojala.

Working life cooperation:

-

521152S: Applied Computing Project II, 10 op**Voimassaolo:** 01.08.2013 -**Opiskelumuoto:** Advanced Studies**Laji:** Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo, Vasileios Kostakos, Simo Hosio

Opintokohteen kielet: English

ECTS Credits:

10

Language of instruction:

In English.

Timing:

Autumn and Spring, periods 1-4.

Learning outcomes:

Upon completing the course the student is able to complete a full cycle of interactive systems development, including requirements elicitation, system design, prototyping, testing, and evaluation. In this work, the student is able apply skills obtained in other courses.

Contents:

Project work.

Mode of delivery:

Face to face teaching, project work as collaborative team work.

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully English.

Target group:

Computer Science and Engineering M.Sc. 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:

Dix, Finlay, Abowd & Beale: Human-Computer Interaction (<http://www.hcibook.com>); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (<http://www.id-book.com>).

Assessment methods and criteria:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Vassilis Kostakos, Timo Ojala.

Working life cooperation:

-

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and implement a small distributed system.

Contents:

Architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed 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.

812331A: Interaction Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

English

Timing:

1st year of Master's studies, autumn semester period 1

Learning outcomes:

Objective: The course explains the role of human interaction with IT products, systems, and services, explains the factors and problems related to it to motivate interaction design, and teaches some user-centered methods for analysis, evaluation and design of interactions.

Learning Outcomes: After completing the course, the student can assess the role of human interaction with IT products, systems, and services and identify factors and problems related to it within a practical design case. The student is able to:

- use methods for analysis and evaluation of existing interfaces;
- understand the role of requirements, plan and conduct a simple requirements collection and analysis;
- use basic principles of usability and user experience for user interface design;
- use interaction design methods in designing for target user experiences.

Contents:

The course provides an overview of interaction design, introducing the terminology and fundamental concepts, the main activities, and the importance of user involvement in the design process. The course addresses establishing requirements for IT products, systems, and services. The focus is on usability and user experience from the viewpoint of the intended users, their tasks and the context of use. The course covers user-centered methods for designing for and evaluating usability and user experience of IT products, systems, and services. All the main activities of interaction design are carried out in a practical design case.

Mode of delivery:

Face-to-face teaching, self-study

Learning activities and teaching methods:

Lectures (20 h), exercises and seminar (25 h), individual and group assignments (88 h), or self-study: an opening lecture (2 h), one larger assignment (110 h) and individual tasks (21 h).

Target group:

Master's level students of the IS Oriented Module (compulsory), Master's level students of the SE Oriented Module (optional) and GS ³D students (optional).

Prerequisites and co-requisites:

Basic knowledge on human-computer interaction with usability and user-centered design.

Recommended or required reading:

Rogers, Sharp and Preece (2011, 3rd edition) *Interaction Design: Beyond Human-Computer Interaction* and related lecture and assignment materials

Assessment methods and criteria:

Accepted assignments and individual tasks

Grading:

1-5

Person responsible:

Netta Iivari

Working life cooperation:

No

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4

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 an individual project throughout the semester: either build a mobile application, or conduct analysis of a provided dataset. Passing criteria: the project 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:

Vassilis Kostakos

Denzil Ferreira

Working life cooperation:

None.

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Kukka

Opintokohteen kielet: Finnish

Language of instruction:

In English.

Timing:

Autumn, periods 1-2.

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:

Researcher Hannu Kukka.

Working life cooperation:

None.

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Pietikäinen, Matti

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A Artificial Intellig (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

In Finnish. The exam and coursework can be passed in English.

Timing:

Periods 3-4.

Learning outcomes:

After taking the course, the student is able to identify the types of problems that can be solved using methods of artificial intelligence. The student knows the basic concepts of intelligent agents, the common search methods used in artificial intelligence, logic based reasoning and applying planning techniques to problems of artificial intelligence. The student can also apply simple methods to reasoning under uncertainty and machine learning from observation. In addition the student will be able to implement the most common search methods.

Contents:

1. Introduction, 2. Intelligent agents, 3. Solving problems by searching, 4. Informed search and exploration, 5. Constraint satisfaction problems, 6. Games, 7. Logical agents, 8. First-order logic, 9. Inference in first-order logic, 10. Planning, 11. Uncertainty, 12. Bayesian Networks, 13. Learning from observation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures and a programming exercise (approximately 25 hours) during periods 3-4, the rest as independent work.

Target group:

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

Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

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

Recommended or required reading:

Primary text book and slides (in English): Russel S., Norvig P.: Artificial Intelligence, A Modern Approach (AIMA), Second Edition, Prentice Hall, 2003. Lecture notes (in Finnish): Syrjänen, M.: Tietämystekniikan peruskurssin luentomoniste, Teknillinen korkeakoulu, 2004. More details on the course WWW page <http://www.ee.oulu.fi/research/imag/courses/ai/>.

Assessment methods and criteria:

The course is passed with a final exam and a passed programming exercise.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1-5 / fail.

Person responsible:

Professor Matti Pietikäinen

Working life cooperation:

-

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

After completing the course, the student can explain the big data phenomena and the possibilities it has in data processing and exploitation. The student can analyse concrete technologies for big data management and processing. The student can explain the most common solutions available for cloud services, and understand the benefits, risks and restrictions of them. The course offers viewpoints for big data exploitation and applications. One aim is to learn to apply methods of data preprocessing, knowledge extraction, data analysis and statistics on big data platforms. The focus will be on open data. In the exercises, the student will learn the principles of the current new technologies and utilize them on a basic level.

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying

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:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise with a report. The reports will be evaluated in seminar work through student opponents.

Grading:

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

Person responsible:

Susanna Pirttikangas, Mika Rautiainen

Working life cooperation:

None

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

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:

Upon completing the required coursework, the student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods. He is also able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the filters. Moreover, the student is able to explain the impacts of finite word length in filter design. After the course the student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. 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:

031018P Complex Analysis, 031050A 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:

Olli Silvén

Working life cooperation:

None.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A Digital Image Processing (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.

Timing:

Autumn, period 1.

Learning outcomes:

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

Contents:

This course provides an introduction to digital image processing and machine vision. Topics: 1.Introduction, 2.Image enhancement, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression,7. Morphological image processing, 8. Image segmentation, 9. Representations and descriptions, 10. Pattern recognition.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and Matlab design exercises 30 h. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

In order to obtain deep understanding of the content, it is a benefit if the student has completed the first year mathematic courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Second Edition, Addison-Wesley, 2002 (see course website: <http://www.ee.oulu.fi/research/imag/courses/dkk/>). Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed by a final exam and programming 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:

Matti Pietikäinen

Working life cooperation:

None.

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4

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 an individual project throughout the semester: either build a mobile application, or conduct analysis of a provided dataset. Passing criteria: the project 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:

Vassilis Kostakos

Denzil Ferreira

Working life cooperation:

None.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.

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:

Professor Timo Ojala.

Working life cooperation:

-

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S Statistical Signal Processing 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.

Contents:

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.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab design exercise (10 h). The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031019P 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:

Esa Rahtu

Working life cooperation:

None.

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Kukka

Opintokohteen kielet: Finnish

Language of instruction:

In English.

Timing:

Autumn, periods 1-2.

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:

Researcher Hannu Kukka.

Working life cooperation:

None.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

After completing the course, the student can explain the big data phenomena and the possibilities it has in data processing and exploitation. The student can analyse concrete technologies for big data management and processing. The student can explain the most common solutions available for cloud services, and understand the benefits, risks and restrictions of them. The course offers viewpoints for big data exploitation and applications. One aim is to learn to apply methods of data preprocessing, knowledge extraction, data analysis and statistics on big data platforms. The focus will be on open data. In the exercises, the student will learn the principles of the current new technologies and utilize them on a basic level.

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying

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:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise with a report. The reports will be evaluated in seminar work through student opponents.

Grading:

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

Person responsible:

Susanna Pirttikangas, Mika Rautiainen

Working life cooperation:

None

813625S: Information Systems Theory, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

English

Timing:

2nd year of Master's studies, autumn semester, periods 1 + 2

Learning outcomes:

After completing the course, the student:

- Will have a good knowledge and understanding of a broad array of research topics and themes within the field of information systems;
- Will have good knowledge and understanding of information systems research and the process by which that research is produced;
- Can publish critical IS research articles in some of the leading academic journals and conference proceedings;
- Can critically analyse and synthesise academic sources;
- Can verbally present arguments in an academic fashion;
- Can write a literature review on an IS research topic.

Contents:

1. Information Systems Research Overview
2. A contemporary selection of IS research themes, such as:
 - Information systems success and failure;
 - Information systems development;
 - Understanding the end-user;
 - Risk management;
 - Cultural Issues in information systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 1.5 ECTS credits (40.5 hours of work), class preparation 1.5 ECTS (40.5 hours of work), and exercises 2 ECTS (53 hours of work).

Target group:

Master's level students

Prerequisites and co-requisites:

Bachelor degree or other equivalent degree and "Research Methods" course (813621S). 813624S is a substantive overview of research in information systems not a methods course, and students should be familiar with research methods prior enrolling to 813624S.

Recommended optional programme components:

Recommended or required reading:

To be announced during the course implementation

Assessment methods and criteria:

Paper summary and its presentation, class quizzes, and research essay are assessed. Note that there is no final exam.

Grading:

1–5

Person responsible:

Netta Iivari

Working life cooperation:

No

Other information:

Course material can be found at OPTIMA e-learning environment, Urkund is used for course work submissions.

812331A: Interaction Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta livari

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

English

Timing:

1st year of Master's studies, autumn semester period 1

Learning outcomes:

Objective: The course explains the role of human interaction with IT products, systems, and services, explains the factors and problems related to it to motivate interaction design, and teaches some user-centered methods for analysis, evaluation and design of interactions.

Learning Outcomes: After completing the course, the student can assess the role of human interaction with IT products, systems, and services and identify factors and problems related to it within a practical design case. The student is able to:

- use methods for analysis and evaluation of existing interfaces;
- understand the role of requirements, plan and conduct a simple requirements collection and analysis;
- use basic principles of usability and user experience for user interface design;
- use interaction design methods in designing for target user experiences.

Contents:

The course provides an overview of interaction design, introducing the terminology and fundamental concepts, the main activities, and the importance of user involvement in the design process. The course addresses establishing requirements for IT products, systems, and services. The focus is on usability and user experience from the viewpoint of the intended users, their tasks and the context of use. The course covers user-centered methods for designing for and evaluating usability and user experience of IT products, systems, and services. All the main activities of interaction design are carried out in a practical design case.

Mode of delivery:

Face-to-face teaching, self-study

Learning activities and teaching methods:

Lectures (20 h), exercises and seminar (25 h), individual and group assignments (88 h), or self-study: an opening lecture (2 h), one larger assignment (110 h) and individual tasks (21 h).

Target group:

Master's level students of the IS Oriented Module (compulsory), Master's level students of the SE Oriented Module (optional) and GS ³D students (optional).

Prerequisites and co-requisites:

Basic knowledge on human-computer interaction with usability and user-centered design.

Recommended or required reading:

Rogers, Sharp and Preece (2011, 3rd edition) *Interaction Design: Beyond Human-Computer Interaction* and related lecture and assignment materials

Assessment methods and criteria:

Accepted assignments and individual tasks

Grading:

1-5

Person responsible:

Netta livari

Working life cooperation:

No

815657S: Open Source Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Henrik Hedberg

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Timing:

1st year of Master's studies, periods 1+2

Learning outcomes:

After passing the course, a student will be able to

- define the historical background and the ideology of Open Source Software (OSS),
- participate in OSS development project,
- evaluate the impact of the usage of OSS and OSS licenses on software development and exploitation, and
- view the phenomenon through the essential scientific research.

Contents:

The course introduces OSS development paradigm and current topics in OSS research. OSS affects both the way to produce software and the decisions of user organizations. It can be understood, for example, from different social, legal, economical, software engineering and data security viewpoints. The aim is to study from different perspectives, for example, what OSS is and what it is not, the history and organisation of OSS projects, methods of OSS development and usage, as well as licensing models and possible risks. The emphasis on research work.

Mode of delivery:

Mostly face-to-face teaching but some parts are implemented as distance learning

Learning activities and teaching methods:

Lectures and seminars about 40 h, exercises and peer reviews about 20 h, seminar article and presentation about 70 h

Prerequisites and co-requisites:

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work. The course allows passing Project following the OSS development principles, or writing Master's thesis on a OSS topic.

Recommended or required reading:

Fogel, K. (2005): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media; Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

Assessment methods and criteria:

Active participation, seminar article and other assignments

Grading:

1-5

Person responsible:

Henrik Hedberg

815305A: Real Time Distributed Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Petri Pulli

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/135 hours of work

Timing:

1st year of Master's studies, autumn semester, periods 1 + 2

Learning outcomes:

After completing the course, the student:

- Is able to analyse the characteristics of real-time distributed systems;
- Is able to acquire an object-oriented, model-based approach to solve the design problems found in real-time systems;
- Is able to detect and derive specific problems facing the real-time software designer, and to suggest design patterns to solve those problems.

Contents:

Introduction

1. Characteristics of real-time systems;
2. Resource management;
3. Safety and reliability;
4. Time constraints;
5. Concurrency;
6. Scheduling;
7. Interrupts

Characteristics of Distribution

1. Distribution architectures
2. Concept of time;
3. Synchronisation;
4. Latency and jitter;
5. Quality of service;
6. Service discovery;
7. Networking primitives

Real-Time UML Modelling Methodology

Real-Time Design Patterns

Design Examples: Embedded, Ubiquitous, Mobile, Web/Internet

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Prerequisites and co-requisites:

Student understands computer architecture, object-oriented analysis and design (UML), programming language C and/or Java.

Recommended or required reading:

Lecture notes based on reference books

- Douglass B.P. (2009) Real-Time Design Patterns – Robust Scalable Architecture for Real-Time Systems. Addison-Wesley ISBN 0-201-69956-7. 500 p.

Assessment methods and criteria:

Exam and project evaluation

Grading:

1-5

Person responsible:

Petri Pulli

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.

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:

Professor Timo Ojala.

Working life cooperation:

-

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

-

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

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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 1-4.

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:

-

817603S: System Design Methods for Information Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Li Zhao

Opintokohteen kielet: English

ECTS Credits:

5 credits/134 hours of work

Language of instruction:

English

Timing:

1st year of Master's Studies, autumn semester, period1.

Learning outcomes:

Objective: The objective of the course is to widen students' understanding of methodologies and techniques for information systems development (ISD) and provide students with skills in using the variety of techniques.

Learning Outcomes: After the course the student understands the complexity of business, organizational, technical, and human aspects that affect ISD and the selection of methods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to these defects and to other challenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques the student is able to re-plan and develop the sub-systems (automated and non-automated) of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments which method is suitable for an ISD project in an organization.

Contents:

What is information systems development (ISD), waterfall method, socio-technical methods like SSM and ETHICS, miscellaneous methods or frameworks like evolutionary approach, prototyping, rapid application development, Agile development, XP, business process re-engineering, process innovation, stakeholders analysis, and critical success factors, as well as how to select ISD methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h, exercises 24h, homework 30h, essay 30h, examination 30h.

Target group:

Prerequisites and co-requisites:

Bachelor studies recommended

Recommended optional programme components:

Recommended or required reading:

Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.

Research articles (to be announced during the course implementation).

Assessment methods and criteria:

Exercises, assignments, essay, and examination.

Grading:

1-5

Person responsible:

Li Zhao

Working life cooperation:

No

521428S: UBI summer school, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Arvostelu: 1 - 5, pass, fail

Opettajat: Kontinen, Jukka Pekka

Opintokohteen kielet: Finnish

Leikkaavuudet:

521027S Advanced practical training 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

3

Language of instruction:

Finnish/English

Timing:

Whole academic year. Periods 1-4.

Learning outcomes:

After the 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 study. 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 gives 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:

Students find their training jobs themselves.

Target group:

Computer Science and Engineering MSc students.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

-

Recommended or required reading:

None.

Assessment methods and criteria:

For the compulsory MSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. A more exact compilation instruction of the training report is on the WWW pages of the degree programs.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail.

Person responsible:

Jukka Kontinen

Working life cooperation:

Yes.

521993S: Master's Thesis in Computer Engineering, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

30

Language of instruction:

Finnish/English

Timing:

Second year of MSc studies

Learning outcomes:

The student is able to set goals for a given task. He can structure the topic coherently, with emphasis on the key issues. Depending on the nature of the work, the student is able to present the existing results or technological implementations so that the methods used in the work are justified in relation to the state of the art in the field of engineering or science in question. He is able to apply the knowledge and state of the art methods of the subject area in his work. He can present clearly his plan and solution implemented, justify the choices made, and assess the functionality of the solution with relevant testing and evaluation methods. In addition, he is able to compare the results against goals and to consider their general significance to modern engineering or science, and assess the broader significance of the results to the company, organization or project. The student is able to produce smooth, clear and finalized text based on technical and scientific writing practices of the field.

Contents:

The thesis work is carried out independently. The student defines the content of the thesis under the guidance of the supervisor. The degree program committee approves the thesis topic and content.

The thesis is recorded in accordance with the orientation using the following codes:

- 521981S Master's Thesis in Information Processing Engineering, 30 ECTS cr
- 522985S Master's Thesis in Applied Computing, 30 ECTS cr
- 521984S Master's Thesis in Embedded Systems, 30 ECTS cr

Mode of delivery:

Face-to-face meetings with the supervisor and independent studying.

Learning activities and teaching methods:

Independent work under the guidance of the supervisor.

Target group:

Second year MSc students.

Prerequisites and co-requisites:

Compulsory advanced studies preceding the thesis (90 ECTS cr).

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

The thesis is assessed by two reviewers (supervisor and second reviewer) and approved by the degree program committee. Assessment Criteria at the University of Oulu can be found [here](#).

Grading:

1-5 (1=sufficient, 2=satisfactory, 3=good, 4=very good, 5=excellent)

Person responsible:

Supervising professor or researcher

Working life cooperation:

Yes.

Other information:

Detailed instructions: <http://www.oulu.fi/cse/studying/masters-thesis>

A452120: Basic and Intermediate Studies, Information Engineering, 120 - 150 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Basic and Intermediate Studies

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Second official language, select 2

901048Y: Second Official Language (Swedish), Written Skills, 1 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

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: Negotiated Education

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: Negotiated Education

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:** Negotiated Education**Opintokohteen kielet:** Finnish*Compulsory studies***521002P: Orientation to Computer Science and Engineering, 5 op****Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Basic Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Mika Rautiainen**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

521005P Orientation Course for New CSE Students 1.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Main language is Finnish, but can be completed with English.

Timing:

The course is held during the autumn and spring semesters, over the periods I to IV. It is mandatory to for the 1st year students.

Learning outcomes:

Student understands the characteristics of studying in computer science and engineering program and knows about the devices and software related to the studies. He has created his personal study plan, participates in community activities, and is aware of the challenges related to studying. The student has gained hands-on experience with computer gadgets, Linux systems, agile software development tools and scientific computing environment. Student understands how microcontroller devices operate and how signal data can be manipulated using Matlab software environment.

Student has gained knowledge on scientific principles (academic responsibility, studying and ways of work) and understands the responsibility over his personal studies. Student knows his department, degree, key university personnel, tutor and small group. Student has become acquainted with the degree structure, goals and content, and knows how to create a personal study plan (HOPS) to achieve the degree. Student has practical knowledge about initializing his studies and utilizing Lukkari service to plan and manage his studies and time use.

Contents:

Comprises of the following sections: Study planning, studying in communities, introduction to Matlab computing environment, introduction to Linux systems, introduction to agile software development tools, and introduction to programmable gadgets.

Mode of delivery:

Course is based on blended teaching (web-based teaching + face-to-face teaching).

Learning activities and teaching methods:

Lectures:

2+4 h (student counseling)
 4+4 h (best practices for studying, seminars)
 7 h (introduction to Matlab, introduction to Linux systems -> one day)
 = 15 h
 Group work:
 20 h (small-group meetings)
 7 h (introduction to programmable gadgets -> one day)
 3*4h (introduction to agile tools)
 PSP Advising 2 h
 = 27 h

Self-studying: 73 h (study planning and follow-up, studying in communities)

Introductions to Matlab, Linux-systems, agile software development tools and programmable gadgets are organized as one-day courses. The courses give guided introductions to scientific computation environments, agile tools, Linux systems and programmable gadgets in order to get student acquainted with the tools and technologies they need in their further studies.

The sections require attendance in the organized seminars, guided teaching sessions and small-group meetings as well as creating personal study plan, time tracking, reporting and proven participation in activities related to studying in communities.

To pass Orientation to computer science course and get credits, all sections of the course must be passed.

Target group:

Computer science and engineering students.

Prerequisites and co-requisites:

-

Recommended optional programme components:

The course is designed to carry out in the first year while planning and following obligatory studies in computer science and engineering.

Recommended or required reading:

Study material is provided during guided teaching and seminars.

Assessment methods and criteria:

The course utilizes continuous assessment. To pass sub-sections, student is required to attend in the organized seminars and guided teaching sessions, creating personal study plan, time tracking, reporting and proven participation in activities related to studying in communities.

Grading:

The course will be graded as "pass / fail".

Person responsible:

Mika Rautiainen

Working life cooperation:

-

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

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**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.

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

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:

Finnish, the course can be completed in English by answering the lecture questions and doing the programming exercises and the final exercise.

Timing:

Fall, period 1.

Learning outcomes:

Upon completing the required coursework, the student is able to explain the basic programming concepts and structures and to solve problems using these concepts and structures. Moreover, the student is able to implement small programs independently.

Contents:

Basic concepts of programming, basic structures of programming languages, solving problems by programming.

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

Learning assignments in a web environment. Contact teaching: 20h of exercise groups.

Target group:

1st year students of computer science and engineering and electrical engineering 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:

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.

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

031075P: Calculus II, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Basic Studies**Laji:** Course**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:

-

031021P: Probability and Mathematical Statistics, 5 op**Opiskelumuoto:** Basic Studies**Laji:** Course**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:

-

902011P: Technical English 3, 6 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

[CEFR B2 - C1](#)

Status:

This course is compulsory for the students who have chosen English as their foreign language. (See the foreign language requirements for your own degree programme.)

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:

6 ECTS credits (The workload is 160 hours.)

STUDENTS OF ENGINEERING: The course consists of 3 x 2-ECTS modules.

STUDENTS OF ARCHITECTURE: The course consists of 2 x 3-ECTS modules.

Students with the matriculation exam grade *Laudatur* or *Eximia cum laude approbatur* will be exempted from part of the course (2 ECTS credits).

Language of instruction:

English

Timing:

STUDENTS OF ENGINEERING:

PYO, KO, TuTa: *1st & 2nd* years of studies, beginning 1st year autumn.

SO & CSE: 2nd & 3rd years of studies, beginning 2nd year autumn.

STUDENTS OF ARCHITECTURE:

1st & 2nd years of studies, beginning 1st year spring and continuing 2nd year autumn.

Learning outcomes:

By the end of the course, you will be able to

- demonstrate efficient strategies and methods for developing and maintaining your English proficiency
- communicate using the core vocabulary required for professional language use in your field
- apply language skills, intercultural awareness and presentation techniques necessary for working in a multicultural environment
- use language, culture and communication skills at a B2-C1 CEFR level in accordance with your own professional needs.

Contents:

In this course, you will focus on developing oral and written English language skills which enable you to follow developments in your own professional field and manage successfully in an international, intercultural working environment.

STUDENTS OF ENGINEERING:

The course consists of three modules:

1. first, [Professional English for Technology](#) (PET, 2 ECTS credits),
2. then **two modules** (2 ECTS credits each) from a [free-choice module menu, in which each module has its own content](#). These modules allow you to develop further skills in specific core areas. Read the module descriptions with care so that you choose modules which match your own needs, interests and level.

TuTa students, however, take ONE module from the free-choice menu and then, in second year autumn, the [Business Plan](#) module, which is integrated with a course in their own department ([555222A Tuotantotalouden harjoitustyöt](#)).

STUDENTS OF ARCHITECTURE:

The course consists of two modules:

See the course description of each module ([902011P-38](#) module A and [902011P-39](#) module B for a detailed explanation of the course content.

Mode of delivery:

STUDENTS OF ENGINEERING: The mode of delivery varies according to the modules you take. See the course descriptions for the individual modules.

STUDENTS OF ARCHITECTURE: face-to-face teaching in the premises of your own department and independent study

Learning activities and teaching methods:

STUDENTS OF ENGINEERING: The teaching methods and learning activities depend on which free-choice modules you choose. See the course descriptions for the individual modules.

STUDENTS OF ARCHITECTURE:

The classroom teaching comprises about 50% of the total student workload for the course and includes mini-lectures, group and teamwork, student presentations. The independent work component comprises online work and independent study in preparation for classroom activities.

Target group:

Students of the Faculty of Technology

- all Engineering Departments

- the Department of Architecture

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials will be provided by the teacher.

Assessment methods and criteria:

Assessment methods vary according to the individual modules taken. The assessment criteria are based on the learning outcomes of the module.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

pass / fail.

Person responsible:

Each department in the Technical Faculty has its own [Languages and Communication contact teacher](#) for questions about English studies.

Working life cooperation:

-

Other information:

[See the Languages and Communication Study Guide, English, TTK.](#)

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031077P Complex analysis (OPEN UNI) 5.0 op

031018P Complex Analysis 4.0 op

Ei opintojaksokuvauksia.

031023P: Mathematical Structures for Computer Science, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

Ei opintojaksokuvauksia.

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Faculty of Technology

Arvostelu: 1 - 5, pass, fail

Opettajat: Sassali, Jani Henrik, Ursula Heinikoski

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:

-

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

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.

761113P: Electricity and magnetism, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P Electromagnetism 1 5.0 op

761119P-01 Electromagnetism 1, lectures and exam 0.0 op

761119P-02 Electromagnetism 1, lab. exercises 0.0 op

766319A Electromagnetism 7.0 op

761103P Electricity and Magnetism 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:

Spring

Learning outcomes:

The student is able to describe the basic concepts of electricity and magnetism and to apply those when solving the problems related to electromagnetism.

Contents:

Electromagnetic interaction is one of the four fundamental interactions in physics and many phenomena like light, radio waves, electric current, magnetism and formation of solid matter are based on electromagnetism. The current technological development is largely based on applications of electromagnetism in energy production and transfer, telecommunications and information technology. *Contents in brief:* Coulomb's law. Electric field and potential. Gauss's law. Capacitors and dielectrics. Electric current, resistors, electromotive force and DC circuits. Magnetic field, motion of a charged particle in electric and magnetic fields, and applications. Ampère's law and Biot-Savart law. Electromagnetic induction and Faraday's law. Inductance and inductors. R-L-C circuits, alternating current and AC circuits.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 6 exercises (12 h), 2 laboratory exercises (8 h), self-study 81 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 are needed.

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 21-31. 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://wiki oulu.fi/display/761113P/>

*Compulsory***761113P-01: Electricity and magnetism, lectures and exam, 0 op**

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P Electromagnetism 1 5.0 op

761119P-01 Electromagnetism 1, lectures and exam 0.0 op

761119P-02 Electromagnetism 1, lab. exercises 0.0 op

766319A Electromagnetism 7.0 op

761103P	Electricity and Magnetism	4.0 op
761121P	Laboratory Exercises in Physics 1	3.0 op

Ei opintojaksokuvauksia.

761113P-02: Electricity and magnetism, lab. exercises, 0 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Basic Studies

Laji: Partial credit

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P	Electromagnetism 1	5.0 op
761119P-01	Electromagnetism 1, lectures and exam	0.0 op
761119P-02	Electromagnetism 1, lab. exercises	0.0 op
766319A	Electromagnetism	7.0 op
761103P	Electricity and Magnetism	4.0 op

Ei opintojaksokuvauksia.

Compulsory Intermediate Studies

521109A: Electrical Measurement Principles, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Course is lectured in Finnish. Laboratory exercises and the exam can be done in English.

Timing:

Periods 1-2.

Learning outcomes:

Upon completion of the course, students are able to measure basic measurements with a ammeter, voltmeter and oscilloscope. They can operate signal and function generators. They can estimate the validity of their measurements.

Contents:

Units of measures, standards of measures, analysis of errors, most commonly used analog and digital measuring methods, equipment and 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.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Kurssimateriaali Optimasta.

Assessment methods and criteria:

Exam and passed lab exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Saarela

Working life cooperation:

None.

Other information:

-

521301A: Digital Techniques 1, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

After the course, students are able to ably binary number system and Boolean algebra in the form of switching algebra to the design and functional analyze of simple digital circuits. In addition, they are also able to use in their designs graphical symbols specified in the dependency notation standard (SFS4612 ja IEEE/ANSI Std.91-1991) and different descriptions of function and structure of state machines. Based on this knowledge, students are able to implement and analyze digital devices consisting of ordinary simple digital components. 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:

1st year BSc students

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Text books, MIT OpenCourseWare and exercise 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:

-

Other information:

-

521150A: Introduction to Internet, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

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:

Upon completing the course the student is able to explain the structure of the public Internet and the TCP/IP protocol stack, solve simple Internet problems, and design and implement a small Internet application.

Contents:

Internet's design principles and architecture, most important access networks, TCP/IP protocol stack and most important network layer and transport layer protocols, most important Internet applications, basics of Internet security and multimedia.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 32 h / problem solving exercises 12 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 and other Students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

-

Recommended or required reading:

Will be 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:

Professor Timo Ojala.

Working life cooperation:

-

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521142A Embedded Systems Programming 5.0 op

ECTS Credits:

8

Language of instruction:

Lecturing in Finnish, course and exercise material available in English.

Timing:

Autumn, periods 1-2. Will be held next time in the autumn of 2016.

Learning outcomes:

Upon completing the course, the student understands the basic computer architecture and organization. Student understands CPU operation and datapath in general. Student knows number systems and data representations in computers. 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 for embedded systems. Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Computer architecture and organization, CPU, memory organization and management, data types, registers and I/O, general computer and embedded systems programming, basics of the C programming language.

Mode of delivery:

Web-based and face-to-face teaching.

Learning activities and teaching methods:

Lectures (40h), course exercises (20h), laboratory exercise (3h) and course projects in groups.

Target group:

2nd year students of computer science and engineering and 3rd year students of electrical engineering.

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. Mano M., Computer System Architecture. Prentice Hall, 1993. Patterson D., Hennessy J., Computer Organization and Design. Morgan Kaufman, 2005. Williams, E.: Make: AVR Programming, Learning to Write Software for Hardware, O'Reilly, 2014.

Assessment methods and criteria:

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course projects in groups. Assessment is based on the exercises and the course projects. More detailed information on assessment can be found from the course Web page, <https://noppa.oulu.fi/noppa/kurssi/521286a/>.

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:

No.

521457A: Software Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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, 5. structural analysis and design, 5. software testing methods and strategies, 6. introduction to object-oriented analysis and design.

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:

-

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Autumn, periods 2

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

Working life cooperation:

-

811312A: Data Structures and Algorithms, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Vesanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521144A Algorithms and Data Structures 6.0 op

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

Finnish

Timing:

2nd year, autumn semester, period 2

Learning outcomes:

After completing the course, the student can describe the concept of algorithm and explain what correctness and time complexity of algorithms mean. Furthermore, the student is able to explain the design paradigms presented in the course and to describe the complexity classes of relevant sorting algorithms. The student can analyse simple algorithms, i.e. to prove their correctness and evaluate their time

complexity. Moreover, the student is able to describe the basic data structures and apply essential graph algorithms. Finally, the student can construct suitable data structures and algorithms for given problems; the student can also justify the choice of a data structure or an algorithm for an application.

Contents:

The concept and analysis of algorithms, sorting and searching algorithms and their complexity, algorithm design paradigms, the concept of data structure and basic data structures, hash tables, binary search trees, graphs and their algorithms.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40h, exercises 24h, independent work 70h.

Target group:

Prerequisites and co-requisites:

Mastery of subject matter of the course "Discrete Structures" is required.

Recommended optional programme components:

Recommended or required reading:

Cormen, Leiserson, Rivest, Stein: Introduction to algorithms, 2nd edition, MIT Press 2001 (or later). From this edition chapters 1–4, 6–13, 15–16, 22–24, Appendix A and B are covered.

Assessment methods and criteria:

Exam+assignment

Grading:

1-5

Person responsible:

Ari Vesanen

Working life cooperation:

No

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa lisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A Signal Analysis 4.0 op

Ei opintojaksokuvauksia.

521453A: Operating Systems, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

After the course the student is capable of explaining the basic structure and functioning of operating system. He/She is able to point the problems related to process management and synchronization as well as is able to apply learned methods to solve basic problems. Student is capable of explaining the cause and effect related to deadlocks and is able to analyse them related to common circumstances in operating systems. Additionally, the student is able to explain the basics of memory management, the use of virtual memory in modern operating systems as well as the structure of the most common file-systems.

Contents:

Topics: 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 course consists of lectures and laboratory work, which includes pre-exercise and guided exercise performed in a group of one or two students in the unix environment.

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:

-

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Pietikäinen, Matti

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A Artificial Intellig (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

In Finnish. The exam and coursework can be passed in English.

Timing:

Periods 3-4.

Learning outcomes:

After taking the course, the student is able to identify the types of problems that can be solved using methods of artificial intelligence. The student knows the basic concepts of intelligent agents, the common search methods used in artificial intelligence, logic based reasoning and applying planning techniques to problems of artificial intelligence. The student can also apply simple methods to reasoning under uncertainty and machine learning from observation. In addition the student will be able to implement the most common search methods.

Contents:

1. Introduction, 2. Intelligent agents, 3. Solving problems by searching, 4. Informed search and exploration, 5. Constraint satisfaction problems, 6. Games, 7. Logical agents, 8. First-order logic, 9. Inference in first-order logic, 10. Planning, 11. Uncertainty, 12. Bayesian Networks, 13. Learning from observation.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures and a programming exercise (approximately 25 hours) during periods 3-4, the rest as independent work.

Target group:

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

Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

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

Recommended or required reading:

Primary text book and slides (in English): Russel S., Norvig P.: Artificial Intelligence, A Modern Approach (AIMA), Second Edition, Prentice Hall, 2003. Lecture notes (in Finnish): Syrjänen, M.: Tietämystekniikan peruskurssin luentomoniste, Teknillinen korkeakoulu, 2004. More details on the course WWW page <http://www.ee.oulu.fi/research/imag/courses/ai/>.

Assessment methods and criteria:

The course is passed with a final exam and a passed programming exercise. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1-5 / fail.

Person responsible:

Professor Matti Pietikäinen

Working life cooperation:

-

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

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:

Upon completing the required coursework, the student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods. He is also able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the filters. Moreover, the student is able to explain the impacts of finite word length in filter design. After the course the student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. 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:

031018P Complex Analysis, 031050A 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:

Olli Silvén

Working life cooperation:

None.

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A Digital Image Processing (OPEN UNI) 5.0 op

ECTS Credits:

5

Language of instruction:

Lectures in Finnish and exercises in English. Course can be passed in Finnish and English.

Timing:

Autumn, period 1.

Learning outcomes:

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

Contents:

This course provides an introduction to digital image processing and machine vision. Topics: 1.Introduction, 2.Image enhancement, 3.Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression,7. Morphological image processing, 8. Image segmentation, 9. Representations and descriptions, 10. Pattern recognition.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and Matlab design exercises 30 h. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

In order to obtain deep understanding of the content, it is a benefit if the student has completed the first year mathematic courses in the computer science and engineering BSc program or otherwise has equivalent knowledge.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Second Edition, Addison-Wesley, 2002 (see course website: <http://www.ee.oulu.fi/research/imag/courses/dkk/>). Lecture notes and exercise material.

Assessment methods and criteria:

The course is passed by a final exam and programming 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:

Matti Pietikäinen

Working life cooperation:

None.

521330A: Telecommunication Engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521357A	Telecommunication Engineering 1	3.0 op
521361A	Basics of Digital Communications	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Second year's spring term, period 4.

Learning outcomes:

After completing the course, a student 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. In addition, a student can tell limitations on system performance caused by noise interference and transmission channels, and can propose methods to suppress interference both in analog and digital transmission. Based on simple assumptions on channel models, a student can perform system analysis, and can calculate performances of analog and digital modulations. A student can also compare modulations from the standpoints of resource use (transmitted power and bandwidth needed) and implementation complexity. In addition, a student understands the meanings of various equalizing, diversity and coding methods from the standpoint of improvement for digital transmission reliability. A student understands various standards and specifications of new digital transmission systems, and can apply gained knowledge to design of systems and their sub-system units, and can also perform computer simulations.

Contents:

Essential and optional blocks of coherent and non-coherent analog and digital transmission systems and their operation principles. Frequently used analog (DSB, AM, SSB, VSB, PM, FM, DM, PCM, PAM, PWM, PPM) and digital (ASK/MASK, PSK/MPSK, FSK/MFSK, MSK/GMSK, QAM, MCM/OFDM, TCM) carrier and pulse modulation methods and their performance analysis (SNR, BEP) and comparison based on the AWGN channel model. Influence of single-tone carrier interference in the case of analog modulations. The threshold effect in the case of non-linear modulations and non-linear receivers. Mixing-principle and superheterodyne receiver. Phase-lock and multiplexing techniques. 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), and diversity and channel equalizing methods aiming to reduce interference. Spread-spectrum technique, and benefits & limitations & applications of that principle. Basics of information theory, source coding and error-control coding methods.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 40 h, class-exercises 16 h, and self-study 69. Total 125 h.

Target group:

Second year's candidate level students.

Prerequisites and co-requisites:

Signal analysis course.

Recommended optional programme components:

-

Recommended or required reading:

Lecture slides 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, 6. edition, 2010, John Wiley & Sons, partially chapters 3, 4, 7, 8, 9, and 11.

Assessment methods and criteria:

Course can be passed either with two mid-term exams, 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:

Kari Kärkkäinen

Working life cooperation:

-

Other information:

This course replaces the following candidate courses of electrical engineering study programme: 521357A Telecommunication Engineering I and 521361A Telecommunication Engineering II.

*Compulsory Bachelor's Thesis***523991A: Bachelor's Thesis / Information Engineering, 8 op**

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish. Bachelor's thesis can be written also in English.

Timing:

All periods

Learning outcomes:

The student is able to set goals for a given task. He can structure the topic coherently, with emphasis on the key issues. The student is able to use sources of information critically. He can present clearly his plan and solution implemented, justify the choices made, and assess the functionality of the solution with relevant testing and evaluation methods. In addition, he is able to compare the results against goals, and produce smooth, clear and finalized text based on technical and scientific writing practices of the field.

Contents:

The student selects the topic together with the supervisor.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

Course is completed at the end of bachelor's studies, typically, in the spring semester of the third study year. The work may be a theoretical or practically oriented study from a topic provided by a company or a research group.

Target group:

Computer Science and Engineering students.

Prerequisites and co-requisites:

Compulsory basic and intermediate studies and the module preparing for the option.

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Bachelor's thesis and the maturity test. Assessment Criteria at the University of Oulu can be found [here](#).
Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass / fail

Person responsible:

Professors and researchers in the Department of Computer Science and Engineering.

Working life cooperation:

Yes

900060A: Technical Communication, 2 op**Voimassaolo:** 01.08.2005 - 31.07.2021**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Negotiated Education**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:

Electrical Engineering, Computer Science and Engineering and Communications Technologies: 2nd year spring term or 3rd year autumn term or 3rd year spring term.

Mechanical Engineering: 3rd year.

Process and Environmental Engineering: 1 st year spring or autumn term.

Learning outcomes:

Upon completion of the course the student should be familiar with the central principles of work and study-related communication, both oral and written, and be able to apply this knowledge in his/her own communication. The student should be able to prepare and give an illustrative and understandable oral presentation on a topic related to his/her own field in a way that suits the audience and the situation. The student should also be able to seek information and report on his/her findings in writing. The student should be able to analyse and assess his/her own writing and the writing of his/her peers. He/she should be able to act in group communication situations in a target-oriented manner. The student should also be able to give and receive constructive criticism.

Contents:

Professional communication skills: team writing, the process of writing and its different stages, distinctive features of formal scientific and professional texts, oral communication, preparing an illustrative presentation, methods of convincing one's audience, giving and receiving constructive criticism, the features of a functioning team, the group process and the roles of team members, negotiations and meeting practices.

Mode of delivery:

Multimodal teaching

Learning activities and teaching methods:

Contact hours ca. 20 h and independent group work or self-study ca. 40 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.

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521484S: Statistical Signal Processing, 5 op**Voimassaolo:** - 31.07.2012**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Heikkilä, Janne Tapani**Opintokohteen kielet:** Finnish**ECTS Credits:**

5

Language of instruction:

In Finnish.

Timing:

Periods 4-6.

Learning outcomes:

Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.

Contents:

1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (30 h), exercises (24 h) and Matlab design exercise (10 h).

Target group:

-

Prerequisites and co-requisites:

Matrix Algebra, Probability and Mathematical Statistics

Recommended optional programme components:

Digital Filters, Signal Analysis

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.

Grading:

Numeric scale 1-5

Person responsible:

Janne Heikkilä

Working life cooperation:

-

Other information:

031022P: Numerical Analysis, 5 op**Opiskelumuoto:** Basic Studies**Laji:** Course**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 specific 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:

-

A452149: Module Preparing for the Option, Applied computing, 10 - 30 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory studies

521151A: Applied Computing Project I, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Vasileios Kostakos, Ojala, Timo Kullervo, Simo Hosio

Opintokohteen kielet: English

Leikkaavuudet:

521041A Applied Computing Project I 8.0 op

ECTS Credits:

10

Language of instruction:

In English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

Upon completing the course the student is able to complete a full cycle of interactive systems development, including requirements elicitation, system design, prototyping, testing, and evaluation. In this work, the student is able apply skills obtained in B.Sc. courses.

Contents:

Project work.

Mode of delivery:

Face to face teaching, project work as collaborative team work.

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully English.

Target group:

3rd year Computer Science and Engineering B.Sc. 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:

Dix, Finlay, Abowd & Beale: Human-Computer Interaction (<http://www.hcibook.com>); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (<http://www.id-book.com>).

Assessment methods and criteria:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Vassilis Kostakos, Timo Ojala.

Working life cooperation:

-

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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

- write and solve the equations describing the operation of a given electrical circuit
- solve the sinusoidal steady-state solution using complex phasor arithmetics
- solve time responses of electric circuits
- simplify electrical circuits e.g. using equivalent circuits
- 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, 22 h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

-

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:

-

Other information:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

On completion of the study module students 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:

-

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:

-

Other information:

-

521012A: Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

521019A Practical training 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

3

Language of instruction:

Finnish.

Timing:

Periods 1-6.

Learning outcomes:

After the practical training the student can describe the job in question 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.

Contents:

The training offers students general insight into working life and to support and to support theoretical studying. Likewise the training has to acquaint the trainee with the social points and work safety in the work place.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

The students find their training jobs themselves.

Target group:

Computer Science and Engineering BSc students.

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:

None.

Assessment methods and criteria:

For BSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. Detailed instructions for 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:

Computer Science and Engineering Planning Officer or Laboratory Engineer Jukka Kontinen

Working life cooperation:

Yes.

Other information:

Practical training is compulsory in the BSc. Tech degree for students who started in 2010 or earlier. For students starting 2011 or later, practical training (521012A) is optional.

H452229: Other Supplementary Module (Computer Science and Engineering), 15 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Supplementary Module / Bachelor's Degree

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

Supplementary module primarily consists of a preparatory module of another orientation (Information Processing Engineering, Applied Computing or Embedded Systems). In this case one additional course of 5 ECTS cr from the same field should be selected to complement the module. Another alternative is to select the supplementary module from the fields of Electrical Engineering, Information Processing Science, Industrial Engineering and Management, Working life & Entrepreneurship, or Economics and Management. In all cases the extent of the supplementary module is 15 ECTS cr.

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

521484S: Statistical Signal Processing, 5 op

Voimassaolo: - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In Finnish.

Timing:

Periods 4-6.

Learning outcomes:

Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.

Contents:

1. Introduction, 2. Modeling of estimation problems, 3. Least Squares estimation, 4. BLUE-estimation, 5. Signal detection, 6. ML estimation, 7. MS estimation, 8. MAP estimation, 9. Kalman Filter.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (30 h), exercises (24 h) and Matlab design exercise (10 h).

Target group:

-

Prerequisites and co-requisites:

Matrix Algebra, Probability and Mathematical Statistics

Recommended optional programme components:

Digital Filters, Signal Analysis

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.

Grading:

Numeric scale 1-5

Person responsible:

Janne Heikkilä

Working life cooperation:

-

Other information:

-

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

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 specific 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:

-

A452149: Module Preparing for the Option, Applied computing, 10 - 30 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory studies

521151A: Applied Computing Project I, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Vasileios Kostakos, Ojala, Timo Kullervo, Simo Hosio

Opintokohteen kielet: English

Leikkaavuudet:

521041A Applied Computing Project I 8.0 op

ECTS Credits:

10

Language of instruction:

In English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

Upon completing the course the student is able to complete a full cycle of interactive systems development, including requirements elicitation, system design, prototyping, testing, and evaluation. In this work, the student is able apply skills obtained in B.Sc. courses.

Contents:

Project work.

Mode of delivery:

Face to face teaching, project work as collaborative team work.

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully English.

Target group:

3rd year Computer Science and Engineering B.Sc. 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:

Dix, Finlay, Abowd & Beale: Human-Computer Interaction (<http://www.hcibook.com>); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (<http://www.id-book.com>).

Assessment methods and criteria:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Vassilis Kostakos, Timo Ojala.

Working life cooperation:

-

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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

- write and solve the equations describing the operation of a given electrical circuit
- solve the sinusoidal steady-state solution using complex phasor arithmetics
- solve time responses of electric circuits
- simplify electrical circuits e.g. using equivalent circuits
- 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, 22 h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

-

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:

-

Other information:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Häkkinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

On completion of the study module students 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:

-

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:

-

Other information:

-

*Supplementary Module: Electrical Engineering (15 ECTS cr)***521302A: Circuit Theory 1, 5 op****Opiskelumuoto:** Intermediate Studies**Laji:** Course**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

- write and solve the equations describing the operation of a given electrical circuit
- solve the sinusoidal steady-state solution using complex phasor arithmetics
- solve time responses of electric circuits
- simplify electrical circuits e.g. using equivalent circuits
- 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, 22 h exercises, and a simulation exercise.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

-

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:

-

Other information:

-

521431A: Principles of Electronics Design, 5 op**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Juha Häkkinen**Opintokohteen kielet:** Finnish**ECTS Credits:**

5

Language of instruction:

Finnish.

Timing:

Spring, period 4

Learning outcomes:

On completion of the study module students 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:

-

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:

-

Other information:

-

521077P: Introduction to Electronics, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**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

Language of instruction:

Finnish

Timing:2nd period.**Learning outcomes:****Objective:** The course provides basic concepts of electronic systems with emphasis on properties of electronics components and how the materials affect to their operation**Learning outcomes:** Student understands the block structures of electronic devices and their signal processing paths. Student can identify the interfaces of analog and digital electronics and the software operations. Student is able to identify and classify electronics components and compare their properties. Students can describe electric conductivity and apply the phenomenon on designing and choosing resistors. Student is able to estimate the difference between dielectric materials and how they affect the properties of a capacitor. Student can compare properties of magnetic materials and how identify they effect on inductive components. Student can identify semiconductivity and is able to list typical semiconductor components. Student can classify different circuit board techniques and is able to choose proper coupling techniques. In addition 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:

Classroom teaching and independent work.

Learning activities and teaching methods:

Lectures (24 h) and guided laboratory work (24 h).

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:

Course work and final exam.

Grading:

Numerical grading 1-5.

Person responsible:

Jari Hannu

Working life cooperation:

-

521329A: Hands-on Course in Wireless Communication, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**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:

Autumn, period 1

Learning outcomes:

This course introduces students into problems of wireless communication technology with the aid of small laboratory exercises which do not require prior knowledge on telecommunication engineering. A student observes and learns the operation principles, properties and limitations of existing wireless communication systems with the aid of modern measurement instruments & methods used in laboratory environment. After completing the course a student can approach different kinds of wireless communication problems utilizing engineering practices.

Contents:

Students are introduced to the wireless communication systems and corresponding phenomena with the aid of guided laboratory exercises. The course utilizes various existing wireless communication systems, in order to create simple connections between various equipment and modules in a laboratory environment.

Mode of delivery:

Contact teaching and guided laboratory exercises.

Learning activities and teaching methods:

Students will participate in briefing lectures which introduce the theory needed to conduct the laboratory work items. After each lecture students will study a given problem with the aid of measuring instruments in a laboratory environment. Work items are conducted by groups of two students, and results are given in written report. Course contains 14 h of contact teaching and 28 h of laboratory work. In addition, self-study, discussion and reporting of results are performed.

Target group:

Second year bachelor level electrical engineering students.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Lecture slides and problem assignments. Materials are stored into OPTIMA environment.

Assessment methods and criteria:

A group of two students participates in contact teaching and prepares a final report according teacher's instructions. Participation in laboratory exercises is mandatory for both students of a group.

Grading:

The course unit utilizes a numerical grading scale 1-5.
Read more about [assessment criteria](#) at the University of Oulu webpage.

Person responsible:

Kari Kärkkäinen

Working life cooperation:

-

Other information:

-

521104P: Introduction to Material Physics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In Finnish.

Timing:

Periods 3.

Learning outcomes:

Objective: The students are introduced to the physical principles of electronic and atomic phenomena existing in electronic materials and components. The connections to the general principles of solid state physics are emphasized in the consideration of the phenomena.

Learning outcomes: After completing the course, student is able to explain the principal solid state crystal structures. He or she can explain how propagating waves and electrons in a crystal lattice can be presented. Moreover, he or she 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. He or she 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:

Lectures, exercises and home works.

Learning activities and teaching methods:

Lectures 28 h / exercises 22 h / self-access learning 60 h.

Target group:

Second year electrical engineering students

Prerequisites and co-requisites:

Basic physics and mathematics.

Recommended optional programme components:

-

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:

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

Person responsible:

Juha Hagberg

Working life cooperation:

No

521071A: Principles of Semiconductor Devices, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

Leikkaavuudet:

521205A Principles of Semiconductor Devices 4.5 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Period 4

Learning outcomes:

Objective: The course is an introduction to physical principles of design and operation, and main characteristics of semiconductor diodes and transistors used in electronic circuits.

Learning outcomes: Student will be able to explain physical phenomena in semiconductor materials and junctions; describe main types and characteristics of semiconductor diodes and transistors. Student 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:

Lectures, laboratory work and exercises.

Learning activities and teaching methods:

Lectures 28 h / exercises 20 h / Laboratory work 2h / self-access learning 60 h.

Target group:

-

Prerequisites and co-requisites:

521104P Introduction to materials physics.

Recommended optional programme components:

-

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.

Grading:

Numerical grading 1 – 5.

Person responsible:

Juha Hagberg

Working life cooperation:

No.

521303A: Circuit Theory 2, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

Period 2

Learning outcomes:

After the course the student can:

- use Laplace transform for solving time and frequency response of electric circuits;
- derive continuous-time transfer functions.;
- solve their poles and zeros and understand the meaning of those;
- draw the pole-zero map and Bode plots of any given transfer function;
- construct 2-port parameter models of a given circuit

Contents:

Use of Laplace transform in network analysis. Properties of network functions, poles and zeros, Bode magnitude and phase plots. 2-port parameter models.

Mode of delivery:

Classroom

Learning activities and teaching methods:

30h lectures, 22 h exercises, and simulation exercises.

Target group:

Finnish BSc students

Prerequisites and co-requisites:

Basics of circuit theory, differential equations.

Recommended optional programme components:

-

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:

-

Other information:

-

521432A: Electronics Design I, 5 op**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Juha Häkkinen**Opintokohteen kielet:** Finnish**ECTS Credits:**

5

Language of instruction:

Finnish.

Timing:

Autumn, period 1

Learning outcomes:

On completion of the study module students should be able to recount the principles covering the design of multistage amplifiers, analyze and set the frequency response of a transistor amplifier and make use of feedback to improve the properties of an amplifier in the desired manner. They should also be able to analyze the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability. Students should similarly be able to describe the principles governing the design of power amplifiers, to make widespread use of operational amplifiers for realizing electronic circuits and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers. They should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and tuned amplifiers and 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:

Not defined.

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:

-

Other information:

-

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

After completing this course the student 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.

Objective: To deepen the knowledge of digital logic design acquired in Digital Techniques 1, and to learn advanced design methods and use of design tools.

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 arithmetics. 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:

Finnish BSc students.

Prerequisites and co-requisites:

Digital techniques I.

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam and a design exercise, 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:

-

Other information:

-

521384A: Basics in Radio Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

1

Learning outcomes:

After completing the course the student can define what radio engineering is and list its separate areas. He /she is also able to describe different terms and applications of radio engineering. Using Maxwell's equations the student can solve the propagation of radio waves in a homogeneous medium, the reflection and transmission at an interface of two lossless media, the power and energy of the electromagnetic fields, as well as, the radio wave propagate on in common transmission lines and waveguides. In addition, he/she is able to apply these solutions to typical problems in radio engineering. The student can utilize the methods based on the Smith chart for the impedance matching of microwave circuits and antennas. He /she can describe the operation of passive transmission line and waveguide devices, resonators and filters, as well as, the operation of the circuits based on the semiconductor devices. In addition, he/she is able to calculate their characteristics with the microwave circuit theory. The student is capable to describe the antenna terms, to classify antenna types and antenna arrays, as well as, to calculate the electromagnetic fields radiated by them. He/she can classify and describe the most significant radio wave propagation mechanisms occurring over the radio links on the Earth's surface, through the troposphere and via the ionosphere. The student is able to summarize the structure of a radio system and to calculate the properties of its blocks. In addition, he/she can design a free-space radio link using the link budget. The student can identify the biological effects and safety standards of radio waves and can apply them to himself or herself and to other people.

Contents:

Introduction to radio waves and radio engineering. Fundamentals of electromagnetic fields. Transmission lines and waveguides. Impedance matching. Microwave circuit theory. Passive transmission line and waveguide devices. Resonators and filters. Circuits based on semiconductor devices. Antennas. Propagation of radio waves. Radio system. Applications of radio engineering. Biological effects and safety standards.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 26 h and exercises 16 h.

Target group:

3rd 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. Otatiето, 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. Otatiето, 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:

-

Other information:

-

521070A: Introduction to Microfabrication Techniques, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

Objective: The course provides basic knowledge on fabrication methods of micro- and nanotechnologies including standard fabrication methods of integrated circuits

Learning outcomes: After the course student can

- to explain properties of micro- and nanoelectronics and micro- and nanomechanics materials, processing of source materials and basics of fabrication methods
- design fabrication processes for simple microdevices, and able to analyze fabrication processes of complex microdevices

Contents:

The various fabrication techniques that are relevant for micro devices in the field of electronics, optoelectronics and micro-electro-mechanical-systems (MEMS) will be addressed in the lectures. Silicon and thin film materials and their basic processes and utilization in component fabrication; pattern

generation, add, remove and alter layers, metallization, passivation, isolation, bonding and packaging. Processes and fabrication methods and materials utilized in nanotechnology, MEMS systems and printed electronics. Fabrication methods are demonstrated with a component fabricated in laboratory exercises.

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. Course book will be informed later.

Assessment methods and criteria:

Final written exam and passes laboratory exercises.

Grading:

Numerical grading 1-5.

Person responsible:

Merja Teirikangas

Working life cooperation:

No

Other information:

-

Compulsory

521070A-01: Introduction to Microfabrication Techniques, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Teirikangas, Merja Elina

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521070A-02: Introduction to Microfabrication Techniques, exercise work, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Teirikangas, Merja Elina

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521304A: Filters, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**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:

- draw a pole-zero map for a given transfer function;
- perform impedance and frequency scaling for component values;
- choose an appropriate prototype filter and filter degree;
- synthesize passive RLC filters;
- synthesize active opamp based filters;
- can compare various filter technologies;
- 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:

Classroom

Learning activities and teaching methods:

30 h lectures, 16 h exercises. A design exercise (15h).

Target group:

Finnish students

Prerequisites and co-requisites:

Basics of circuit theory and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 12-18.

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:

-

Other information:

*Compulsory***521304A-02: Filters, exercise work, 0 op****Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Partial credit**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Marko Neitola, Rahkonen, Timo Erkki**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

521331A-02 Filters, exercise work 0.0 op

521331A Filters 4.0 op

Ei opintojaksokuvauksia.

521304A-01: Filters, exam, 0 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Partial credit**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Rahkonen, Timo Erkki**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

521331A Filters 4.0 op

Ei opintojaksokuvauksia.

521092A: Electronic Measurement Techniques, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**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

Language of instruction:

Course is lectured in Finnish. Laboratory exercises and the exam can be done in English.

Timing:

Period 4

Learning outcomes:

Learning outcome: Upon completion of the course, students can name the electrical measurement technique terminology associated to measurement systems, sensors and buses to candidate level. They can plan and implement complicated measurements with oscilloscopes and basic measurements with spectrum analyzers and light detectors. Students can measure common sources of noise and interference and can name means to control them. Students can name methods to realize electrical quantities.

Contents:

Calibration, measurement amplifiers, spectrum analysers and correlation measurements, noise and interference, grounding, CMR and processing of measurement results

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.

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.

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

On completion of the study module students should be able to design basic electronic structural blocks and verify their functionality in a CAD simulation environment. They should be 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:

-

Target group:

-

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:

Principles of Electronics Design and Electronics Design I.

Recommended or required reading:

-

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:

-

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S Statistical Signal Processing 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for

different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.

Contents:

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.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab design exercise (10 h). The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031019P 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:

Esa Rahtu

Working life cooperation:

None.

Supplementary Module: Information Processing Science. (15 ECTS cr)

810136P: Introduction to Information Processing Sciences, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kuutti, Kari Pekka Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay810136P Introduction to information processing sciences (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/135 hours of work

Language of instruction:

Finnish

Timing:

1st year of Bachelor studies, autumn semester, period 1

Learning outcomes:

Students are able to complete information searches belonging to subject areas related to the course, analyse the information they have found and write short reports and essays.

Contents:

The course consists of lectures of various aspects of computer science and current research. Practical working life is discussed from the information science point of view. The course also introduces scientific work and its sub-processes through listening, discussing, reading, critical and creative thinking, material search, structuring and writing papers.

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Lectures (24 h), exercise work (40 h), and self-study (71 h). The course uses a web-based learning environment for sharing information and exercises in support of reading.

Target group:**Recommended optional programme components:****Recommended or required reading:**

Will be announced during the course.

Assessment methods and criteria:

Will be announced during the course.

Grading:

1 - 5

Person responsible:

Kari Kuutti

811122P: Introduction to Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811122P Introduction to Programming (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

Finnish

Timing:

1st year, period 2

Learning outcomes:

Objective: Student can systematically design, accomplish and test simple programs using C-language as a target language.

Learning outcomes: After the course, the student:

- Understands the importance of design in programming;
- Can design and implement modular programs;
- Understands the principles of control structures and can exploit them;
- Understands the meaning on array constructions and can exploit them;
- Understands the meaning of pointers and can exploit them;
- Understands the meaning of data structures and can exploit them;
- Can manipulate text files programmatically.

Contents:**Contents:**

- Software design method (waterfall)
- Problem solving
- Stepwise refinement
- Control structures
- Modular programming, calling modules, communication between modules
- Data types
- Arrays
- Pointers
- Character strings
- Data structures
- File processing

Learning activities and teaching methods:

Mode of delivery: Lectures and exercises

Target group:

Target group: Bachelor level students, compulsory

Recommended optional programme components:

-

Recommended or required reading:

Study materials: <https://noppa.oulu.fi/noppa/kurssi/811122p/etusivu>

Course book: Datel, Datel: C HOW TO PROGRAM; Pearson Education Inc. 2007

Assessment methods and criteria:

Assessment methods: two ways : 1. Final exam & exercise points; and 2. Weekly exams & exercise points

Grading:

1-5

Person responsible:

Ilkka Räsänen

813316A: Business Process Modeling, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kontula

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

English

Timing:

The course unit is held in the spring semester, during period 4. It is recommended to complete the course in the second year of Bachelor studies.

Learning outcomes:

After completing the course, students are able to model and develop business processes, as well as use a computer-based process modeling tool. The students are able to distinguish between business process change on the enterprise level, business process level and the implementation level, and to and evaluate these business process changes.

Contents:

Process architecture and how it can be fitted to the organisation, process modelling, process performance measurement, understanding process-related problems, process development, software tools for modelling and analysing processes, exercises.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 30h, exercises 12h, course assignments 45h, problem-based learning 27h, exam 20h. The course assignments will be done as group work, the lecture reflections and the exam will be done as individual work.

Target group:

Recommended optional programme components:

-

Recommended or required reading:

Harmon, Paul (2007). Business Process Change. A Guide for Business Managers and BPM and Six Sigma Professionals. Morgan Kaufmann Publishers.

Assessment methods and criteria:

This course unit utilizes continuous assessment. Lectures are voluntarily, but participation is highly recommended. The students will write lecture reflections, a problem-based learning report, and will create a process model with a software tool. In addition, there will be an exam at the end of the course, which will be assessed. The assessment of the course unit is based on the learning outcomes of the course unit. 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:

Karin Väyrynen

Working life cooperation:

No

811177P: Humans as Users and Developers of Information Technology, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Minna Isomursu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811177P Humans as Users and Developers of Information Technology (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/130 hours of work

Language of instruction:

finnish

Timing:

1st year, autumn semester, period 2

Learning outcomes:

After completing the course, students will be able to examine humans as both users and developers of information technology. The student learns core concepts of the phenomenon, and understands their meaning in relation to practice. Students are also familiar with the background of usability research and some of its scientific theories. Students are able to observe and specify a variety of use situations and user experiences of information technologies. Students also understand the challenges of the information technology developers when targeting to create pleasant use experiences for the users of these technologies. After completing the course, students also realize they have started their own journey to become an expert in information technology development.

Contents:

The key themes and concepts of the course are the diversity of information technology, humans as users and developers of information technology, usability, use and user experience, user-centred design.

Mode of delivery:

Face-to-face teaching and self-studying supported with web-based learning environment.

Learning activities and teaching methods:

Lectures (24h), home assignments and written task based on required reading (about 106h).

Recommended or required reading:

Antti Oulasvirta (ed.): "Ihmisen ja tietokoneen vuorovaikutus" (2011), parts I and II. In addition, the material during lectures and other supplementary material.

Assessment methods and criteria:

Course assessment is mainly based on the pre-assignment, home assignments, and individual essay based on the required reading. In addition, one may improve one's own grade by optional advanced assignment. Assessment criteria will be available in the web-based learning environment.

Grading:

1-5

Person responsible:

Minna Isomursu

Working life cooperation:

No

811375A: User Interface Programming, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Lappalainen, Jouni Esko Antero

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

Finnish

Timing:

3rd year, autumn semester, periods 1 + 2

Learning outcomes:

After completing the course, the student can implement a software application that utilises a database for storage and has a graphical user interface. The GUI (as well as the entire application) must be developed by implementing usability design principles from the beginning of the development process.

Contents:

The course deals with the following: UI elements, foundations of the Swing library, UI design principles, layout managers, MVC-paradigm, event-driven programming, web-usability, JSP, programmatically utilising databases, JDBC, web-programming.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Exercise 33h, coursework 75h, independent study 26h.

Target group:

Prerequisites and co-requisites:

Knowledge and skills of the course "811380A Basics of Databases" and fundamentals of user interface design. In addition, the knowledge and skills of object-oriented programming are needed.

Recommended optional programme components:

Recommended or required reading:

Lectures in textual format within the course web space. In addition (if needed), for example Kosonen, Peltomäki & Silander (2005). Java 2 ohjelmoinnin peruskirja. Docendo. In addition, Lauesen, S. 2005. User Interface Design: A Software Engineering Perspective.

Assessment methods and criteria:

The student must submit coursework that fulfils the given requirements (defined during the course). Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1–5 / fail

Person responsible:

Jouni Lappalainen

Working life cooperation:

No

811379A: Basics of Human Computer Interaction, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Anna-Liisa Syrjänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811379A Basics of Human Computer Interaction (OPEN UNI) 5.0 op

812327A Introduction to HCI design 4.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish

Timing:

2nd year, spring semester, period 3

Learning outcomes:

After completing the course, a student is able to define the basic concepts of user interface design, introduce the basic design process and its steps, the most common design and evaluation methods and tasks, and apply them in the context of graphical user interface design from the viewpoint of a certain user group and system.

Contents:

The fundamental concepts of user interface design and usability evaluation; user-centred design process; evaluation of the user group's viewpoint and application to graphical interface design, structure and elements by prototyping and user-based evaluation; user interface description, universal design and user support.

Mode of delivery:

Face-to-face teaching, self-study

Learning activities and teaching methods:

Learning Activities and Teaching Methods: Lectures (21 h), assignments in exercises (24 h), individual and group tasks (88 h); or self-study: an opening lecture (2 h), one larger assignment (110 h) and individual tasks (21 h).

Target group:**Prerequisites and co-requisites:**

Course "Humans as Users and Developers of Information Technology" (811171P) or similar knowledge.

Recommended optional programme components:**Recommended or required reading:**

Dix et al. (2004, 3rd edition or later edition) Human-Computer Interaction and lecture and assignment materials.

Assessment methods and criteria:

Accepted assignments and individual tasks.

Grading:

1–5

Person responsible:

Anna-Liisa Syrjänen

Working life cooperation:

No

815345A: Software Architectures, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juustila, Antti Juhani

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

Finnish

Timing:

3rd year, periods 3-4

Learning outcomes:

The course aims to give an overview of concepts and techniques related to software architectures. The emphasis is on object-oriented systems but generic architectural models and techniques are discussed, too. After the course, the student is able to identify and analyse different software architecture solutions and understands the pros and cons of each solution from the perspective of building and executing the software, as well as from the viewpoints of quality and maintainability. The student is able to describe software architecture solutions and the elements of such, including the interfaces between the elements, using UML. The student is able to create alternative architectural solutions based on the functional and non-functional requirements of the software, and evaluate the suitability of the solution regarding the purpose of the software. The student is able to identify the differences between the design of product/product family architectures with conventional software architectures

Contents:

The fundamentals of software architectures. Documenting software architectures. Components and interfaces. Dependencies in software. Design patterns. Architectural styles. Product line architectures. Frameworks. Evaluating software architectures.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24h, exercises 20h, assignment 90h

Target group:

Bachelor level students

Prerequisites and co-requisites:

General knowledge of software development, UML basics and general experience with object-oriented programming (included in courses: 811335A Software Engineering, 812346A Object-oriented Analysis and Design, 812347A Object-oriented Programming).

Recommended optional programme components:

Advanced Object-oriented Programming is a recommended prerequisite.

Recommended or required reading:

- Robert Hanmer: Pattern-Oriented Software Architecture For Dummies, 2013
- K. Koskimies, T. Mikkonen: Ohjelmistoarkkitehtuurit. Talentum 2005;
- L. Bass, R. Clements, R. Kazman: Software Architecture in Practice. Addison-Wesley 2003;
- Other material announced .

Assessment methods and criteria:

The assessment of the course unit is based on the learning outcomes of the course unit. The student must pass the exercises and the assignments. The more detailed assessment criteria are available on the Noppa page of the course unit.

Grading:

Fail, 1-5

Person responsible:

Antti Juustila

Working life cooperation:

No

811174P: Introduction to Software Business, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Marianne Kinnula

Opintokohteen kielet: Finnish

Leikkaavuudet:

811178P Technology Business and Innovations 5.0 op
ay811174P Introduction to Software Business (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

Finnish

Timing:

1st year, spring semester, period 4

Learning outcomes:

After completing the course, a student can:

- Explain how the industry is structured;
- Describe the software industry's business logic as typically used in business models and the reasoning behind their use;
- Describe the important areas of the software business.

Contents:

This course provides an overview of software business from three different viewpoints: software industry, business logic, and functions of a software company. The course topics include history of software business, structuring and clusters of software industry, business models in software industry, networking and outsourcing, growth and development of a software company, software marketing and sales, and internalization of a software company.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (26-30h), exercises (20h), independent work (54-58h), take home examination (30h)

Target group:

Recommended optional programme components:

-

Recommended or required reading:

Kurssimateriaali ja siihen liittyvä kirjallisuus.

Assessment methods and criteria:

Assignments, take home examination.

Grading:

1 - 5

Person responsible:

Marianne Kinnula

811346A: Software Engineering, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Lappalainen, Jouni Esko Antero**Opintokohteen kielet:** Finnish**ECTS Credits:**

5 ECTS

Language of instruction:

Finnish

Timing:2nd year, period 2**Learning outcomes:**

After completing the course, a student is able to explain various aspects of software engineering areas such as process models, requirement specification, analysis and design methods, quality management and project management, their importance and know how to use them for small-scale task solving. A student is familiar with software engineering practices and activities (review, testing, software product management, risk management, project management) and knows how to use them in software development at different levels. A student can explain the maintenance and redesign of software evolution and its importance.

Contents:

Software process, software requirements, software design methods, software engineering practices, software quality management, software project management

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Implementation methods of the course vary: a) Lectures 32h, exercises 24h, study group working 40h, assignment 40h and self-study 24h; b) Lectures 32h, exercises 24h, exam 64h, assignment 40h; c) Lectures 32h, exercises 24h, essay 64h, assignment 40h.

Prerequisites and co-requisites:

Course "811169P Introduction to Information Systems Design" and "812346A Object Oriented Analysis and Design" or similar knowledge.

Recommended optional programme components:**Recommended or required reading:**

Pressman R., Software Engineering, A Practitioner's Approach, 7th edition, McGraw-Hill, 2010, lecture material

Assessment methods and criteria:

Exam and assignment, exam can be replaced by study group work or essay.
Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Jouni Lappalainen

Working life cooperation:

No

812341A: Object-Oriented Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812341A Object-oriented Programming (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

finnish

Timing:

1st year, spring semester, period 4

Learning outcomes:

After completing the course, the student is able to explain the general objectives and techniques of object-oriented programming paradigm. Furthermore, the student can describe the practical meaning of concepts of object-oriented programming. The student can construct Java programs that apply inheritance, composition, and polymorphism.

Contents:

Introduction to object-orientation, Basics of programming in Java language, Composition, inheritance and polymorphism, Java collections and exception handling.

Mode of delivery:

face to face

Learning activities and teaching methods:

Lectures 32h, laboratory exercises 21h, weekly assignments and independent work 80h

Prerequisites and co-requisites:

Course Introduction to Programming or similar knowledge.

Recommended or required reading:

- Timothy Budd: Introduction to object-oriented programming, 3rd edition.
- Vesterholm – Kyppö: Java-ohjelmointi 6. tai uudempi painos, luvut 1-11.
- Kurssin verkkomateriaali

Assessment methods and criteria:

Weekly assignments (preferred) or final exam + programming assignment

Grading:

1-5

Person responsible:

Ilkka Räsänen

Compulsory

812341A-01: Object-oriented programming, exercise work, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

812341A-02: Object-oriented programming, exam, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

812342A: Object Oriented Analysis and Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812342A Object Oriented Analysis and Design (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish. If at least four non-Finnish student take the course, English exercises group is organised.

Timing:

2nd year, start of the autumn semester

Learning outcomes:

After completing the course, the students know possibilities of UML-language family to describe different views. They can picture a task using Use cases and scenarios. Moreover they can produce detailed descriptions using activity-, class-, interaction- and state diagrams. They know principles of object-orientedness and can use abstract as well interface classes. Additionally they can model user interface by state diagrams. They understand what design patterns are and how they are described and categorised.

Contents:

Principles of object orientation and object-oriented programming; quality criteria of object orientation; design patterns; case use; activity, class, interaction and state machine diagrams; class realisation.

Mode of delivery:

Face to face

Learning activities and teaching methods:

Lectures 30h, compulsory exercises and assignments 28h, independent work 85 h.

Prerequisites and co-requisites:

Course of elementary programming (such as 811192P Introduction of programming) is a compulsory prerequisite.

Basic knowledge of object programming and information systems analysis and design are assumed.

Recommended or required reading:

Bennet, McRobb & Farmer: Object-oriented systems analysis and design, Using UML.

Assessment methods and criteria:

Examination. At least 50% on points needed for passing the course.

Grading:

1-5

Person responsible:

Juha Iisakka

812305A: Information Systems in Organisations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Seppo Pahnila

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/134 hours of work.

Language of instruction:

finnish

Timing:

1st year of Bachelor level studies, fall semester, periods 1-2.

Learning outcomes:

After completing the course, the student

- Can explain the importance of information systems in organizations
- Can define the conditions for the successful operation of the information in the organization
- Can explain the main features of the development of information systems

Contents:

The basics issues of organization, structure, and operation, the basics of a digital organization, information types and roles of the organizations, interaction between information and organization, the role of information systems in the management of organizations and decision-making, formation of organizational knowledge and management, enterprise resource planning (ERP) systems, organizational reform of information systems and the economic importance of information systems.

Mode of delivery:

Face-to-face lectures. Individual lecture assignments. Each student write at minimum eight so called week essays of ten. Lectures and the subject of each essay are available in Optima learning environment. Students upload the essays into Optima.

Grading:

1-5

Person responsible:

Seppo Pahnila

811167P: Introduction to Information Systems Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Rajanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811167P Introduction to Information Systems Design (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/136 hours of work

Language of instruction:

finnish

Timing:

1st year of Bachelor studies, period 3

Learning outcomes:

After completing the course, the student will be able to:

- Explain the main areas of the information system design on technical level, main design process models for the information system design, basics of the requirement gathering, basics of the information system initialization, and basics of how to evaluate information systems.;
- Produce use-case descriptions, use-case diagrams and other types of diagrams and descriptions needed to model the operational environment of the information system

Contents:

Basic concepts of Information Systems, Information System Design, Information System Modeling, Operational Environment Modeling, Process models for Information System Development, Evaluation of Information Systems

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (9x3h), Exercises (7x3h), Assignment (85h), Exam (3h).

Recommended or required reading:

Structure and contents of the course are based on:

- Satzinger, Jackson ja Burd (2007), Systems Analysis and Design in a Changing World
- Hoffer, George and Valacich (2008), Modern systems Analysis and Design, 5. revision

Assessment methods and criteria:

Exam and mandatory assignment

Grading:

1-5

Person responsible:

Mikko Rajanen

Compulsory

811167P-01: Introduction to Information Systems Design, exercise work, 0 op

Opiskelumuoto: Basic Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

811167P-02: Introduction to Information Systems Design, exam, 0 op

Opiskelumuoto: Basic Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Rajanen

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

812332A: Information Systems Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kaisu Juntunen

Opintokohteen kielet: Finnish

Grading:

1-5

Person responsible:

Kaisu Juntunen

811394A: Database systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/ 133 hours of studying

Language of instruction:

finnish

Timing:

Spring. Period 4.

Learning outcomes:

After completing the course, students have constructed a small database application. They are able to build simple XML- database and they can use object-relational database with object oriented program.

In addition, they have knowledge of modern non-relational database solutions (such as data warehouses and NoSQL-databases) and they have commanding knowledge of making use of those non-relational databases (such as data mining and Big data techniques).

Contents:

Relational database application, Object- and XML extensions in relational databases. Modern database solutions and the use of them.

Mode of delivery:

Face to face

Learning activities and teaching methods:

Lectures 30h, compulsory computer exercises 54h, another exercises 21 h and self-study 32h.

Prerequisites and co-requisites:

Basics of database -course (such as 811380A) and Object oriented analysis and design course (such as 812346A) are compulsory prerequisites.

Recommended or required reading:

Will be announced in lectures.

Assessment methods and criteria:

Will be announced in lectures.

Grading:

1-5

811395A: Basics of Databases, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/ 133 hours of studying

Language of instruction:

finnish

Learning outcomes:

After completing the course, students understand what databases are and what their meaning for information systems is. They can model conceptually for database designing purposes, design a high-quality relational database and make queries to it. They understand transactions, schedules of transactions, serialiseability of schedules and recovery choices of schedules. They also know what different SQL Isolation levels means to safety of transactions.

Contents:

Conceptual modelling (ER- and EER-diagrams), relational model (theory, databases, query techniques and normalization), transactions.

Mode of delivery:

face to face

Learning activities and teaching methods:

Lectures 45h, compulsory exercises 24h and (reading 20h) and exams 21h. Self-studying 23 h.

Prerequisites and co-requisites:

The student knows basics of programming.

Recommended or required reading:

Silberschatz, Korth & Sudarshan: Database system concepts. Elmasri & Navathe: Fundamentals of database systems.

Assessment methods and criteria:

The course is divided to five parts. All parts must be passed in a year. Students must show they achieve at least half of required knowledge of each part.

Grading:

1-5

Person responsible:

Jua lisakka

810122P: Computer Architecture, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Oivo, Markku Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521267A Computer Engineering 4.0 op

ECTS Credits:

5 ECTS credits/135 hours of work

Language of instruction:

finnish

Timing:

1st year, spring semester, period 3

Learning outcomes:

After completing the course, a student understands and manages the software platform for the performance of the structure and activities related to performance, resource needs, and error situations. Students master the basic vocabulary, which is able to communicate and document the software development, particularly in the nearby device applications such as embedded software, mobile systems, multimedia and scientific computing.

Contents:

1. Basics of digital logic and components of a processor
2. Display formats of digital information
3. The processor and its functions
4. The processor instruction set
5. Assembly language
6. Memory management
7. Input and output
8. Interrupts, device drivers and BIOS
9. Multimedia support
10. Mobile processors
11. Parallel computing

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 40h, home exercises 15h, laboratory exercises 15h, examination either through 2 intermediate exams (preparation 65h) or through final exam (preparation 65h)

Recommended or required reading:

Comer; D.E., Essentials of Computer Architecture. Pearson/Prentice Hall. ISBN 0-13-106426-7. 2005. 369 s.

Also examples of the following books are used in lectures :

- Tanenbaum A.S., Structured Computer Organizations. 4th Edition. Prentice Hall. 1999. 700 s.
- Stallings, W. Computer Organization and Architecture. 5th Edition. Prentice Hall. 2000. 768 s.

Assessment methods and criteria:

Examination

Grading:

1-5

Person responsible:

Petri Pulli

811168P: Information Security, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Mari Karjalainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811168P Information Security (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

Finnish

Timing:

2nd year, period 1

Learning outcomes:

After completing the course, a student remembers the main features of the history of information security and is able to define essential security concepts. She/he recognises the different phases of security systems development, is able to evaluate their contents and can describe the fundamental characteristics of planning for security. The student is capable on a basic level of analysing the main scientific methods of information security (risk management, encryption, authentication, access control, etc.) and can explain the functioning of the most important security algorithms and protocols. She/he is able to solve small-scale problems in encryption and authentication and can use security software tools whose functioning principles he/she understands.

Contents:

1. History and basic structures;
2. The need and concepts of information security;

3. Risk management;
4. Planning of security;
5. Cryptography;
6. Access control;
7. Security protocols;
8. Software security;
9. Implementing information security;
10. Information security maintenance.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32h, exercises 32h, autonomous work about 64h

Target group:**Prerequisites and co-requisites:**

Mastering the material presented in the courses "Discrete Structures" and "Internet and Computer Networks" is of use

Recommended optional programme components:**Recommended or required reading:**

Lecture slides (about 250 slides), text book: M. Whitman and H. Mattord, H., *Principles of Information Security 2nd ed.*, Thomson Course Technology, Boston, 2005. ISBN 0-619-21625-5

Assessment methods and criteria:

lectures by final exam

Grading:

1-5

Person responsible:

Mari Karjalainen

Working life cooperation:

No

811391A: Requirements Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Saukkonen, Samuli

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811391A Requirements Engineering (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

Finnish

Timing:

3rd year, autumn semester, period 2

Learning outcomes:

After completing this course, the student can analyse the requirements from the problem-domain and solution-domain viewpoints, and understands the special issues associated with these viewpoints. The

student can distinguish the roles of problem-domain and solution-domain requirements for the customer and developer; he/she is able to identify various project types and knows which requirement style fits best to each project type. The student will be familiar with various requirement definition styles together with their pros and cons, and is able to use some of the most important definition styles. Several requirements elicitation techniques will be added to the student's toolbox with the skills of mastering some of them. The principles of requirements management, validation and verification during the product life cycle will be familiar to the student at the end of this course.

Contents:

Concepts of problem and solution domain. Requirements in different use contexts. Description styles for functional and non-functional requirements. Validation and verification of requirements. Requirements negotiation and prioritisation. Release planning. Requirements management during the product life cycle.

Mode of delivery:

The tuition will be implemented as face-to-face teaching.

Learning activities and teaching methods:

Lectures 32h, weekly assignments and project assignment about 102h.

Target group:

Prerequisites and co-requisites:

We assume the basic skills from the following courses: "811169P Introduction to Information System Design", "812346A Object-Oriented Analysis and Design", "811380A Basics of Databases", "811335A Software Engineering" and "812334A Information Systems Planning".

Recommended optional programme components:

Recommended or required reading:

S. Lauesen, Software Requirements – Styles and Techniques. Pearson Education 2002; chapters 1–4 and 6–9. A.M. Davis, Just Enough Requirements Management, Dorset House Publishing 2005; parts. Lecture slides.

Assessment methods and criteria:

Two ways of passing:

- 1) Active participation: weekly assignments and project assignment (only for Finnish-speaking students)
- 2) Conventional exam

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Active participation will be evaluated based on the weekly assignments and the project work; the scale will be 1–5. The exam will be evaluated on a scale of 1–5.

Person responsible:

Samuli Saukkonen

Working life cooperation:

No

Supplementary Module: Industrial Engineering and Management (15 ECTS cr)

555225P: Basics of industrial engineering and management, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Majava

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay555225P Basics of industrial engineering and management (OPEN UNI) 5.0 op

555221P Introduction to Production 2.0 op

555220P Basic Course in Industrial Engineering and Management 3.0 op

Language of instruction:

Finnish. English material is also used.

Timing:

Periods 1-2.

Learning outcomes:

Upon completion of the course the student should be able to describe what operations management means. The student can explain the core concepts of business operations and utilize these concepts in describing and analyzing organizational operations. In addition, he/she can explain in general terms the factors that affect economic performance of organizations. The student is able to utilize the terminology used in operations management, describe the financial processes of companies and based on this describe the use of cost accounting in organizational decision-making. The student can also calculate unit costs in various simplified settings, calculate various alternatives, as well as perform planning and goal oriented calculations based on given data, and draw conclusions based on the calculation results.

Contents:

Operations and productivity, operations strategy, forecasting, cost accounting, investments, sustainability, capacity management, location decisions, layout strategies, human resources management, supply chain management, subcontracting, inventory management, production planning, MRP & ERP, production scheduling, Just-in-Time & Lean operations, maintenance.

Mode of delivery:

The tuition will be implemented as blended teaching (web-based teaching and face-to-face teaching).

Learning activities and teaching methods:

Web-based lectures 20 h / exercises 18 h / self-study 96 h.

Target group:

: Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

No prerequisites exist.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555285A Project management, 555242A Product development, 555264P Managing well-being and quality of working life, and 555286A Process and quality management.

Recommended or required reading:

Lecture and exercise materials. Heizer, J. & Render, B. (2014) Operations management: sustainability and supply chain management, 11th ed. Pearson.

Assessment methods and criteria:

This course utilizes continuous assessment. During the course, there are nine mandatory weekly assignments. At least half of the assignments must be passed.

Grading:

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

Person responsible:

D.Sc. Jukka Majava.

Working life cooperation:

No.

Other information:

Substitutes courses 555220P Basic Course in Industrial Engineering and Management 3 ECTS cr and 555221P Introduction to Production 2 ECTS cr.

555285A: Project management, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Kirsi Aaltonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

555288A	Project Management	5.0 op
ay555285A	Project management (OPEN UNI)	5.0 op
555282A	Project Management	4.0 op
555280P	Basic Course of Project Management	2.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

Finnish. English material may also be used.

Timing:

Period 1.

Learning outcomes:

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

Contents:

Defining project management, project planning, organising and scope management, schedule management, cost management, earned value calculation and project risk management, project stakeholder management.

Mode of delivery:

The tuition will be implemented as blended teaching (web-based teaching and face-to-face teaching).

Learning activities and teaching methods:

Lectures or web-based lectures 16h, self-study 118h

Target group:

Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

No prerequisites exist.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555225P Basics of industrial engineering and management, 555242A Product development, 555264P Managing well-being and quality of working life, and 555286A Process and quality management.

Recommended or required reading:

Lecture material, exercise book, Arto, Martinsuo & Kujala 2006. Projekttiliiketoiminta. WSOY

Assessment methods and criteria:

The course includes three mandatory assignments, exercise book and exam. The course grading is based on the exam. Well completed assignments and exercise book may raise grading.

Grading:

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

Person responsible:

Professor Jaakko Kujala.

Working life cooperation:

No.

Other information:

Substitutes courses 555280P Basic Course of Project Management + 555282A Project Management.

555242A: Product development, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Haapasalo, Harri Jouni Olavi

Opintokohteen kielet: English

Leikkaavuudet:

ay555242A	Product development (OPEN UNI)	5.0 op
555240A	Basic Course in Product Development	3.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

Period 1.

Learning outcomes:

This course introduces product development and innovations management in a company environment. The course provides fundamental understanding over tools and frameworks that can be used for analysing and managing products, innovations, and technology development. The aim is to create a connection between product development and other company functions. Upon completion of the course a student is capable of explaining the role of product development as a company function. The student understands the difference between innovation activities and systematic product development, and knows the difference

between different phases of product development process and its activities. Student learns how to transform customer needs into requirements for product development process and finally into product features. Additionally, the student is able to define the meaning of other company functions to product development activities.

Contents:

Meaning of products for the operations of an industrial enterprise, product development paradigm and defining relevant concepts, realising product development methodologically (U&E model, Cooper's stage-gate model, QFD), managing innovations, and product development success factors.

Mode of delivery:

The tuition will be implemented as blended teaching.

Learning activities and teaching methods:

Lectures 20 h / exercises 6 h / group work and self-study 108 h.

Target group:

Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

555226A Operations and production.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555225P Basics of industrial engineering and management, 555285A Project management, 555264P Managing well-being and quality of working life, and 555286A Process and quality management..

Recommended or required reading:

Handouts, course work, and a collection of articles. Ulrich, K. & Eppinger, S. (2008) Product Design and Development. McGraw-Hill. 358 p.

Assessment methods and criteria:

Assignment and final exam.

Grading:

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

Person responsible:

Professor Harri Haapasalo.

Working life cooperation:

No.

Other information:

Substitutes course 555240A Basic Course in Product Development.

555286A: Process and quality management, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opettajat: Osmo Kauppila

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay555286A Process and quality management (OPEN UNI) 5.0 op

555281A Basic Course of Quality Management 5.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

Finnish.

Timing:

Period 4.

Learning outcomes:

Upon completion the student is able to explain the role of process and quality management in a business organization. The student is capable of developing business processes based on the principles of quality management and appropriate tools.

Contents:

Foundations of total quality management, planning of quality, performance measurement, process management, people management in relation to quality management, implantation of total quality management.

Mode of delivery:

The tuition will be implemented as face-to-face teaching (integrated classroom lectures and exercises).

Learning activities and teaching methods:

20 h lectures, 114 h independent study including tutored group work.

Target group:

Industrial Engineering and Management students and other students studying Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

-

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial engineering and management that also includes 555225P Basics of industrial engineering and management, 555285A Project management, 555242A Product development, and 555264P Managing well-being and quality of working life.

Recommended or required reading:

Oakland, J.S. (2014) Total quality management and operational excellence (4th ed.). Routledge, 529 pp. and material handed out during the course.

Assessment methods and criteria:

To pass the course, the student must pass the course exam and complete the classroom exercises and the group work. The course grade is calculated based on the exam and group work grades.

Grading:

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

Person responsible:

Osmo Kauppila.

Working life cooperation:

No.

Other information:

Substitutes course 555281A Basic Course of Quality Management.

555264P: Managing well-being and quality of working life, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay555264P	Managing well-being and quality of working life (OPEN UNI)	5.0 op
555261A	Basic Course in Occupational Psychology	3.0 op
555262A	Usability and Safety in Product Development	3.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

Finnish.

Timing:

Periods 3-4.

Learning outcomes:

After the course the student is capable of using the central concepts related to well-being at work, can set targets for it, and is able to choose appropriate methods from the management and personal career point of views. Furthermore, the student is able to develop well-being at work in the contexts of labour legislation, good practices, productivity, occupational safety expertise, management and human resources. The student can utilise basic knowledge, search for more information and knows the key players in the field. Also, the student knows the key sources of information, typical goal-setting and management practices and the methods for assessing the performance of an individual employee, supervisor, company and entrepreneur. The student can assess the impact of well-being at work from the economic perspective, especially in cases of work ability, occupational health, job satisfaction, occupational safety, productivity and the overall quality of working life. The student knows essential national and international regulation and strategic goal setting practices, good practices of the case companies, current trends, and methods in research. In brief, the focus of the course is to learn key factors for guaranteeing successful contribution of humans in issues of production.

Contents:

The course gives the student a vision of building sustainable, productive and satisfactory career for the work community he/she leads - and for himself/herself as an employee or a supervisor. The contents cover the whole area of basic quality issues of working life analysing them in the following framework "Well-being at work means safe, healthy, and productive work in a well-led organisation by competent workers and work communities who see their job as meaningful and rewarding, and see work as a factor that supports their life management".

Mode of delivery:

The tuition will be implemented as blended teaching (web-based teaching and face-to-face teaching).

Learning activities and teaching methods:

Lectures 22 h / self-study 100 h / group work & exercises 12 h.

Target group:

Industrial Engineering and Management students and other students taking Industrial Engineering and Management as minor.

Prerequisites and co-requisites:

No prerequisites exist.

Recommended optional programme components:

This course is part of the 25 ECTS module of Industrial Engineering and Management that also includes 555225P Basics of industrial engineering and management, 555285P Project Management, 555242A Product development, and 555286A Process and quality management.

Recommended or required reading:

Essential background information can be available from Arnold, J. et al. (2010), Work Psychology; Understanding Human Behaviour in the Workplace. 5th Edition. Financial Times/Prentice Hall. Other literature will be informed during the course.

Assessment methods and criteria:

This course utilizes continuous assessment including exercises during the lectures (weight 20 %), seminar work (weight 30 %) and examination (weight 50 %).

Grading:

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

Person responsible:

Professor Seppo Väyrynen

Working life cooperation:

No.

Other information:

Lecturers: Seppo Väyrynen and Henri Jounila along with visiting lecturers and exercise supervisors.
Substitutes courses 555261A Basic Course in Occupational Psychology + 555262A Usability and Safety in Product Development.

Supplementary Module: Working life & Entrepreneurship (15 ECTS cr)

910001S: Working Life and Studies, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

Group 1 (Finnish) and Group 2 (English)

Timing:

Part A (3 ECTS): Working life (online course Group 1 and Group 2) September 28 – November 30.

Learning outcomes:

After the course the students will have understanding how to analyse and appraise their interest areas, skills and competences, networks and objectives regarding their planned career options. The students will know how to seek work, prepare work applications and prepare for work interviews and prepare a competence portfolio. They will also learn what are their rights and responsibilities regarding intellectual property at work.

Contents:

Consists of parts A (3 ECTS) and B (2 ECTS) . Working life A focuses on career planning and career skills and competences during studies. It is for students who want to analyse their potential and build competences, knowledge, and networks for their career. The course highlights the role of active learning and networking throughout studies. The course gives the students the basics tools needed for seeking work, writing the applications and preparing for interviews and selection processes in the modern working environment. Working life B focuses on immaterial property rights and their role business. The course covers different forms of intellectual property, IP ownership, and IP protection. The course considers IP both from personal and business perspectives.

Mode of delivery:

Online studies and face-to-face teaching

Learning activities and teaching methods:

Self-studying through online materials, online rehearsals, and reporting of the learning activities and exercises through the online system. Following the lectures and lecture discussion and rehearsals.

Target group:

Open to all

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials available in Optima. Lecture notes.

Assessment methods and criteria:

Assessment based on self-learning reports submitted to Optima.

Grading:

Pass or Fail.

Person responsible:

Tiina Salmijärvi (Group 1) and Jaana Liimatainen (Group 2)

Working life cooperation:

-

Other information:

The number of students is restricted

910002S: Toward Entrepreneurial Mindsets, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Fall (period A)

Learning outcomes:

After the course the students will have understanding over the different forms of entrepreneurial activity, and have the skills for assessing the risks and opportunities related to their entrepreneurial career options. They will also be familiar with the key stakeholders around the business creation network. In addition, this course will enhance overall entrepreneurial mindset and attitude amongst the participants.

Contents:

The course outlines what entrepreneurship is and discusses its different forms and roles in society and for individuals in or considering entrepreneurial career options. The focus is on entrepreneurial mindsets and what entrepreneurship calls for from individuals, especially from the "me as entrepreneur", standpoint through the process where ideas for enterprising are turned into a real business idea. This process is promoted by real entrepreneurs. The students' attention is guided toward assessing the safety and risks of entrepreneurship, to the different stages in the process of establishing a company, and to the role of networks and supporting services for the entrepreneurial activity. The key processes of entrepreneurial action, such as planning, selling, marketing, funding and financial planning are covered together with the experts' support in those areas

Mode of delivery:

Face-to-face teaching and workshops together with real-life experts in different areas.

Learning activities and teaching methods:

Learning takes place in intensive lectures, visitor presentations, and discussions, workshops and exercises both in the class and at different places with real-life entrepreneurship professionals for example at Business Kitchen and Business Oulu.

Target group:

Open to all

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials available in optima

Assessment methods and criteria:

Assessment is based on learning diary type reflection report prepared by the students based on the lectures and meetings with entrepreneurship professionals and in addition, course materials.

Grading:

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

Person responsible:

Anne Keränen

Working life cooperation:

-

Other information:

The number of students is restricted

910003S: Building Business through Creativity and Collaboration, 5 op

Voimassaolo: 01.08.2014 - 31.07.2017

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Fall (Period C)

Learning outcomes:

During the course the students will get familiar with concepts of learning, collaboration, creativity and emotions. They will explore entrepreneurship from the perspective of artistic process, experience and learn the process of artistic creation in teams, experience and analyse emotions; such as uncertainty, frustration, enthusiasm and joy alone and in teams. The students will produce a piece of art as an outcome of the course workshops, and organise and host an art exhibition together.

Contents:

This course employs creative collaborative methods to learn and experience entrepreneurship through art. This process enables outside-of-the-box thinking, creative propositions and getting to know multidisciplinary team members through concrete learning by doing approach. Art is used as an illustration, as materials for case studies, and as a place to work and develop business oriented thinking. The art world is a new metaphor to describe our economy based on innovations and digitalization. The participants will learn a creative mindset and bonding of closer ties in teams.

Mode of delivery:

Participating in the face-to-face sessions and workshops

Learning activities and teaching methods:

Producing a piece of art and presenting it in an exhibition together with others. Reflecting the learning experiences in a personal learning diary during the course. Returning the learning diary latest one week after the course.

Target group:

Open to all

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials provided during the course.

Assessment methods and criteria:

Active participation in the teamwork. Learning diary assessment.

Grading:

Pass or Fail.

Person responsible:

Johanna Bluemink

Working life cooperation:

-

Other information:

The number of students is restricted

Find the Facebook group: "Building Business through Creativity and Collaboration"

<https://www.facebook.com/groups/108738746124019/>

910004S: Turning Opportunities to Business, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Spring

Learning outcomes:

After the course the students have learned to assess and develop business opportunities, they know the basic concepts related to business context or environment and the factors defining or influencing business opportunities. They will also learn how to build and assess business context specific future scenarios for planning alternative business model for their business opportunity. The students will learn how to build, present and evaluate sales presentations, and how to pitch their business to potential investors.

Contents:

The contents comprise business development especially through business opportunity development, business idea, concept and business model basics and the key processes of strategic decision-making. The business environment and its changes are discussed by using the through scenario methodology. Key concepts of selling and sales presentations, both to customers and potential investors, are covered and practiced.

Mode of delivery:

Face-to-face teaching , workshops

Learning activities and teaching methods:

The course applies anticipatory action learning as a pedagogic approach. Students will learn in face-to-face discussions and workshops by applying in teams strategic management concepts, processes, tools, and templates.

Target group:

Open to all.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials provided during the course

Assessment methods and criteria:

Assessment is based on final report that presents and discusses the whole of the workshop outcomes generated during the course.

Grading:

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

Person responsible:

Petri Ahokangas

Working life cooperation:

-

Other information:

The number of students is restricted

910005S: Entrepreneurial Field Project, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Negotiated Education

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Apply for Demola projects on [Demola website](#) by September 15, read more [here](#). (Press ctrl+enter to open the links)

Learning outcomes:

After the course the students have learned to solve in a multidisciplinary team a real-life business related challenge or problem given by a company or other organization. The problem solving process provides the students multicultural teamwork skills, business skills, problem solving skills and communications and pitching skills.

Contents:

The entrepreneurial field project is organized within the international Demola collaboration and the project comprises facilitated and supported real-life problem definition, data collection, problem solving, implementation and communication. For doctoral students it is possible to bring their own problem or challenge to the course.

Mode of delivery:

Facilitated and supported project.

Learning activities and teaching methods:

Learning takes place during the project as a team learning and problem solving, with feedback from the responsible teachers and problem owning company or organization.

Target group:

Open to all. Doctoral students can bring their own project to the course if they wish.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Materials vary according to the assignment.

Assessment methods and criteria:

Assessment based on participation and project outcomes.

Grading:

Pass or Fail.

Person responsible:

Mia Kemppaala

Working life cooperation:

-

Other information:

The number of students is restricted

Supplementary Module: Economics and Management (15 ECTS cr)

724103P: Strategic Management, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Anniina Rantakari, Sari Laari-Salmela

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724103P Strategic Management (OPEN UNI) 5.0 op

721519P Business Management 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period A (2nd year).

Learning outcomes:

After the course students understand the purpose of the different schools of strategic management and recognize their role in organizations' strategy formation. Students are able to define the core concepts of strategic management, analyze the relations between strategy, markets and operations, and are able to communicate strategies with clear market value.

Contents:

The course aims at analyzing how we could model organizational change processes involving genuine uncertainties, and, at the same time, model individuals and organizations as being able to make strategic choices. The purpose of this course is twofold: First, the aim is to introduce the basic concepts, historical developments and schools of strategic management. Second, the course explores the contemporary developments in strategic thinking.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Intensive contact learning with 18 hours of functional lectures with reflection (54 h) and with 18 hours of workshop sessions with cases (54 h). In addition, the students are required to independently read the course literature and prepare for the workshops (25 h). Further details will be provided by the responsible person in the first session.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Johnson, G., K. Scholes & R. Whittington. Exploring corporate strategy (Prentice Hall); [Check the availability of course material from this link](#)

Mintzberg, H., B. Ahlstrand & J. Lampel. Strategy safari: the complete guide through the wilds of strategic management (Prentice Hall/Financial Times); [Check the availability of course material from this link](#)

Article collection

Assessment methods and criteria:

Assessment will be based on group assignment and individual assignments based on the criteria presented during the course.

Grading:

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

Person responsible:

Sari Laari-Salmela and Anniina Rantakari

Working life cooperation:

-

Other information:

The number of students is limited.

724105P: Management Accounting, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Janne Järvinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724105P Management Accounting (OPEN UNI) 5.0 op

721172P Management Accounting 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

English (course is lectured separately in Finnish and in English).

Timing:

Period C

Learning outcomes:

After passing the course, the student knows the basic cost concepts and the elements of cost accounting systems. Students are also able to apply the basic cost information in the company's decision making and explain which costs should be included in these calculations under different circumstances.

Contents:

Theoretical framework for understanding cost accounting, cost concepts, cost recording, different product costing methods, cost-volume-profit analysis, using cost accounting information in decision making.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

20 h lectures, 16 h exercises and independent reading of study materials (97 hours).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Drury, C.: Management and cost accounting. Thomson Business Press, 5th ed. 2000 or newer. Chapters 1-13;

[Check the availability of course material from this link.](#)

Supplementary material: Järvenpää, M.-Lämsiluoto, A.-Partanen, V. –Pellinen, J.: Talousohjaus ja kustannuslaskenta, WSOYpro, chapters 1-8.

[Check the availability of course material from this link.](#)

Assessment methods and criteria:

Lectures and literature examination.

Grading:

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

Person responsible:

Professor in Management Accounting.

Working life cooperation:

-

Other information:

The number of students is limited.

724106P: Principles of Marketing, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Nätti

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724106P Principles of Marketing (OPEN UNI) 5.0 op

ay721409P Principles of Marketing (OPEN UNI) 5.0 op

721409P Firm in the Network Contexts 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period C (1st year).

Learning outcomes:

Upon completion of this course, students are able to understand the basic concepts of marketing as part of the business system and society. The student is able to describe the role of marketing in any organization (company, non-profit organization, charity institution etc.) and its linkages to other organizational activities (units, strategy and other processes). Basic concepts of marketing and their linkages become familiar for the student (customer value, value based market analysis and strategy, segmenting, targeting, positioning and marketing mix). After completing this course the student is able to use different types of methods such as (market analysis) and concepts of marketing to aid decision making and evaluate the suitability of these decisions (effectiveness of the decisions) and is able to alter the decision making to yield better value from the customers. The student also realizes the role that marketing partakes in everyday actions in one's personal life and professional development.

Contents:

During the course, following themes will be discussed: 1) marketing as science and practice, 2) definitions of marketing 3) marketing strategy and analysis, 4) marketing mix, 5) segmenting, targeting and positioning, 6) marketing in different contexts, 7) market analysis and new product/service/idea/solution development, 8) distribution, 9) planning, implementation and control value based marketing processes

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36 hours of lectures, exam (4h), independent reading of the textbook and articles (43 h) and exercises (50 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

-

Recommended optional programme components:

This course is part of "Introduction to business studies" -module

Recommended or required reading:

Kotler, P & Armstrong, G. (2013). Principles of marketing, 15th ed.

[Check the availability of course material from this link.](#)

Assessment methods and criteria:

Examination and exercise.

Grading:

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

Person responsible:

Professor of Marketing Jari Salo.

Working life cooperation:

-

Other information:

The number of students is limited.

724109P: Investment Decisions, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Mirjam Lehenkari

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724109P Investment Decisions (OPEN UNI) 5.0 op

ay721178P Fundamentals of Corporate Finance (OPEN UNI) 5.0 op

721178P Principles of Corporate Finance 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period B. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

The course is an introduction to the theory and practice of capital budgeting. Upon successful completion of the course, the student will be able to evaluate the profitability of an investment project using various capital budgeting techniques.

Contents:

1) the most common capital budgeting techniques, 2) cash flow calculations, 3) determining the appropriate discount rate for a project, 4) sensitivity, scenario, and break-even analysis, 5) capital rationing, 6) leasing, 7) real options, 8) capital budgeting in practice, 9) mergers & acquisitions

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

lectures 36h, self-study 93h, exam 4h

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Ross, Westerfield & Jordan: Fundamentals of Corporate Finance (4th or later edition) / Corporate Finance Fundamentals, Irwin/McGraw-Hill

[Check the availability of course material from this link.](#)

Assessment methods and criteria:

faculty examination

Grading:

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

Person responsible:

postdoctoral researcher Mirjam Lehenkari

Working life cooperation:

-

Other information:

The number of students is limited.

724110P: Introductory Economics, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Puhakka Mikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724110P	Introductory Economics (OPEN UNI)	5.0 op
721211P	Principles of Economics	10.0 op
721210P	Principles of Economics	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period A. It is recommended that students complete the course during the first autumn semester.

Learning outcomes:

After completing the course students (i) understand the basic concepts of economics and the rudiments of economic theory, (ii) can explain the determination of resource allocation and prices in a market economy, (iii) know how the aggregate economy operates in the short and long run, and (iv) how economic policy affects the Finnish economy and also the European economy.

Contents:

The course introduces students to the tools and ideas economics uses to describe and explain economic phenomena. The topics include:

- the long-term development of the Finnish and World economy
- basic ideas and principles of economics
- opportunity cost and comparative advantage
- market equilibrium: demand and supply
- how well does market economy work?
- firms and competition in market economy
- aggregate economic activity and its measurement
- business cycles
- monetary and fiscal policy
- economic growth

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

36 lectures including problem sets. Students are expected to do the problem sets on their own and familiarize themselves with the required and recommended materials (93 h). Exam (4 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

-

Recommended optional programme components:

This course is part of "Introduction to business studies" -module

Recommended or required reading:

Material posted at the webpage. Textbook: N. Gregory Mankiw ja Mark P. Taylor, Economics. 2014. 3. ed. Cengage Learning. [Check the availability of course material from this link.](#)

Extra readings: Timothy Taylor, The Instant Economist. Everything You Need to Know About How the Economy Works. 2012. A Plume Book (Penguin), New York NY. [Check the availability of course material from this link.](#)

Robert P. Murphy, Lessons for the Young Economist. Ludwig von Mises Institute 2010; http://mises.org/books/lessons_for_the_young_economist_murphy.pdf

Assessment methods and criteria:

Final Exam.

Grading:

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

Person responsible:

Professor Mikko Puhakka

Working life cooperation:

-

Other information:

The number of students is limited.

A452221: Module of the Option, Information Technology, 34 - 35 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module of the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

All compulsory

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:

-

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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/134 hours of work

Language of instruction:

English

Timing:

The course starts in autumn and continues to spring semester (periods 2 and 3). It is recommended that the course is completed during the first year of Master's studies.

Learning outcomes:

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

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:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail

Person responsible:

Arto Lanamäki

Working life cooperation:

No

Other information:

-

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

In English

Timing:

Spring, periods 3.

Learning outcomes:

This 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.

Upon completion of the course, the student can utilize common machine vision methods for various image analysis problems. He is able to detect and recognize objects using features computed from images. He can use motion information in image analysis and model matching in image registration and object recognition. The student can explain the basics of geometric computer vision and is able to calibrate cameras as well as to obtain 3D coordinate measurements from the scene using for example stereo imaging. After the course the student has the rudimentary skills to use the Matlab environment and its tools for implementing machine vision methods and analyzing the results.

Contents:

1. Introduction, 2. Imaging and image representation, 3. 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.

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:

521467A Digital Image Processing and Machine Learning. This courses provide complementary information on pattern recognition and classification applied in machine vision. It is recommended to be studied simultaneously.

Recommended or required reading:

Shapiro L.G., Stockham G.C.: Computer vision, Prentice Hall, 2001. Szeliski R: Computer Vision: Algorithms and Applications, Springer, 2011. Lecture notes, exercise material.

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:

Esa Rahtu

Working life cooperation:

No.

521289S: Machine Learning, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:

5

Language of instruction:

English. Examination can be taken in English or Finnish.

Timing:

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

Learning outcomes:

After completing the course the student can design simple optimal classifiers from the basic theory and assess their performance. The student can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers. The student can apply the basics of gradient search method to design a linear discriminant function. The student can apply regression techniques to practical machine learning problems.

Contents:

Introduction. Bayesian decision theory. Discriminant functions. Parametric and non-parametric classification. Feature extraction. Classifier design. Example classifiers. Statistical regression methods.

Mode of delivery:

Face-to-face teaching and guided laboratory work.

Learning activities and teaching methods:

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

Target group:

Computer Science and Engineering students and other students of the University of Oulu who are interested in data analysis technology.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001. Handouts.

Assessment methods and criteria:

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

Grading:

The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail. The final grade is established by weighing the written exam by 2/3 and the task assignment by 1/3.

Person responsible:

Tapio Seppänen

Working life cooperation:

No

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

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 (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

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silvén

Working life cooperation:

No.

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

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:

-

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara, 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 3-4.

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 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 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".

A452224: Module of the Option, Applied computing, 35 - 62 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Module of the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521148S: Ubiquitous Computing Fundamentals, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannu Kukka

Opintokohteen kielet: Finnish

Language of instruction:

In English.

Timing:

Autumn, periods 1-2.

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:

Researcher Hannu Kukka.

Working life cooperation:

None.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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/134 hours of work

Language of instruction:

English

Timing:

The course starts in autumn and continues to spring semester (periods 2 and 3). It is recommended that the course is completed during the first year of Master's studies.

Learning outcomes:

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

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:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail

Person responsible:

Arto Lanamäki

Working life cooperation:

No

Other information:

-

811395A: Basics of Databases, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: lisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits/ 133 hours of studying

Language of instruction:

finnish

Learning outcomes:

After completing the course, students understand what databases are and what their meaning for information systems is. They can model conceptually for database designing purposes, design a high-quality relational database and make queries to it. They understand transactions, schedules of transactions, serialisability of schedules and recovery choices of schedules. They also know what different SQL Isolation levels means to safety of transactions.

Contents:

Conceptual modelling (ER- and EER-diagrams), relational model (theory, databases, query techniques and normalization), transactions.

Mode of delivery:

face to face

Learning activities and teaching methods:

Lectures 45h, compulsory exercises 24h and (reading 20h) and exams 21h. Self-studying 23 h.

Prerequisites and co-requisites:

The student knows basics of programming.

Recommended or required reading:

Silberschatz, Korth & Sudarshan: Database system concepts. Elmasri & Navathe: Fundamentals of database systems.

Assessment methods and criteria:

The course is divided to five parts. All parts must be passed in a year. Students must show they achieve at least half of required knowledge of each part.

Grading:

1-5

Person responsible:

Jua lisakka

521290S: Distributed Systems, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**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:

Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and implement a small distributed system.

Contents:

Architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed 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.

521147S: Mobile and Social Computing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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

ECTS Credits:

5

Language of instruction:

In English.

Timing:

Spring, periods 3-4

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 an individual project throughout the semester: either build a mobile application, or conduct analysis of a provided dataset. Passing criteria: the project 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:

Vassilis Kostakos
Denzil Ferreira

Working life cooperation:

None.

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara, 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 3-4.

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 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 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".

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

-

A452223: Module of the Option, Embedded Systems, 30,5 - 32 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module of the Option

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

All compulsory

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

After completing this course the student 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.

Objective: To deepen the knowledge of digital logic design acquired in Digital Techniques 1, and to learn advanced design methods and use of design tools.

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 arithmetics. 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:

Finnish BSc students.

Prerequisites and co-requisites:

Digital techniques I.

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam and a design exercise, 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:

-

Other information:

-

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic, Maria Kangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

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. 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. The student is able to describe the basic protocol model of the UMTS and LTE/LTEA radio interface and radio access network. The student knows the basic properties of routing protocols in fixed, wireless and ad hoc networks. He 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.

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.

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.

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:

-

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:

-

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

-

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

After passing the course a student can explain the life cycle of the embedded system, the characteristic features related to embedded systems development, and the risks involved. In addition, the student can explain the roles of the client and the system developer during the requirements specification, and the role of the iteration phase as a part of the requirements specification phase. The student can explain the factors affecting to SW/HW partitioning process, and the concept of SW/HW dualism. The student can fairly analyze the factors affecting to the selection of the processor and the operating system. The student can recognize the basic development tools used and their possible advantages and disadvantages. The

student can compare various testing approaches. The student can explain how a design error affects to the final cost of the system in different phases of the development. The student can do some basic I/O programming using C programming language.

Contents:

The embedded design life cycle, the selection process, the partitioning decision, the development environment, the special software techniques, a basic toolset, JTAG/ICE, testing, I/O programming.

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, 521267A Computer Engineering and Embedded Systems. Also recommended 521275A Embedded Software Project, Principles of Electronics Design.

Recommended optional programme components:

Digital Techniques I, Computer Engineering, Embedded Systems. Also recommended Embedded Software Project, Principles of Electronics Design.

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.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English

Timing:

Autumn, period 1.

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 (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

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in English.

Assessment methods and criteria:

Final exam and approved design exercises.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silvén

Working life cooperation:

No.

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

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:

-

A452271: Advanced Module/Information Technology, Signal Processing (obligatory), 13,5 - 20 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

After completing this course the student 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.

Objective: To deepen the knowledge of digital logic design acquired in Digital Techniques 1, and to learn advanced design methods and use of design tools.

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 arithmetics. 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:

Finnish BSc students.

Prerequisites and co-requisites:

Digital techniques I.

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam and a design exercise, 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:

-

Other information:

-

521288S: Multiprocessor Programming, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**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:

-

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

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 processing.

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.

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

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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, period 2

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. The Objective of the course is to learn the information theory as a discipline and its most important applications in information technology in general and in communications engineering in particular as well as the basics of forward error control coding.

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:1st year M.Sc. and WCE students**Prerequisites and co-requisites:**

Signal Analysis, Telecommunication Engineering

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:

-

A452272: Advanced Module/Information Technology, Signal Processing (optional), 15 - 22 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Linatti

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

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them. Student can explain design methods signals for band-limited channels and can classify different channel equalizers, and perform the performance analysis.

Objective: Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.

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 M.Sc. and WCE students

Prerequisites and co-requisites:

Telecommunication Engineering, Broadband Communications Systems

Recommended optional programme components:

Recommended: Statistical Signal Processing

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 linatti

Working life cooperation:

-

*Compulsory***521323S-01: Wireless Communications I, Exam, 0 op**

Opiskelumuoto: Advanced Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari linatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521323S-02: Wireless Communications I, Exercise, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari linatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

After passing the course, student knows special characteristics of the biosignals and typical signal processing methods. Student can solve small-scale problems related to biosignal analysis.

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, preferably at their master's level studies. Computer Science and Engineering students and other 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, A Case-Study Approach", R.M Rangayyan. 516 pages. + Lecture transparencies + 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.

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.

477607S: Advanced Control and Systems Engineering, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ikonen, Mika Enso-Veitikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

470444S Advanced Control Methods 6.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish (English if necessary)

Timing:

Period 3 (spring term)

Learning outcomes:

After completing the course the student can design the model based control systems, can formulate and solve state estimation problems, and discover research trends in control and systems engineering

Contents:

1. Model-based control: as DMC, QDMC; GPC.
2. State estimations: as Kalman filtering and particle filters.
3. Active research directions (elected annually)

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and demonstration exercises

Target group:

M.Sc. students in process and environmental engineering

Prerequisites and co-requisites:

The courses 477602A Control system analysis, 477603A Control system design, 4776xxS Control system methods, 477605S Digital control theory recommended beforehand

Recommended optional programme components:

None

Recommended or required reading:

Materials distributed during the contact teaching and through the course web pages

Assessment methods and criteria:

Exam and homework

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 1.5 or fail

Person responsible:

Professor Enso Ikonen

Working life cooperation:

No

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation. 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:

Professor Timo Ojala.

Working life cooperation:

-

521324S: Communication Signal Processing I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

- 521373S Communication Signal Processing I 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 III. It is recommended to complete the course during the first year of master studies.

Learning outcomes:

Upon completing the required coursework, the student is able to use the methodology of statistical signal processing in the design communication transceivers. He or she will be able to design and simulate various receiver algorithms and use linear algebra, estimation theory and optimization theory to solve algorithm design problems.

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.

Learning activities and teaching methods:

Lectures 32h, exercises 16h, group project work 12h, 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, Wireless Communications I

Recommended optional programme components:

Wireless Communications II.

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 accepted simulation work report.

Grading:

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

-

Other information:

-

521493S: Computer Graphics, 7 op**Opiskelumuoto:** Advanced Studies**Laji:** Course**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:

Upon completing the required coursework, the 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, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line 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, self-study: 50 hours. Student independently solves programming assignments: 100 hours

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.

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 fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521445S: Digital Techniques 3, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

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:

After completing this course the student 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. The student is also able to use the tools needed in industrial design projects.

Objective: To learn the design methods and tools for digital systems' hardware design that are used in industrial FPGA- and ASIC design projects.

Contents:

1. Digital systems design process. 2. System level design and modeling of digital systems. 3. Architecture level synthesis of digital circuits. 3. FPGA circuit design and verification (technology choice, logic synthesis, physical synthesis and timing analysis) 4, ASIC-design and verification (technology choice, logic synthesis, physical synthesis, timing analysis, power analysis, design for testability).

Mode of delivery:

Classroom

Learning activities and teaching methods:

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

Target group:

-

Prerequisites and co-requisites:

Digital techniques I + II

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam and a design exercise, 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:

-

Other information:

-

521325S: Communication Signal Processing, 5 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Juntti, Markku Johannes**Opintokohteen kielet:** English**Leikkaavuudet:**

521360S Synchronisation for Digital Receivers 4.0 op

521360S-01 Synchronization for Digital Receivers, exam 0.0 op

521360S-02 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:

Upon completing the required coursework, the student is able to design and model communication receiver algorithms. He or she will be able to simulate the performance of a receiver modeling implementation imperfections, and use baseband design tools to implement a receiver algorithm. The student can make choice on the baseband tools for receiver implementation platforms.

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.

Learning activities and teaching methods:

Lectures 16h, group project work 40h, 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:

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 accepted simulation work report.

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

Working life cooperation:

-

Other information:

-

A452273: Advanced Module/Information Technology, Intelligent Systems (obligatory), 14 - 17 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

*Obligatory courses***521493S: Computer Graphics, 7 op**

Opiskelumuoto: Advanced Studies

Laji: Course

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:

Upon completing the required coursework, the 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, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line 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, self-study: 50 hours. Student independently solves programming assignments: 100 hours

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.

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 fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

Upon completing the required coursework, student is able to explain the emotion theory and modeling, implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities, use the basic tools to synthesize facial expressions and speech as well as has the ideas of wide applications of affective computing.

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

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

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Guoying Zhao

Working life cooperation:

-

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and implement a small distributed system.

Contents:

Architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, distributed object-based systems, distributed file systems, distributed 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.

A452274: Advanced Module/Information Technology, Intelligent Systems (optional), 18 - 25 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

477624S: Control System Methods, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477614S Control System Methods 3.0 op
 477605S Digital Control Theory 4.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish

Timing:

Period 1 (autumn term)

Learning outcomes:

After completing the course students can identify the problems of the sampled data systems, and know how to apply discrete time methods for systems analysis and control design.

Contents:

1. Control systems design by frequency-response methods. 2. Control systems design in state space methods 3. Sampled data systems: sampling, Z transformation of signals. 4. Discrete-time modelling: difference equation, shift operator, pulse transfer function, polynomial and state-space description. 5. Analysis of discrete-time systems: z-plane, stability. 6. Discrete-time control design strategies: general RST structure, various pole-zero placement control algorithms, minimum-variance control, model-based control, state-space design methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and exercises include guided computer simulations

Target group:

M.Sc. students in process and environmental engineering

Prerequisites and co-requisites:

The courses 477602A Control system analysis and 477603A Control system design recommended beforehand

Recommended optional programme components:

-

Recommended or required reading:

Lecture handout. Dorf, R. (2010) Modern Control Systems. Prentice-Hall, New York, 1104 s, Ogata, K (2002) Modern Control Engineering. Prentice-Hall, New York, 964 s., Åström, K & Murray, R. (2009) Feedback Systems, An Introduction for Scientists and Engineers. Princeton University Press, New Jersey, 396 s., Landau, I. & Zito, G. (2005) Digital Control Systems, Springer. 485 pp. Åström, K.J. & Wittenmark, B. (1984, 1997) Computer Controlled Systems: Theory and Design. Prentice-Hall International. 544 pp.

Assessment methods and criteria:

Final written exam; to request an exam in English, contact the lecturer via email beforehand.

Grading:

Numerical grading scale 1-5 or fail

Person responsible:

University teacher Seppo Honkanen

Working life cooperation:

No

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation. 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:

Professor Timo Ojala.

Working life cooperation:

-

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

After passing the course, student knows special characteristics of the biosignals and typical signal processing methods. Student can solve small-scale problems related to biosignal analysis.

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, preferably at their master's level studies. Computer Science and Engineering students and other 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, A Case-Study Approach", R.M Rangayyan. 516 pages. + Lecture transparencies + 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.

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.

477607S: Advanced Control and Systems Engineering, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ikonen, Mika Enso-Veitikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

470444S Advanced Control Methods 6.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish (English if necessary)

Timing:

Period 3 (spring term)

Learning outcomes:

After completing the course the student can design the model based control systems, can formulate and solve state estimation problems, and discover research trends in control and systems engineering

Contents:

1. Model-based control: as DMC, QDMC; GPC.
2. State estimations: as Kalman filtering and particle filters.
3. Active research directions (elected annually)

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and demonstration exercises

Target group:

M.Sc. students in process and environmental engineering

Prerequisites and co-requisites:

The courses 477602A Control system analysis, 477603A Control system design, 4776xxS Control system methods, 477605S Digital control theory recommended beforehand

Recommended optional programme components:

None

Recommended or required reading:

Materials distributed during the contact teaching and through the course web pages

Assessment methods and criteria:

Exam and homework

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading scale 1.5 or fail

Person responsible:

Professor Enso Ikonen

Working life cooperation:

No

Other information:

-

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Lasse Holmström

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Language of instruction:

Finnish

Timing:

Spring semester, 3rd and 4th periods.

Learning outcomes:

Upon completing the course the student will

-be familiar with the most common classifiers used in pattern recognition

-be able to apply pattern recognition methods to practical problems

-be able derive some of the basic mathematical results of pattern recognition theory

Contents:

The course focuses on the theory and practice of pattern recognition with emphasis on classifiers and feature extraction

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h of lectures, 28 h of exercises

Target group:

Mathematics, applied mathematics and statistics majors. Other students with a sufficient mathematical background.

Prerequisites and co-requisites:

Calculus in one and several dimensions, linear algebra I and II. Probability theory I. Probability theory II or Random variables and distributions.

Recommended or required reading:

Lecture notes.

Optional reading:

R. O. Duda, P. E. Hart, and D. G. Stork. Pattern Classification. Wiley-Interscience, second edition, 2000.

S. Theodoridis and K. Koutroumbas. Pattern Recognition. Academic Press, 1999.

A. Webb. Statistical Pattern Recognition. Arnold, 1999 (Second edition: John Wiley & Sons Ltd, 2002).

Assessment methods and criteria:

Final exam. In the first exam following the course the student gets credit for the (possible) homework problems he/she has solved during the course.

Grading:

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

Person responsible:

Lasse Holmström

Working life cooperation:

No

Other information:

No

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

After completing the course, the student can explain the big data phenomena and the possibilities it has in data processing and exploitation. The student can analyse concrete technologies for big data management and processing. The student can explain the most common solutions available for cloud services, and understand the benefits, risks and restrictions of them. The course offers viewpoints for big data exploitation and applications. One aim is to learn to apply methods of data preprocessing, knowledge extraction, data analysis and statistics on big data platforms. The focus will be on open data. In the exercises, the student will learn the principles of the current new technologies and utilize them on a basic level.

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying

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:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise with a report. The reports will be evaluated in seminar work through student opponents.

Grading:

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

Person responsible:

Susanna Pirttikangas, Mika Rautiainen

Working life cooperation:

None

477525S: Computational intelligence in automation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

477505S Fuzzy-neuromethods in Process Automation 4.0 op

ECTS Credits:

5 ECTS / 133 hours of work

Language of instruction:

Finnish and English

Timing:

Implementation in the autumn term, on the 2nd period. Recommended for fourth year students (first M.Sc. year)

Learning outcomes:

After the course the student is capable of explaining the concepts of intelligent systems and operation principles of fuzzy set systems, neural networks, neuro-fuzzy systems and evolutionary computation. The student has skills to construct and tune fuzzy models in Matlab-Simulink environment and to explain the operation of these models. The student is able to explain in an integrating way the principle concepts of neural computing and construct neural network models in Matlab-Simulink environment. The student recognizes the key problems of the data-driven modelling and is able to choose suitable solutions which ensure generalization. The student is able to explain the operation principles of genetic algorithms and to use them in tuning of fuzzy set systems and neural network models. Moreover, the student is able to describe alternative solutions for dynamic models, hyperplane methods and hybrid solutions. The student can explain the key concepts of cellular automata and evolutionary computation. After the course the student is able to search other relevant programming tools.

Contents:

Fuzzy logic and fuzzy set systems, fuzzy calculus, fuzzy modeling and control, neural computation, learning algorithms, neuro-fuzzy methods, linguistic equations, evolutionary computation, hyperplane methods, cellular automata, intelligent diagnostics and decision making, adaptive intelligent systems, hybrid systems.

Mode of delivery:

Tuition is implemented mainly as face-to-face teaching.

Learning activities and teaching methods:

The amount of guided teaching is 32 hrs, including lectures (16), exercises (10) and seminars (6). Totally 58 hrs are allocated for self-study, which consists of three parts: (1) a case study covering several topics applied in a chosen problem, (2) a seminar work concentrating on a single topic, and (3) the final report.

Target group:

M.Sc. students in process and environmental engineering, machine engineering, computer engineering and industrial engineering and management.

Prerequisites and co-requisites:

No specific prerequisites, but skills for simulation, and programming in Matlab are a benefit. See "Recommended optional programme components" below.

Recommended optional programme components:

Courses Simulation, and Programming in Matlab reinforce abilities for the exercises and the case study

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English.

Assessment methods and criteria:

The assessment of the course is based on the exercises, case study, seminar and the final report. Final exam is an alternative for the final report.

Read more about the course assessment and grading systems of the University of Oulu at www.oulu.fi/english/studying/assessment

Grading:

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

Person responsible:

D.Sc. (Tech.) Esko Juuso

Working life cooperation:

No

Other information:

-

A452275: Advanced Module/Information Technology, Biomedical Information Engineering (obligatory), 11 - 20 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

After passing the course, student knows special characteristics of the biosignals and typical signal processing methods. Student can solve small-scale problems related to biosignal analysis.

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, preferably at their master's level studies.
Computer Science and Engineering students and other 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, A Case-Study Approach", R.M Rangayyan. 516 pages. + Lecture transparencies + 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.

Grading:

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

Person responsible:

Tapio Seppänen

Working life cooperation:

No.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kortelainen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5

Language of instruction:

Lectures and laboratory works are given in English. The examination can be taken in Finnish or English.

Timing:

Periods 4

Learning outcomes:

The course focuses on advanced digital signal processing techniques generally used with biosignals of neural origin. Hands-on guided laboratory working is arranged in parallel to the lectures. After passing the course, students knows the special characteristics of neural signals and the typical signal processing methods related to them. Students can solve advanced problems related to the neural signal analysis.

Contents:

Introduction to EEG, fundamentals of EEG signal processing, event-related potentials, seizure signal analysis, EEG source localization, sleep EEG, brain-computer interfacing.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (10 h) and laboratory work (20 h), written exam.

Target group:

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

Prerequisites and co-requisites:

The basic engineering math courses, digital filtering, programming skills, Biosignal Processing I.

Recommended optional programme components:

-

Recommended or required reading:

The course is based on the book "EEG Signal Processing", S. Sanei and J. A. Chambers, 289 pages, lecture slides and task assignment specific material.

Assessment methods and criteria:

Laboratory work is supervised by the assistants who will also check that the task assignments are completed properly. The course ends with a written exam.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Numerical grading of the accepted exam is in the range 1-5.

Person responsible:

Jukka Kortelainen

Working life cooperation:

No

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

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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 1-4.

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:

-

A452276: Advanced Module/Information Technology, Biomedical Information Engineering (optional), 20 - 24 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

580402S: Biomedical Imaging Methods, 1 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Saarakkala

Opintokohteen kielet: English

ECTS Credits:

1-5 ECTS credit points / 27-135 hours of work.

Language of instruction:

English

Timing:

Master studies, spring. The course is not organized every year.

Learning outcomes:

The student understands and can describe the basic principles and main applications of imaging methods used in biomedical research.

Contents:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Differences between in vivo, ex vivo and in vitro imaging. Light and electron microscopy. Optical projection and coherence tomography. Optical in vivo imaging. Magnetic resonance imaging. Fourier transform infrared imaging spectroscopy. Raman imaging spectroscopy. Micro-computed tomography. Ultrasound imaging. Basics of image analysis and interpretation.

Target group:

Master Students of Medical and Wellness technology and Biomedical Engineering and all other who are interested in methods of biomedical imaging

Recommended or required reading:

Required literature is given in the lectures.

Assessment methods and criteria:

Participation in the lectures and demonstrations, study diary. Exercises. Written exam. The course can be taken as 1, 2, 3 or 5 ECTS.

1 ECTS # participation in the lectures

2 ECTS # participation in the lectures and demonstrations

3 ECTS # participation in the lectures and demonstrations + practical assignment

5 ECTS # participation in the lectures and demonstrations + practical assignment and final exam

Grading:

The 1, 2 or 3 ECTS courses utilize verbal grading: pass or fail. The 5 ECTS course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.

Person responsible:

Associate Professor Simo Saarakkala

Working life cooperation:

No

Other information:

This course is a part of specialization of Biomedical Technology and Medical imaging.

764634S: Medical physics and imaging, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

English

Timing:

4th-5th Autumn

Learning outcomes:

The student is able to define the physical principles on which various medical diagnostic and therapeutic devices are based upon.

Contents:

The course acquaints the students to the basic physics related to imaging modalities and therapeutic systems used in hospitals. Covered topics include e.g. x-ray imaging, computed tomography, magnetic resonance imaging, nuclear medicine, radiation therapy and methods of clinical neurophysiology.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, calculus assignments 4 h, demonstrations 6 h, reporting 25 h, self-study 112 h

Target group:

Physics MSc students with biophysics major or/and medical physics minor, biomedical engineering students. Also for the other students of the University of Oulu.

Prerequisites and co-requisites:

Recommended: physics basic courses and Radiation physics, biology and safety (766116P, 761116P, 764117P or 764317A).

Recommended optional programme components:

No alternative course units or course units that should be completed simultaneously

Recommended or required reading:

Dowsett, Kenny, Johnston: The Physics of Diagnostic Imaging, 2nd ed., Hodder Arnold, 2006.

Webster: Medical instrumentation: application and design, 4th ed, John Wiley & Sons, 2010.

Podgorsak: Radiation Oncology Physics – A handbook for teachers and students, IAEA, 2005 (http://www-pub.iaea.org/mtcd/publications/pdf/pub1196_web.pdf).

Additional literature depending on the lecturers.

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:

Miika Nieminen

Working life cooperation:

No work placement period

Other information:

<https://wiki oulu.fi/display/764634S/>

757314A: Basics of bioinformatics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Biology

Arvostelu: 1 - 5, pass, fail

Opettajat: Tanja Pyhäjärvi

Opintokohteen kielet: Finnish

Leikkaavuudet:

750340A Basics of bioinformatics 3.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish / English.

Timing:

B.Sc. studies, 2nd spring.

Learning outcomes:

After the course the student knows and is able to use the basic methods for handling the nucleotide and protein sequences. The aim is that the student learns how to use the databases, understands the background and principles of the analytic methods, is able to take up a critical attitude towards the used methods and gets a good background for applying new methods that are developed continuously.

Contents:

Searching of material from the databases, inferring the function of a gene and structure of a protein based on sequence data, comparing the sequences and evaluating the differences between them as well as examining the evolution history of the genes.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

12 h lectures, 2 h seminar, 20 h exercises, independent work.

Target group:

BT: compulsory, recommended for all biologists. Suitable also for biochemists.

Prerequisites and co-requisites:

Course Concepts of genetics (753124P) compulsory, also Molecular evolution (753327A) is recommended.

Recommended optional programme components:

-

Recommended or required reading:

Pevsner, Jonathan 2009: Bioinformatics and Functional Genomics. Wiley-Blackwell, cop. 2009.

The availability of the literature can be checked from [this link](#).

Assessment methods and criteria:

Reports or exam, exercises, seminar presentation, independent work and student activity. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

1-5 / Fail.

Person responsible:

Dr. Tanja Pyhäjärvi.

Working life cooperation:

No.

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

Upon completing the required coursework, student is able to explain the emotion theory and modeling, implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities, use the basic tools to synthesize facial expressions and speech as well as has the ideas of wide applications of affective computing.

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

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

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Guoying Zhao

Working life cooperation:

-

521284S: Biomedical Engineering Project, 5 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish or English, depending on the student.

Timing:

As part of the master level studie, in any period suitable to the student.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The topics are from biomedical engineering and depend on the student's interest.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for biomedical data processing. Often the work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study under supervision.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, and documentation. Task assignments can be applied at any time all year round.

Target group:

Master-level students of the Department of Computer Science and Engineering that are interested in biomedical engineering.

Prerequisites and co-requisites:

The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Courses such as Biosignal processing I and II, Biomedical image processing and Machine learning are recommended. Programming skills, especially the Matlab.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Tapio Seppänen

Working life cooperation:

No

521093S: Biomedical Instrumentation, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

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.

A452286: Advanced module/Applied computing technology (optional), 25 - 40 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation. 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:

Professor Timo Ojala.

Working life cooperation:

-

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: lisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812342A Object Oriented Analysis and Design (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish. If at least four non-Finnish student take the course, English exercises group is organised.

Timing:

2nd year, start of the autumn semester

Learning outcomes:

After completing the course, the students know possibilities of UML-language family to describe different views. They can picture a task using Use cases and scenarios. Moreover they can produce detailed descriptions using activity-, class-, interaction- and state diagrams. They know principles of object-orientedness and can use abstract as well interface classes. Additionally they can model user interface by state diagrams. They understand what design patterns are and how they are described and categorised.

Contents:

Principles of object orientation and object-oriented programming; quality criteria of object orientation; design patterns; case use; activity, class, interaction and state machine diagrams; class realisation.

Mode of delivery:

Face to face

Learning activities and teaching methods:

Lectures 30h, compulsory exercises and assignments 28h, independent work 85 h.

Prerequisites and co-requisites:

Course of elementary programming (such as 811192P Introduction of programming) is a compulsory prerequisite.

Basic knowledge of object programming and information systems analysis and design are assumed.

Recommended or required reading:

Bennet, McRobb & Farmer: Object-oriented systems analysis and design, Using UML.

Assessment methods and criteria:

Examination. At least 50% on points needed for passing the course.

Grading:

1-5

Person responsible:

Juha lisakka

812341A: Object-Oriented Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812341A Object-oriented Programming (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

finnish

Timing:

1st year, spring semester, period 4

Learning outcomes:

After completing the course, the student is able to explain the general objectives and techniques of object-oriented programming paradigm. Furthermore, the student can describe the practical meaning of concepts of object-oriented programming. The student can construct Java programs that apply inheritance, composition, and polymorphism.

Contents:

Introduction to object-orientation, Basics of programming in Java language, Composition, inheritance and polymorphism, Java collections and exception handling.

Mode of delivery:

face to face

Learning activities and teaching methods:

Lectures 32h, laboratory exercises 21h, weekly assignments and independent work 80h

Prerequisites and co-requisites:

Course Introduction to Programming or similar knowledge.

Recommended or required reading:

- Timothy Budd: Introduction to object-oriented programming, 3rd edition.
- Vesterholm – Kyppö: Java-ohjelmointi 6. tai uudempi painos, luvut 1-11.
- Kurssin verkkomateriaali

Assessment methods and criteria:

Weekly assignments (preferred) or final exam + programming assignment

Grading:

1-5

Person responsible:

Ilkka Räsänen

*Compulsory***812341A-01: Object-oriented programming, exercise work, 0 op**

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

812341A-02: Object-oriented programming, exam, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Partial credit
Arvostelu: 1 - 5, pass, fail
Opettajat: Ilkka Räsänen
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

812331A: Interaction Design, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Arvostelu: 1 - 5, pass, fail
Opettajat: Netta Iivari
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

English

Timing:

1st year of Master's studies, autumn semester period 1

Learning outcomes:

Objective: The course explains the role of human interaction with IT products, systems, and services, explains the factors and problems related to it to motivate interaction design, and teaches some user-centered methods for analysis, evaluation and design of interactions.

Learning Outcomes: After completing the course, the student can assess the role of human interaction with IT products, systems, and services and identify factors and problems related to it within a practical design case. The student is able to:

- use methods for analysis and evaluation of existing interfaces;
- understand the role of requirements, plan and conduct a simple requirements collection and analysis;
- use basic principles of usability and user experience for user interface design;
- use interaction design methods in designing for target user experiences.

Contents:

The course provides an overview of interaction design, introducing the terminology and fundamental concepts, the main activities, and the importance of user involvement in the design process. The course addresses establishing requirements for IT products, systems, and services. The focus is on usability and user experience from the viewpoint of the intended users, their tasks and the context of use. The course covers user-centered methods for designing for and evaluating usability and user experience of IT products, systems, and services. All the main activities of interaction design are carried out in a practical design case.

Mode of delivery:

Face-to-face teaching, self-study

Learning activities and teaching methods:

Lectures (20 h), exercises and seminar (25 h), individual and group assignments (88 h), or self-study: an opening lecture (2 h), one larger assignment (110 h) and individual tasks (21 h).

Target group:

Master's level students of the IS Oriented Module (compulsory), Master's level students of the SE Oriented Module (optional) and GS ³D students (optional).

Prerequisites and co-requisites:

Basic knowledge on human-computer interaction with usability and user-centered design.

Recommended or required reading:

Rogers, Sharp and Preece (2011, 3rd edition) *Interaction Design: Beyond Human-Computer Interaction* and related lecture and assignment materials

Assessment methods and criteria:

Accepted assignments and individual tasks

Grading:

1-5

Person responsible:

Netta Iivari

Working life cooperation:

No

815657S: Open Source Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Henrik Hedberg

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Timing:

1st year of Master's studies, periods 1+2

Learning outcomes:

After passing the course, a student will be able to

- define the historical background and the ideology of Open Source Software (OSS),
- participate in OSS development project,
- evaluate the impact of the usage of OSS and OSS licenses on software development and exploitation, and
- view the phenomenon through the essential scientific research.

Contents:

The course introduces OSS development paradigm and current topics in OSS research. OSS affects both the way to produce software and the decisions of user organizations. It can be understood, for example, from different social, legal, economical, software engineering and data security viewpoints. The aim is to study from different perspectives, for example, what OSS is and what it is not, the history and organisation of OSS projects, methods of OSS development and usage, as well as licensing models and possible risks. The emphasis on research work.

Mode of delivery:

Mostly face-to-face teaching but some parts are implemented as distance learning

Learning activities and teaching methods:

Lectures and seminars about 40 h, exercises and peer reviews about 20 h, seminar article and presentation about 70 h

Prerequisites and co-requisites:

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work. The course allows passing Project following the OSS development principles, or writing Master's thesis on a OSS topic.

Recommended or required reading:

Fogel, K. (2005): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media; Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

Assessment methods and criteria:

Active participation, seminar article and other assignments

Grading:

1-5

Person responsible:

Henrik Hedberg

815305A: Real Time Distributed Software Development, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Petri Pulli

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/135 hours of work

Timing:

1st year of Master's studies, autumn semester, periods 1 + 2

Learning outcomes:

After completing the course, the student:

- Is able to analyse the characteristics of real-time distributed systems;
- Is able to acquire an object-oriented, model-based approach to solve the design problems found in real-time systems;
- Is able to detect and derive specific problems facing the real-time software designer, and to suggest design patterns to solve those problems.

Contents:

Introduction

1. Characteristics of real-time systems;
2. Resource management;
3. Safety and reliability;
4. Time constraints;
5. Concurrency;
6. Scheduling;
7. Interrupts

Characteristics of Distribution

1. Distribution architectures
2. Concept of time;
3. Synchronisation;
4. Latency and jitter;
5. Quality of service;
6. Service discovery;
7. Networking primitives

Real-Time UML Modelling Methodology

Real-Time Design Patterns

Design Examples: Embedded, Ubiquitous, Mobile, Web/Internet

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Prerequisites and co-requisites:

Student understands computer architecture, object-oriented analysis and design (UML), programming language C and/or Java.

Recommended or required reading:

Lecture notes based on reference books

- Douglass B.P. (2009) Real-Time Design Patterns – Robust Scalable Architecture for Real-Time Systems. Addison-Wesley ISBN 0-201-69956-7. 500 p.

Assessment methods and criteria:

Exam and project evaluation

Grading:

1-5

Person responsible:

Petri Pulli

817603S: System Design Methods for Information Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Li Zhao

Opintokohteen kielet: English

ECTS Credits:

5 credits/134 hours of work

Language of instruction:

English

Timing:

1st year of Master's Studies, autumn semester, period1.

Learning outcomes:

Objective: The objective of the course is to widen students' understanding of methodologies and techniques for information systems development (ISD) and provide students with skills in using the variety of techniques.

Learning Outcomes: After the course the student understands the complexity of business, organizational, technical, and human aspects that affect ISD and the selection of methods in ISD. The student also understands the defects of traditional waterfall model and how other methods aim to answer to these defects and to other challenges in ISD. In particular, with socio-technical methods (e.g., SSM, ETHICS) and their techniques the student is able to re-plan and develop the sub-systems (automated and non-automated) of organization into a coherent whole and to take into account job satisfaction issues in addition to efficiency demands in ISD and in planning workflows in organization. The student is also able to assess and give arguments which method is suitable for an ISD project in an organization.

Contents:

What is information systems development (ISD), waterfall method, socio-technical methods like SSM and ETHICS, miscellaneous methods or frameworks like evolutionary approach, prototyping, rapid application development, Agile development, XP, business process re-engineering, process innovation, stakeholders analysis, and critical success factors, as well as how to select ISD methods.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h, exercises 24h, homework 30h, essay 30h, examination 30h.

Target group:

Prerequisites and co-requisites:

Bachelor studies recommended

Recommended optional programme components:

Recommended or required reading:

Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.
Research articles (to be announced during the course implementation).

Assessment methods and criteria:

Exercises, assignments, essay, and examination.

Grading:

1-5

Person responsible:

Li Zhao

Working life cooperation:

No

813625S: Information Systems Theory, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits/134 hours of work

Language of instruction:

English

Timing:

2nd year of Master's studies, autumn semester, periods 1 + 2

Learning outcomes:

After completing the course, the student:

- Will have a good knowledge and understanding of a broad array of research topics and themes within the field of information systems;
- Will have good knowledge and understanding of information systems research and the process by which that research is produced;
- Can publish critical IS research articles in some of the leading academic journals and conference proceedings;
- Can critically analyse and synthesise academic sources;
- Can verbally present arguments in an academic fashion;
- Can write a literature review on an IS research topic.

Contents:

1. Information Systems Research Overview
2. A contemporary selection of IS research themes, such as:
 - Information systems success and failure;

- Information systems development;
- Understanding the end-user;
- Risk management;
- Cultural Issues in information systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 1.5 ECTS credits (40.5 hours of work), class preparation 1.5 ECTS (40.5 hours of work), and exercises 2 ECTS (53 hours of work).

Target group:

Master's level students

Prerequisites and co-requisites:

Bachelor degree or other equivalent degree and "Research Methods" course (813621S). 813624S is a substantive overview of research in information systems not a methods course, and students should be familiar with research methods prior enrolling to 813624S.

Recommended optional programme components:**Recommended or required reading:**

To be announced during the course implementation

Assessment methods and criteria:

Paper summary and its presentation, class quizzes, and research essay are assessed. Note that there is no final exam.

Grading:

1–5

Person responsible:

Netta Iivari

Working life cooperation:

No

Other information:

Course material can be found at OPTIMA e-learning environment, Urkund is used for course work submissions.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Susanna Pirttikangas

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period IV. It is recommended that the course is taken on the fourth year Spring.

Learning outcomes:

After completing the course, the student can explain the big data phenomena and the possibilities it has in data processing and exploitation. The student can analyse concrete technologies for big data management and processing. The student can explain the most common solutions available for cloud services, and understand the benefits, risks and restrictions of them. The course offers viewpoints for big data exploitation and applications. One aim is to learn to apply methods of data preprocessing, knowledge extraction, data analysis and statistics on big data platforms. The focus will be on open data. In the exercises, the student will learn the principles of the current new technologies and utilize them on a basic level.

Contents:

1. Creating understanding for the Big data framework, 2. The central technologies, solutions and services, 3. Big data and cloud services, 4. Big Data processing and applications, 5. Knowledge extraction, data mining and pattern recognition from Big Data, 6. Design exercise, 7. Seminar.

Mode of delivery:

Face-to-face teaching, seminar and opponent work.

Learning activities and teaching methods:

12h lectures, 27h exercises, 32h seminar, independent studying

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:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge, the exercises do not require programming skills but they are an advantage.

Recommended optional programme components:

Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. Instructions to necessary installations will be given.

Assessment methods and criteria:

Attending lectures and finishing a design exercise with a report. The reports will be evaluated in seminar work through student opponents.

Grading:

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

Person responsible:

Susanna Pirttikangas, Mika Rautiainen

Working life cooperation:

None

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

ECTS Credits:

7

Language of instruction:

In English.

Timing:

Spring, periods 4.

Learning outcomes:

Upon completing the required coursework, the 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, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line 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, self-study: 50 hours. Student independently solves programming assignments: 100 hours

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.

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 fail.

Person responsible:

Guoying Zhao, Jie Chen, Jukka Holappa

Working life cooperation:

No

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, periods 1

Learning outcomes:

Upon completing the required coursework, student is able to explain the emotion theory and modeling, implement algorithms for emotion recognition from visual, audio or physiological signals or the fusion of multi-modalities, use the basic tools to synthesize facial expressions and speech as well as has the ideas of wide applications of affective computing.

Contents:

The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, bio-signals like heart rate, EEG; crowdsourcing study; synthesis of emotional behaviors; emotion applications.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.

Target group:

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

Prerequisites and co-requisites:

A prior programming knowledge, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.

Recommended optional programme components:

-

Recommended or required reading:

All necessary material will be provided by the instructor.

Assessment methods and criteria:

The assessment of the course is based on the exam (100%) with mandatory exercises. Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Guoying Zhao

Working life cooperation:

-

A452285: Advanced module/applied computing technology (obligatory), 10 - 40 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521152S: Applied Computing Project II, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo, Vasileios Kostakos, Simo Hosio

Opintokohteen kielet: English

ECTS Credits:

10

Language of instruction:

In English.

Timing:

Autumn and Spring, periods 1-4.

Learning outcomes:

Upon completing the course the student is able to complete a full cycle of interactive systems development, including requirements elicitation, system design, prototyping, testing, and evaluation. In this work, the student is able apply skills obtained in other courses.

Contents:

Project work.

Mode of delivery:

Face to face teaching, project work as collaborative team work.

Learning activities and teaching methods:

Practical work in project teams. The course is passed with an approved project work. The implementation is fully English.

Target group:

Computer Science and Engineering M.Sc. 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:

Dix, Finlay, Abowd & Beale: Human-Computer Interaction (<http://www.hcibook.com>); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (<http://www.id-book.com>).

Assessment methods and criteria:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

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

Person responsible:

Vassilis Kostakos, Timo Ojala.

Working life cooperation:

-

A452287: Advanced module/Applied computing economy (obligatory), 10 - 40 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

724206A: Strategic Marketing Management, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

ay724206A Strategic Marketing Management (OPEN UNI) 5.0 op

721412P Product and Market Strategies 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period D, third year of studies

Learning outcomes:

After having passed this course, students are able to identify the concepts and tools linked to strategic marketing management. The course improves students' ability to evaluate different market situations among industries and propose solutions to strategic product/market decisions. Furthermore, students are able to explain strategy at different levels; corporation, SBU & functional. Students are able to apply concepts and tools of strategic marketing in global and local context that is, they understand the interdependency of macro- and microenvironments. In addition, students will demonstrate analytical thinking skills by applying different marketing strategies in practice and solving real-life business problems in a case exercise guided by the problem based learning (PBL) method (in four steps; 1) situation assessment, 2) strategy identification, 3) strategy formulation and 4) implementation.). Students will apply oral and written communication skills appropriate for business situations by working in small groups throughout the course, playing various roles of marketing professional, presenting their case exercise in written and oral form and performing a peer review valuation of another group.

Contents:

1) Situation assessment, 2) Marketing strategies, 3) Strategy formulation 4) Implementation

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36 h lectures, related discussions and group works, case exercise with both written and verbal part (53 h), case presentations (14 h) and independent reading of the textbooks and related material (20 h). During the course students will work in small groups and meet regularly in order to solve a marketing challenge proposed by the case company (case company is the same for all groups). Problem based learning (PBL) method will be applied and students play different roles to simulate tasks of the real life marketing professionals. Relating to these roles, students will write a learning diary (10 h). In the end of the course students will return a written report as a solution for the marketing challenge and presents it to other students.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of "Global perspectives"-module

Recommended or required reading:

Kotler, P., Keller, K., Brady, M., Goodman, M. & Hansen, T. (2009 or 2012) Marketing Management (1st or 2nd European Edition) and other material named by the lecturer.

Assessment methods and criteria:

: Lectures and case exercise. The written part of the case exercise will determine 80% and the verbal part 20% of the grade. The assessment of the course unit is based on the learning outcomes of the course unit.

Grading:

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

Person responsible:

Ilkka Ojansivu.

Working life cooperation:

-

Other information:

The number of students is limited.

724201A: Internationalization, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Xiaotian Zhang

Opintokohteen kielet: English

Leikkaavuudet:

ay724201A Internationalization (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period B (3rd year)

Learning outcomes:

Upon completion the students are able to understand and describe internationalization as an inward and outward process. The students are able to recognize and describe different international operation modes. The students are able to compare and evaluate the foreign operation modes in specific decision making

situations. The students also recognize the basic aspects of strategic and financial planning in the context of SME internationalization. The students will also develop their understanding of entrepreneurship and cultural awareness in business context.

Contents:

The course introduces the basic international business operation modes. The contents cover exporting and importing, contractual and investment entry modes, e-business as a mode of international operation, and the role of venture capital in internationalization of SMEs. Content structure: Introduction and Instructions; What is Entrepreneurship? Different Types of Entrepreneurship; International Operation Modes; Internationalization Process; Venture Capital in Internationalization; Strategic Development in Internationalization; Cultural Differences and International Mindset; Summary

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

36 h lectures and reflection (13 h), reading the course literature (40 h), preparing for the exam (40 h) and home-exam (4 h)

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of "Global perspectives"-module

Recommended or required reading:

Welch, L, Benito, G & S Petersen, B. (2007). Foreign Operation Methods. Theory, analysis, strategy. Edward Elgar Publishing Ltd. Cheltenham. Additional material will be assigned during the lectures.

Assessment methods and criteria:

Reflective learning diary, workshops, Examination.

Grading:

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

Person responsible:

Xiaotian Zhang and Irina Atkova.

Working life cooperation:

-

Other information:

The number of students is limited. Students are advised to familiarize themselves with the course's main literature source (Welch et al. 2007) before the beginning of the course.

A452288: Advanced module/Applied computing economy (optional), 20 - 40 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

806118P: Introduction to Statistics, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay806118P Introduction to Statistics (OPEN UNI) 5.0 op

806113P Introduction to Statistics A 5.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

3rd period

Learning outcomes:

After completing the course, student will be able to

- consider issues influencing to data collection
- describe data by appropriate methods (tables, statistics and graphical presentations)
- evaluate the effect size of the sample to the margin of error for instance in Gallup polls and in different market researches
- interpret output of a statistical software.

Contents:

- collecting data, e.g. sampling
- variables and measuring
- descriptive statistical methods and their selection
- margin of error of estimator for population mean and proportion
- statistical literacy
- basic analysis of data using statistical software

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.

Target group:

Minor students

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:

Mid-term exams and/or final exam and possible homework.

Grading:

Fail, 1-5

Person responsible:

Jari Päckilä

Working life cooperation:

No

Other information:

-

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

806113P Introduction to Statistics A 5.0 op

806109P Basic Methods in Statistics I 9.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

4th period

Learning outcomes:

Upon completion of the course, student will be able to

- analyze continuous and categorical response in the most common experimental and observational studies
- critically evaluate scientific articles
- implement and interpret analyses of a statistical software concerning issues of the course.

Contents:

- Skills for performing statistical analyses and inferences on the basis of data obtained in common experimental and observational studies are expanded and deepened
- statistical literacy of scientific articles with quantitative methods

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Total 50 h face-to-face teaching including lectures and exercise (partly computer exercises). Independent work 83 h.

Target group:

Minor students

Prerequisites and co-requisites:

The recommended prerequisite prior to enrolling for the course is the completion of the course: 806118P Introduction to Statistics or 806116P Statistics for Economic Sciences.

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:

Mid-term exams and/or final exam and possible homework.

Grading:

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

Person responsible:

Jari Pääkkilä

Working life cooperation:

No

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation.
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:

Professor Timo Ojala.

Working life cooperation:

555314S: Management Information Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Field of Industrial Engineering and Management

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

Periods 3-4.

Learning outcomes:

Upon completion of the course, the student can explain the key concepts of management information systems. The student is familiar with the significance of information and information management in modern business process management. The student can define the information needs of management processes and understands how information systems can meet these needs. After completing the course, the student is aware of the current trends in management information systems technologies and practices. After the course, the student has readiness to participate for enterprise information system designing, purchasing, and development tasks as a role of industrial engineer/process developer. During the course, the students will also develop their skills in reflective, self-directing learning.

Contents:

Key concepts of management information systems (MIS), information systems in decision making and leadership, the effects of information technology in business processes, current trends in management information systems technologies and practices, multidisciplinary nature of information systems and their development.

Mode of delivery:

The tuition will be implemented as face-to-face teaching.

Learning activities and teaching methods:

Lectures 14 h / learning diary 27 hours / self-study and group work 93 h.

Target group:

Industrial Engineering and Management students.

Prerequisites and co-requisites:

B.Sc. in Industrial Engineering and Management or equivalent, 555313S Management.

Additional information about the course and **pre-assignments** can be found in Noppa (noppa.oulu.fi).

Recommended optional programme components:

-

Recommended or required reading:

Lecture materials. Other materials will be defined at the beginning of the course.

Assessment methods and criteria:

This course utilizes continuous assessment that includes a reflective learning diary (returned on a weekly basis) and conducting the learning tasks.

Grading:

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

Person responsible:

D.Sc. Hanna Kropsu-Vehkaperä.

Working life cooperation:

No.

Other information:

Substitutes the course 555344S Management Information Systems.

724050A: Bachelor's Thesis in Economics and Business Administration, 10 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

724202A: Managing Multinationals, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Irene Lehto

Opintokohteen kielet: English

Leikkaavuudet:

ay724202A Managing Multinationals (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period C (3rd year)

Learning outcomes:

Upon completion of the course, the student is able to understand different perspectives on multinational corporations (MNCs) and recognize why MNCs exist, how they compete, and what is their impact on society. The student is able to analyse the role of cross-cultural management in MNCs as well as the

differences between global and local context. The student pays attention to the diversified nature of MNCs and understands MNC as a network. The student identifies the ethical issues and the corporate responsibility in MNC.

Contents:

Lectures will include the following themes: 1) MNCs as actors in global economy, 2) Different perspectives to MNCs, 3) Changing MNCs (e.g. joint ventures, alliances, mergers and acquisitions), 4) Headquarter and subsidiary relationships, 5) MNCs as networks, 6) Cross-cultural management in MNCs and 7) MNCs in society.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

The course consist of compulsory lectures (36h), preparation for the lectures (9h), group works and exercises based on each course theme (40h), preparation for the exam and independent study (44h) and home exam (4h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of "Global perspectives"-module

Recommended or required reading:

Forsgren, Mats (2008). Theories of the Multinational Firm, article collection and lecture material provided in the course.

Assessment methods and criteria:

Assessment will be at two stages. The group works conducted related to each theme during the course will determine 50% of the grade and the final home exam 50% of the grade. The assessment of the course unit is based on the learning outcomes of the course unit.

Grading:

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

Person responsible:

Dr. Elina Pernu and Lauri Haapanen

Working life cooperation:

-

Other information:

The number of students is limited.

724203A: Financial Statement Analysis, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karjalainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724203A Financial Statement Analysis (OPEN UNI) 5.0 op

721180P Financial Statement Analysis 5.0 op

721180A Financial Statement Analysis 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period A (1st year).

Learning outcomes:

After this course student knows the content of financial statements and understands the main accounting principles in constructing financial statements. In the course student learns the difference between accrual-based –and cash-based accounting. Student understands different stages of financial statement analysis and recognizes main adjustments of the income statement and balance sheet items. The student can calculate and interpret different financial ratios describing profitability, leverage and liquidity of the firm. After this course the student can calculate and interpret the most commonly used market-based ratios. The student knows the main principles for establishment of cash flow statement, knows the content of the cash flow statements and is able to analyze cash flow based ratios. The student understands how different financial ratios are associated and how this information can be applied in the management decisions. Based on the financial statement information, the student recognizes the main leading signals of the firm's financial distress. During the course we practice basic principles for doing the long- and short-term financial planning. The student is able independently to construct large written financial statement analysis and presentation of the target company.

Contents:

The content of the firm's income statement, balance sheet and cash flow statements, main principles of the financial statement analysis, adjustments of the income statement and balance sheets items, calculation and interpretation of financial ratios, cash flow-based statements, main signals and stages of the firm's bankruptcy, tools for analyzing the connections of the ratios.

Mode of delivery:

Face to face teaching, group work and self-study.

Learning activities and teaching methods:

Lectures 20 h, exercises and supervision of the assignment 16 h, assignment as a group work 50 h and examination as a self-study 49 h.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes)

Recommended optional programme components:

The course is part of "Analytical skills" -module.

Recommended or required reading:

Salmi Ilari (2012). Mitä tilinpäätös kertoo? Edita Publishing Oy. Yritystutkimus-neuvottelukunta: Yritystutkimuksen tilinpäätösanalyysi (2005 or newer) Gaudeamus. Other material possibly announced during the lectures.

Assessment methods and criteria:

Lecture- and literature examination and practical work.

Grading:

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

Person responsible:

KTT Pasi Karjalainen

Working life cooperation:

-

Other information:

The number of students is limited.

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Sinikka Moilanen

Opintokohteen kielet: English

Leikkaavuudet:

721176A Management Control 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period C (3rd year)

Learning outcomes:

Upon completion of the course students can define the basic structure of a management control system. They are thus able to describe the design and development needs of management control systems. They can also identify and discuss viewpoints to be taken into account controlling multinational operations. Students can also apply basic accounting control tools, such as budgets and variance analysis, to simple control problems.

Contents:

Management control system design and development, cultural influences on management control systems, budgets and standards, variance analysis, profit centre accounting and transfer pricing, performance measurement.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures and exercises 36 h, self-study 129h, which includes case assignments.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of "Global perspectives"-module

Recommended or required reading:

Drury, C.: Management & Cost Accounting 7th Ed. 2008 (Parts 4 & 5, pp. 346-591), Cengage Learning EMEA; Merchant, K. A. & Van der Stede, W. A.: Management control systems – performance measurement, evaluation and incentives, Prentice-Hall, 2nd Ed. 2007; other material defined by the responsible teacher; lecture notes and exercises.

Assessment methods and criteria:

Students complete the course by completing case-based home assignments. The assessment of the course is based on the learning outcomes of the course unit, which means that in the home assignments they need to show both ability to describe theory in writing, and to apply basic control tools by calculations.

Grading:

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

Person responsible:

Lecturer Sinikka Moilanen.

Working life cooperation:

Other information:

The number of students is limited.

724207A: Financial Decisions, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Mirjam Lehenkari

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay724207A Financial Decisions (OPEN UNI) 5.0 op

ay721178P Fundamentals of Corporate Finance (OPEN UNI) 5.0 op

721178P Principles of Corporate Finance 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period C. It is recommended to complete the course at the 2nd spring semester.

Learning outcomes:

The course is an introduction to the theory and practice of capital structure decisions. Upon successful completion of the course, the student will be able to describe the most well-known capital structure theories and to identify factors that affect capital structure decisions in practice.

Contents:

1) short- and long-term financial planning, 2) cost of capital, 3) financial leverage, 4) capital structure theories, 5) capital structure decisions in practice, 6) risk management and firm value, 7) dividend policy in theory and practice

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

lectures 36h, self-study 93h, exam 4h

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier module (introduction to business studies)

Recommended optional programme components:

This course is part of "Business Processes" -module

Recommended or required reading:

Ross, Westerfield & Jordan: Fundamentals of Corporate Finance (4th or later edition) / Corporate Finance Fundamentals, Irwin/McGraw-Hill

Assessment methods and criteria:

faculty examination

Grading:

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

Person responsible:

postdoctoral researcher Mirjam Lehenkari

Working life cooperation:

-

Other information:

The number of students is limited.

724208A: Portfolio Theory, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Andrew Conlin

Opintokohteen kielet: English

Leikkaavuudet:

721361P Investments 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period A, (3rd year of Bachelor Program)

Learning outcomes:

Upon completion of the course, students will be able to: quantitatively show the beneficial effects of diversification on portfolio expected return and variance; construct optimal portfolios from a limited number of assets; describe the relationship between risk aversion and an investor's optimal complete portfolio; distinguish between active and passive portfolio construction, and form optimal active portfolios; derive, compare, and contrast the CAPM and APT pricing models; define and discuss the Efficient Market Hypothesis; explain the implications of the EMH for investment policy; outline arguments of Behavioral Finance and discuss examples from the literature

Contents:

This course is an introduction to the fundamentals of modern investment theory. Students will create portfolios from limited numbers of assets, and examine the portfolios' return and risk characteristics. The course will cover the CAPM and APT equilibrium models of asset pricing. The Efficient Market Hypothesis, along with both supporting and contradictory evidence, will be presented. The course will also introduce theory and evidence of Behavioral Finance.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

36 hours of lectures, 93 hours of independent study and 4 hours exam.

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies and business processes)

Recommended optional programme components:

This course is part of "Analytical skills"-module

Recommended or required reading:

Bodie, Kane, & Marcus: Investments. Mc-Graw-Hill, 6th (or later) ed.

Assessment methods and criteria:

Assessment methods include a midterm and a final exam. The assessment criteria are based on the learning outcomes of the course.

Grading:

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

Person responsible:

Doctoral Student Andrew Conlin.

Working life cooperation:

-

Other information:

The number of students is limited.

724209A: Monetary Economics, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Svento, Rauli

Opintokohteen kielet: Finnish

Leikkaavuudet:

721115P Theory of Money, Banking and Monetary Policy 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period A. It is recommended to complete the course at the 3rd autumn semester.

Learning outcomes:

After the course the students are able to explain the concept of money, the role of money in the economy and the principles according to which the demand and supply of money and the interest rates are determined. The students can describe in a basic level the functioning of financial markets, financial institutions and the central bank. They are also able to compare the objectives, tools and mechanisms of monetary policy to each other, and evaluate the effects of monetary policy actions on money markets and the real economy. Completing the course enables students to understand and scrutinize the practical statements and news about the monetary policy issues and functioning of markets for money given in the public media.

Contents:

Financial systems; the concepts of money and financial markets, determination of interest rates, monetary and financial institutions, supervision of banking, central banks; tools, objectives and mechanisms of monetary policy, the connection between monetary policy and aggregate demand and supply.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

36 hours lectures, and independent reading of the textbooks and other material distributed during the course (93 h). Exam (4 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes)

Recommended optional programme components:

This course is part of "Analytical skills" -module

Recommended or required reading:

Mishkin, F.S.: The Economics of Money, Banking and Financial Markets, 10th ed. (2013), Pearson;
Howells, P. & Bain, K.: Economics of money, banking and finance: A European text, 4th ed. (2008),
Prentice Hall; the appropriate parts from both of these; other material possibly announced during the
lectures.

Assessment methods and criteria:

Examination based on the literature and lecture materials.

Grading:

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

Person responsible:

Riikka Nuutilainen

Working life cooperation:

-

Other information:

The number of students is limited.

724210A: Global Economics, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Korhonen

Opintokohteen kielet: English

Leikkaavuudet:

721218A Principles of International Economics 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits/133 hours of work

Language of instruction:

English

Timing:

Period B (3rd year)

Learning outcomes:

After the course the student is capable of explaining the impact of international trade on the economy. In addition the student can compare different instruments of trade policy and their welfare effects. Furthermore the student understands basic functioning of foreign exchange markets.

Contents:

Topics of the course include the basic concepts of international trade including the more recent literature on imperfect competition and strategic behaviour. In addition the course introduces issues of trade policy and international macroeconomics, particularly foreign exchange markets.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

24 hours of lectures, 12 hours of exercises and 93 hours of independent reading of the textbooks. Exam (4 hours)

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes and analytical skills)

Recommended optional programme components:

This course is part of "Global perspectives"-module

Recommended or required reading:

Feenstra, R. ja A.M. Taylor (2011): International Economics, 2. painos, Krugman, P. & M. Obstfeld, (2009): International Economics: Theory and Policy, 8. painos, Pearson/AddisonWesley.; other material announced during the lectures.

Assessment methods and criteria:

Lectures and exercises, literature examination.

Grading:

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

Person responsible:

Dr. Marko Korhonen.

Working life cooperation:

-

Other information:

The number of students is limited

724205A: Distribution and Retail Management, 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Juga

Opintokohteen kielet: Finnish

Leikkaavuudet:

721428A Retail Management 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Period D (2nd year).

Learning outcomes:

Upon completion of this course the student knows the functions, flows and processes in distribution channels and can formulate distribution objectives within the context of current logistics and retail management. The student can assess the business concepts and formats of retail and understands the role of vertical and horizontal coordination in distribution channels. The student can identify dependencies of distribution activities and understands their impacts on competitiveness. The student has an understanding of the economic role and importance of distributive functions in society with a special view of sustainable business and economy.

Contents:

Structural, operational and social factors and models in distribution channels. Logistical activities, channel member roles and functions and retail models (e.g. franchising, cooperatives, e-commerce, multi-channel distribution). Functional inter-dependencies in distribution with illustrative cases and numerical examples.

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

36 h lectures, reading the course literature (53 h), assignments (40 h) and exam (4 h).

Target group:

Major students in economics and business administration

Prerequisites and co-requisites:

Earlier modules (introduction to business studies, business processes)

Recommended optional programme components:

The course is part of "Analytical skills" -module.

Recommended or required reading:

Kautto, M., Lindblom A. & Mitronen, L.: Kaupan liiketoimintaosaaminen (Talentum, 2008) and other learning material specified during lectures.

Assessment methods and criteria:

Lecture- and literature examination and course assignments.

Grading:

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

Person responsible:

Professor Jari Juga

Working life cooperation:

-

Other information:

The number of students is limited.

A452281: Advanced Module/Embedded Systems, Embedded Systems Electronics (obligatory), 16 - 21 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

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 processing.

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.

521306A: Circuit Theory 2, 4 op**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Rahkonen, Timo Erkki**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

521303A Circuit Theory 2 5.0 op

ECTS Credits:

4

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, periods 5-6

Learning outcomes:

After the course the student can

- use Laplace transform for solving time and frequency response of electric circuits
- derive continuous-time transfer functions., solve their poles and zeros and understand the meaning of those
- draw the pole-zero map and Bode plots of any given transfer function
- construct 2-port parameter models of a given circuit

Contents:

Use of Laplace transform in network analysis. Properties of network functions, poles and zeros, Bode magnitude and phase plots. 2-port parameter models.

Mode of delivery:

Classroom

Learning activities and teaching methods:

30h lectures, 22 h exercises.

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Basics of circuit theory, differential equations.

Recommended optional programme components:

-

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.

Read more about [assessment criteria](#) at the University of Oulu webpage.**Grading:**

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

Other information:

-

521432A: Electronics Design I, 5 op**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Juha Häkkinen**Opintokohteen kielet:** Finnish**ECTS Credits:**

5

Language of instruction:

Finnish.

Timing:

Autumn, period 1

Learning outcomes:

On completion of the study module students should be able to recount the principles covering the design of multistage amplifiers, analyze and set the frequency response of a transistor amplifier and make use of feedback to improve the properties of an amplifier in the desired manner. They should also be able to analyze the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability. Students should similarly be able to describe the principles governing the design of power amplifiers, to make widespread use of operational amplifiers for realizing electronic circuits and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers. They should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and tuned amplifiers and 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:

Not defined.

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:

-

Other information:

-

521445S: Digital Techniques 3, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

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, periods 3-4

Learning outcomes:

After completing this course the student 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. The student is also able to use the tools needed in industrial design projects.

Objective: To learn the design methods and tools for digital systems' hardware design that are used in industrial FPGA- and ASIC design projects.

Contents:

1. Digital systems design process. 2. System level design and modeling of digital systems. 3. Architecture level synthesis of digital circuits. 3. FPGA circuit design and verification (technology choice, logic synthesis, physical synthesis and timing analysis) 4, ASIC-design and verification (technology choice, logic synthesis, physical synthesis, timing analysis, power analysis, design for testability).

Mode of delivery:

Classroom

Learning activities and teaching methods:

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

Target group:

-

Prerequisites and co-requisites:

Digital techniques I + II

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

Final exam and a design exercise, 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:

-

Other information:

-

A452282: Advanced Module/Embedded Systems, Embedded Systems Electronics (optional), 14 - 39 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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/134 hours of work

Language of instruction:

English

Timing:

The course starts in autumn and continues to spring semester (periods 2 and 3). It is recommended that the course is completed during the first year of Master's studies.

Learning outcomes:

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

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:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail

Person responsible:

Arto Lanamäki

Working life cooperation:

No

Other information:

-

521405A: Electronic System Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Period 1

Learning outcomes:

On completion of the study module a student is able to choose the optimum method of the choices presented in the course in the field of power supply, thermal design, grounding, and routing of the high speed signals. The student is able to calculate problems, caused by electrical disturbances, crosstalk and non-idealities of electrical components. After passing the course the student can calculate reliability of an electrical device or system.

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:

-

Prerequisites and co-requisites:

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

Recommended optional programme components:

-

Recommended or required reading:

Handout. 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:

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:

-

Other information:

-

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Linatti

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

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them. Student can explain design methods signals for band-limited channels and can classify different channel equalizers, and perform the performance analysis.

Objective: Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.

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 M.Sc. and WCE students

Prerequisites and co-requisites:

Telecommunication Engineering, Broadband Communications Systems

Recommended optional programme components:

Recommended: Statistical Signal Processing

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 Linatti

Working life cooperation:

-

Compulsory

521323S-01: Wireless Communications I, Exam, 0 op

Opiskelumuoto: Advanced Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Linatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521323S-02: Wireless Communications I, Exercise, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Linatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521443S: Electronics Design II, 5 op**Opiskelumuoto:** Advanced Studies**Laji:** Course**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:

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:

-

521088S: Optoelectronics, 5 op**Voimassaolo:** 01.01.2014 -**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Juha Kostamovaara**Opintokohteen kielet:** Finnish**ECTS Credits:**

5

Language of instruction:

Finnish

Timing:

Spring, period 3

Learning outcomes:

On completion of the study module students should be able to explain the principles of operation of photo conductors (optic fibers), semiconductor light sources and photo detectors used in optoelectronic measurements and telecommunications, paying due attention to factors affecting their performance. They should also be able to outline circuit-level structures for optical transmitter circuits and photo detector preamplifiers and to compare them in terms of their main performance parameters. They should also be reasonably able to use the main principles of signal processing principles that are typically used in optoelectronic measurement applications.

Contents:

Wave/particle dualism of optical radiation, optical waveguides and their properties, sources of radiation (radiation of black body, LED- and laser structures), photo detectors (photo conductive detector, photo multiplier, PIN- and AP-diodes, position sensitive detectors), light source modulation, preamplifiers and their bandwidth/stability/noise analysis, signal processing concepts used in optoelectronics.

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:

-

Prerequisites and co-requisites:

Principles of semiconductor devices.

Recommended optional programme components:

-

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:

-

Other information:

-

521489S: Research Work on Information Processing, 8 op**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opintokohteen kielet:** Finnish**ECTS Credits:**

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation. 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:

Professor Timo Ojala.

Working life cooperation:

-

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Esa Rahtu

Opintokohteen kielet: Finnish

Leikkaavuudet:

521348S Statistical Signal Processing 5.0 op

ECTS Credits:

5

Language of instruction:

Finnish, Course can be passed in English.

Timing:

Spring, periods 4.

Learning outcomes:

Upon completion of the course, the student is able to utilize the generic linear model as a representation for parameter estimation. He can apply typical deterministic and random parameter estimation methods for different estimation problems. He is able to determine statistical properties of estimators and make comparisons between them. The student can also form a basic state-variable model and utilize Kalman filtering for state estimation. Moreover, he is able to apply basic methods of detection theory for solving simple detection problems. After the course, the student can implement the learned methods and assess their statistical properties with the Matlab software.

Contents:

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.

Learning activities and teaching methods:

Lectures (24 h), exercises (24 h) and Matlab design exercise (10 h). The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031019P 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:

Esa Rahtu

Working life cooperation:

None.

521385S: Mobile Telecommunication Systems, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

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:

-

Recommended or required reading:

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

Assessment methods and criteria:

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

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.

521304A: Filters, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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:

- draw a pole-zero map for a given transfer function;
- perform impedance and frequency scaling for component values;
- choose an appropriate prototype filter and filter degree;
- synthesize passive RLC filters;
- synthesize active opamp based filters;
- can compare various filter technologies;
- 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:

Classroom

Learning activities and teaching methods:

30 h lectures, 16 h exercises. A design exercise (15h).

Target group:

Finnish students

Prerequisites and co-requisites:

Basics of circuit theory and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 12-18.

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:

-

Other information:

-

Compulsory

521304A-02: Filters, exercise work, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Neitola, Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521331A-02 Filters, exercise work 0.0 op

521331A Filters 4.0 op

Ei opintojaksokuvauksia.

521304A-01: Filters, exam, 0 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521331A Filters 4.0 op

Ei opintojaksokuvauksia.

521328A: Simulations and Tools for Telecommunications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuhtoniemi

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

Learning outcomes:

A student recognizes problems and limitations related to simulations. A student can select a suitable simulation method and knows how to validate the model. Student knows how to generate signals, random numbers and noise as well as fading channels. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results. A student can explain principles of network level simulations. Furthermore, a student knows basics of one or two fundamental simulation programs.

The goal is to familiarize the students with simulation of communication systems, protocols, algorithms and transceiver RF/IF-blocks. The course gives answers to questions why, when and how to simulate. In addition to simulation principles students are familiarized to some basic simulation software.

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:

-

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 Vuhtoniemi

Working life cooperation:

-

Other information:

-

A452283: Advanced Module/Embedded Systems, Embedded Systems Software (obligatory), 10 - 20 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521266S: Distributed Systems, 6 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

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, communication, 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.

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara, 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 3-4.

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 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 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".

A452284: Advanced Module/Embedded Systems, Embedded Systems Software (optional), 23 - 35 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses: is chosen so that the total size of the advanced module is 35 ECTS cr

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

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/134 hours of work

Language of instruction:

English

Timing:

The course starts in autumn and continues to spring semester (periods 2 and 3). It is recommended that the course is completed during the first year of Master's studies.

Learning outcomes:

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

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:

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

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail

Person responsible:

Arto Lanamäki

Working life cooperation:

No

Other information:

-

812342A: Object Oriented Analysis and Design, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812342A Object Oriented Analysis and Design (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

Finnish. If at least four non-Finnish student take the course, English exercises group is organised.

Timing:

2nd year, start of the autumn semester

Learning outcomes:

After completing the course, the students know possibilities of UML-language family to describe different views. They can picture a task using Use cases and scenarios. Moreover they can produce detailed descriptions using activity-, class-, interaction- and state diagrams. They know principles of object-orientedness and can use abstract as well interface classes. Additionally they can model user interface by state diagrams. They understand what design patterns are and how they are described and categorised.

Contents:

Principles of object orientation and object-oriented programming; quality criteria of object orientation; design patterns; case use; activity, class, interaction and state machine diagrams; class realisation.

Mode of delivery:

Face to face

Learning activities and teaching methods:

Lectures 30h, compulsory exercises and assignments 28h, independent work 85 h.

Prerequisites and co-requisites:

Course of elementary programming (such as 811192P Introduction of programming) is a compulsory prerequisite.

Basic knowledge of object programming and information systems analysis and design are assumed.

Recommended or required reading:

Bennet, McRobb & Farmer: Object-oriented systems analysis and design, Using UML.

Assessment methods and criteria:

Examination. At least 50% on points needed for passing the course.

Grading:

1-5

Person responsible:

Juha Iisakka

812341A: Object-Oriented Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812341A Object-oriented Programming (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits/133 hours of work

Language of instruction:

finnish

Timing:

1st year, spring semester, period 4

Learning outcomes:

After completing the course, the student is able to explain the general objectives and techniques of object-oriented programming paradigm. Furthermore, the student can describe the practical meaning of concepts of object-oriented programming. The student can construct Java programs that apply inheritance, composition, and polymorphism.

Contents:

Introduction to object-orientation, Basics of programming in Java language, Composition, inheritance and polymorphism, Java collections and exception handling.

Mode of delivery:

face to face

Learning activities and teaching methods:

Lectures 32h, laboratory exercises 21h, weekly assignments and independent work 80h

Prerequisites and co-requisites:

Course Introduction to Programming or similar knowledge.

Recommended or required reading:

- Timothy Budd: Introduction to object-oriented programming, 3rd edition.
- Vesterholm – Kyppö: Java-ohjelmointi 6. tai uudempi painos, luvut 1-11.
- Kurssin verkkomateriaali

Assessment methods and criteria:

Weekly assignments (preferred) or final exam + programming assignment

Grading:

1-5

Person responsible:

Ilkka Räsänen

*Compulsory***812341A-01: Object-oriented programming, exercise work, 0 op**

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

812341A-02: Object-oriented programming, exam, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Partial credit

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Räsänen

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521323S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Linatti

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

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to make the performance comparison of them. Student can explain design methods signals for band-limited channels and can classify different channel equalizers, and perform the performance analysis.

Objective: Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.

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 M.Sc. and WCE students

Prerequisites and co-requisites:

Telecommunication Engineering, Broadband Communications Systems

Recommended optional programme components:

Recommended: Statistical Signal Processing

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 Linatti

Working life cooperation:

-

*Compulsory***521323S-01: Wireless Communications I, Exam, 0 op****Opiskelumuoto:** Advanced Studies**Laji:** Partial credit**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Jari linatti**Opintokohteen kielet:** English**Leikkaavuudet:**

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521323S-02: Wireless Communications I, Exercise, 0 op**Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Advanced Studies**Laji:** Partial credit**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Jari linatti**Opintokohteen kielet:** English**Leikkaavuudet:**

521395S Wireless Communications I 5.0 op

Ei opintojaksokuvauksia.

521489S: Research Work on Information Processing, 8 op**Opiskelumuoto:** Advanced Studies**Laji:** Course**Arvostelu:** 1 - 5, pass, fail**Opintokohteen kielet:** Finnish**ECTS Credits:**

8

Language of instruction:

Finnish/English.

Timing:

Autumn and spring, periods 1-4.

Learning outcomes:

The work will develop skills for being initiative, creativity, application of theoretical knowledge, programming and cooperation. The student will also learn how to document the results of the work in a form of a scientific publication.

Contents:

A small-scale research work in an active research group. Topics will be selected from the needs of present research activities in the site of work. Main emphasis is on the development and application of methods and algorithms for information processing. Often work includes programming with Matlab, C or Java languages.

Mode of delivery:

Self-study.

Learning activities and teaching methods:

First the research group is studied to get understanding of what are its goals. Detailed task description is written with the advisor. Typically, the work includes study of theoretical background information, programming, testing and simulations, documentation, and presentation. The presentation will include a technical report written in English in the form of a scientific publication, and an oral presentation with slides. Depending on task assignment, a more detailed report may be necessary. Task assignments can be applied at any time all year round.

Target group:

Computer Science and Engineering students + Other Students of the University of Oulu.

Prerequisites and co-requisites:

A prerequisite will be a good success in the studies. Good grades in programming courses are beneficial. Additional criteria are set on the task basis.

Recommended optional programme components:

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

Recommended or required reading:

Literature and scientific articles depending on the task assignment.

Assessment methods and criteria:

Course assessment is based on the technical report and oral presentation. 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:

Professor Timo Ojala.

Working life cooperation:

-

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

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:

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 processing.

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.

521328A: Simulations and Tools for Telecommunications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

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

Learning outcomes:

A student recognizes problems and limitations related to simulations. A student can select a suitable simulation method and knows how to validate the model. Student knows how to generate signals, random numbers and noise as well as fading channels. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results. A student can explain principles of network level simulations. Furthermore, a student knows basics of one or two fundamental simulation programs.

The goal is to familiarize the students with simulation of communication systems, protocols, algorithms and transceiver RF/IF-blocks. The course gives answers to questions why, when and how to simulate. In addition to simulation principles students are familiarized to some basic simulation software.

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:

-

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 Vuhtoniemi

Working life cooperation:

-

Other information:

-

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Arvostelu: 1 - 5, pass, fail

Opettajat: Kontinen, Jukka Pekka

Opintokohteen kielet: Finnish

Leikkaavuudet:

521027S Advanced practical training 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

3

Language of instruction:

Finnish/English

Timing:

Whole academic year. Periods 1-4.

Learning outcomes:

After the 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 study. 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 gives 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:

Students find their training jobs themselves.

Target group:

Computer Science and Engineering MSc students.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

-

Recommended or required reading:

None.

Assessment methods and criteria:

For the compulsory MSc stage practical training lasting at least two months a training report is required for which an acceptable grade must be obtained. A more exact compilation instruction of the training report is on the WWW pages of the degree programs.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/fail.

Person responsible:

Jukka Kontinen

Working life cooperation:

Yes.

521993S: Master's Thesis in Computer Engineering, 30 op

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

30

Language of instruction:

Finnish/English

Timing:

Second year of MSc studies

Learning outcomes:

The student is able to set goals for a given task. He can structure the topic coherently, with emphasis on the key issues. Depending on the nature of the work, the student is able to present the existing results or technological implementations so that the methods used in the work are justified in relation to the state of the art in the field of engineering or science in question. He is able to apply the knowledge and state of the art methods of the subject area in his work. He can present clearly his plan and solution implemented, justify the choices made, and assess the functionality of the solution with relevant testing and evaluation methods. In addition, he is able to compare the results against goals and to consider their general significance to modern engineering or science, and assess the broader significance of the results to the company, organization or project. The student is able to produce smooth, clear and finalized text based on technical and scientific writing practices of the field.

Contents:

The thesis work is carried out independently. The student defines the content of the thesis under the guidance of the supervisor. The degree program committee approves the thesis topic and content.

The thesis is recorded in accordance with the orientation using the following codes:

- 521981S Master's Thesis in Information Processing Engineering, 30 ECTS cr

- 522985S Master's Thesis in Applied Computing, 30 ECTS cr
- 521984S Master's Thesis in Embedded Systems, 30 ECTS cr

Mode of delivery:

Face-to-face meetings with the supervisor and independent studying.

Learning activities and teaching methods:

Independent work under the guidance of the supervisor.

Target group:

Second year MSc students.

Prerequisites and co-requisites:

Compulsory advanced studies preceding the thesis (90 ECTS cr).

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

The thesis is assessed by two reviewers (supervisor and second reviewer) and approved by the degree program committee. Assessment Criteria at the University of Oulu can be found [here](#).

Grading:

1-5 (1=sufficient, 2=satisfactory, 3=good, 4=very good, 5=excellent)

Person responsible:

Supervising professor or researcher

Working life cooperation:

Yes.

Other information:

Detailed instructions: <http://www.oulu.fi/cse/studying/masters-thesis>

521009S: The Maturity Test for Master`s Degree, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset**721704P: Business Logistics, 5 op**

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Juga

Opintokohteen kielet: English

Leikkaavuudet:

ay721704P Business Logistics (OPEN UNI) 5.0 op

721704A Business Logistics 5.0 op

Ei opintojaksokuvauksia.

721462S: Business Networks, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Nätti

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

6 ECTS credits / 160 hours of work

Language of instruction:

English.

Timing:

Period C

Learning outcomes:

Upon completion of the course, students have deepened their theoretical understanding of business networks. They are able to explain, why the different kinds of networks are important in global business life and how they are able to coordinate them considering strategic goals of the company. They can critically apply different network discourse conceptions to their global business environment. They are able to analyze the underlying logic of different types of strategic nets, learning, and knowledge transfer within the global network likewise sources of conflict and conflict resolution strategies. After passing this course, students are capable to evaluate and argue the relevance and usefulness of such theories in their Master's Thesis when needed.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Students need to attend the pre-exam (40 h) to enter the course. 36 hours lectures and related article analysis and mini cases, group work and related presentation (30 h), independent reading of the textbooks and related material for the exam (54 h).

Target group:

Master's level students in marketing.

Prerequisites and co-requisites:

A pre-exam needs to be passed (book Håkansson, H. & Snehota, I eds: Developing Relationships in Business Networks, 1995). Detailed information on the pre-exam will be provided on Noppa.

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 pre-exam: Developing Relationships in Business Networks (1995) Håkansson, H. & Snehota, I (eds.) (sections given by the lecturer before the course). The final exam: Lecture material AND Parolini, C. (1999) The Value Net – A Tool for Competitive Advantage.

[Check the availability of course material from this link.](#)

Assessment methods and criteria:

Assessment will be at three stages. Pre-examination will determine 20% of the grade. The group work conducted during the course will determine 30% and the final exam 50%. The assessment is based on the learning outcomes of the course unit.

Grading:

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

Person responsible:

Dr. Satu Nätti

Working life cooperation:

No

Other information:

The number of students is limited.

721419P: Consumer Behavior, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Annu Perttunen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay721419P Consumer Behavior (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

721672S: Economics of Network Industries, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Koivumäki

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521275A: Embedded Software Project, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning, Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

8

Language of instruction:

Material of the course is available in English, lecturing is given in Finnish or English if needed.

Timing:

Autumn and Spring, periods 2-4.

Learning outcomes:

Embedded software project is the final course in the Bachelor's degree. The skills to pass this course have been acquired in previous courses. During the course, students work in groups to implement a program into an embedded system and write a technical report of the work. The subject of the program is not necessarily covered in previous courses.

After completing the course work, students have demonstrated that they can employ their skills in acquiring information to find a feasible solution to a given problem while still addressing the constraints imposed by a given embedded system. The student has shown that they are capable of designing and then implementing the non-trivial solution as a program to the given embedded system. Furthermore, they have demonstrated that they are capable of writing good-quality scientific text, including a literature survey, theory, technical documentation, testing documentation and other necessary chapters.

Contents:

This course familiarizes the student with modern embedded system development with modern methods and tools. Topics: Development tools, practical application program for an embedded system.

Mode of delivery:

Face-to-face teaching.

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:

Data periodicals, handouts, handbooks

Assessment methods and criteria:

Project 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:

Juha Röning, Teemu Tokola

Working life cooperation:

None.

521014S: Expert Training, 0 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Practical training

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

1-5.

Language of instruction:

Finnish/English.

Timing:

Periods 1-4.

Learning outcomes:

Upon completion of the course the student knows in details the duties of her or his field of expertise, and is able to apply the knowledge and the skills learned in challenging practical tasks.

Contents:

Familiarizing with the duties of the field of expertise, tasks in the work community requiring responsibility and deep know-how, reporting.

Mode of delivery:

Independent work.

Learning activities and teaching methods:

Students find their training jobs themselves.

Target group:

Computer Science and Engineering students

Prerequisites and co-requisites:

None.

Recommended optional programme components:

-

Recommended or required reading:

None.

Assessment methods and criteria:

The student must make a report which describes the duties as well as the knowledge and the skills obtained during the training. The report should be delivered to the study affairs office together with testimonials (witnessed copies) that indicate the duration of the work, part-time or full-time status, and duties. Training is granted 1.5 ECTS cr / working year with the minimum of 1 ECTS cr and maximum of 5 ECTS cr.

Read more about [assessment criteria](#) at the University of Oulu webpage.

Grading:

Pass/Fail.

Person responsible:

Programme Director Janne Heikkilä.

Working life cooperation:

Yes.

721412P: Product and Market Strategies, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Ojansivu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay721412P Product and Market Strategies (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.