Opasraportti

ITEE - Computer Science and Engineering DP (2020 - 2021)

University's new study guide for academic year 2020-2021 is published at https://opas.peppi.oulu.fi

The study guide includes information on degrees, curriculums, courses and course timetables. Course registrations are still done in Oodi.

If you have questions on information in the study guide, please contact the study field's Academic Affairs Service Team https://www.oulu.fi/forstudents/faculty-study-affairs

Degree Programme in Computer Science and Engineering

Programme Structure Diagram of Degree Programme in Computer Science and Engineering: Bachelor of Science (Technology) and Master of Science (Technology, 5 year),

Programme Structure Diagram of Master's Programme in Computer Science and Engineering (2 year) and

International Master's Programme in Computer Science and Engineering (2 year), Programme Structure Diagrams are here.

Programme Director of Degree Programme is Janne Heikkilä.

Study Advising

In the Degree Programme in Computer Science and Engineering: study.itee(at)oulu.fi.

More information about studying can be found on the website: https://www.oulu.fi/forstudents/

Tutor Teachers and Student Tutors

Everyone new student is appointed tutor teacher and student tutor in Univeristy of Oulu. Tutor Teachers of Degree Programme in Computer Science and Engineering and student tutors is here.

Courses and registering

University's new study guide for academic year 2020-2021 is published at https://opas.peppi.oulu.fi. The study guide includes information on degrees, curriculums, courses and course timetables. Information about the courses can be found by adding course code or name to 'Search box'.

During the first period (August 31- October 25) of the autumn semester, lectures will primarily be delivered remotely. PEPPI's study guide may still be information about the lecture hall, but the lectures are remote in the first period. Teachers send information about the course closer to the start of the course, when you are registered in the course.

Students still register for the courses in WebOodi.

Exams

Registration for the exam takes place via WebOodi or in the electronic exam system. It is not always mandatory to register teacher's the course exams.

Tutkintorakenteet

Computer Science and Engineering, Master's Degree Programme (2 years), International Programme

Tutkintorakenteen tila: published

Lukuvuosi: 2020-21

Lukuvuoden alkamispäivämäärä: 01.08.2020

Specialization Options (37 - 55 op)

Artificial Intelligence, Compulsory Courses 55 ECTS cr

521285S: Affective Computing, 5 op
521283S: Big Data Processing and Applications, 5 op
521273S: Biosignal Processing I, 5 op
521140S: Computer Graphics, 5 op
521153S: Deep Learning, 5 op
031025A: Introduction to Optimization, 5 op
521289S: Machine Learning, 5 op
521466S: Machine Vision, 5 op
521161S: Multi-Modal Data Fusion, 5 op
521158S: Natural Language Processing and Text Mining, 5 op
521156S: Towards Data Mining, 5 op

Applied Computing, Compulsory Courses 50 ECTS cr

521283S: Big Data Processing and Applications, 5 op
521042S: Creative Design, 5 op
521290S: Distributed Systems, 5 op
521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op
521043S: Internet of Things, 5 op
521158S: Natural Language Processing and Text Mining, 5 op
521260S: Programmable Web Project, 5 op
521044A: Social Computing, 5 op
521156S: Towards Data Mining, 5 op
521291S: VR Systems and Humans, 5 op

Computer Engineering, Compulsory Courses 37 ECTS cr

521281S: Application Specific Signal Processors, 5 op
521155S: Computer Security, 5 op
521423S: Embedded System Project, 5 op
521043S: Internet of Things, 5 op
521288S: Multiprocessor Programming, 5 op
521279S: Signal Processing Systems, 5 op
521479S: Software Project, 7 op

Advanced Modules: Artificial Intelligence Orientation (30 op)

A452295: Advanced Module / Artificial Intelligence, 25 - 60 op

Optional Studies:l Artificial Intelligence, Choose f.g. from the following courses total 30 ECTS cr

521155S: Computer Security, 5 op
031051S: Numerical Matrix Analysis, 5 op
521489S: Research Work on Information Processing, 8 op
521348S: Statistical Signal Processing 1, 5 op
521291S: VR Systems and Humans, 5 op
521145A: Human-Computer Interaction, 5 op
521290S: Distributed Systems, 5 op
521337A: Digital Filters, 5 op
521293A: Introduction to XR Systems, 5 op
813621S: Research Methods, 5 op
521260S: Programmable Web Project, 5 op
521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op
521282S: Biosignal Processing II, 5 op
521157A: Introduction to Social Network Analysis, 5 op
521045S: Mobile Computing, 5 op
521495A: Artificial Intelligence, 5 op
521467A: Digital Image Processing, 5 op

Advanced module: Applied Computing Orientation

A452300: Advanced Module / Applied Computing, 23 - 28 op

Optional Studies: Applied Computing, Choose f.g. from the following courses total 35 ECTS cr. You can find more studies in the study guide https://weboodi.oulu.fi/oodi/opasopiskopas.jsp

521479S: Software Project, 7 op
811372A: Software Development, Maintenance and Operations, 5 op
521155S: Computer Security, 5 op
521286A: Computer Systems, 8 op
521423S: Embedded System Project, 5 op
521495S: Artificial Intelligence, 5 op
811607S: Persuasive Systems Design, 5 op
812671S: User Experience (UX) and Usability Evaluation, 5 op
521275A: Embedded Software Project, 8 op
521140S: Computer Graphics, 5 op
812651S: ICT and Behaviour Change, 5 op
521157A: Introduction to Social Network Analysis, 5 op
521489S: Research Work on Information Processing, 8 op
521152S: Applied Computing Project II, 10 op
521154S: UBISS - International UBI Summer School, 5 op
521149S: Special Course in Information Technology, 5 - 8 op
813621S: Research Methods, 5 op
812650S: Advanced Topics in Digital Cultures and Design, 5 op

Advanced Modules: Computer Engineering (vähintään 20 op)

A452298: Advanced Module / Computer Engineering, Software, 48 op

Compulsory studies, 20 ECTS cr

521348S: Statistical Signal Processing 1, 5 op
521340S: Communications Networks I, 5 op
521290S: Distributed Systems, 5 op
521395S: Wireless Communications I, 5 op

Optional Courses, Choose f.g. from the following courses total 28 ECTS cr

521156S: Towards Data Mining, 5 op
521307A: Laboratory Exercises on Analogue Electronics, 5 op
521489S: Research Work on Information Processing, 8 op
031025A: Introduction to Optimization, 5 op
521145A: Human-Computer Interaction, 5 op
521273S: Biosignal Processing I, 5 op
521070A: Introduction to Microfabrication Techniques, 5 op
521337A: Digital Filters, 5 op
813621S: Research Methods, 5 op

521260S: Programmable Web Project, 5 op
521466S: Machine Vision, 5 op
521289S: Machine Learning, 5 op
521467A: Digital Image Processing, 5 op
521283S: Big Data Processing and Applications, 5 op
521140S: Computer Graphics, 5 op

Supplementary module

Choose Supplementary studies so that your degree is the minimun of 120 cr.

Supplementary module can include for example courses from the basic module of another orientation.

900013Y: Beginners' Finnish Course 1, 3 op
900017Y: Survival Finnish, 2 op

Advanced Practical Training (5 op)

521027S: Advanced practical training, 5 op

Master's Thesis (30 op)

The Master's Thesis requires a written maturity test.

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

Degree Programme in Computer Science and Engineering, B.Sc.

Tutkintorakenteen tila: published

Lukuvuosi: 2020-21

Lukuvuoden alkamispäivämäärä: 01.08.2020

Basic and Intermediate Studies (120 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
English 6 ECTS cr
902150Y: Professional English for Technology, 2 op
902145Y: Working Life Skills, 2 op
902147Y: Academic Vocabulary for Science and Technology, 2 op
902142Y: Business Correspondence, 2 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
521159P: Principles of Digital Fabrication, 5 op
521160P: Introduction to Artificial Intelligence, 5 op

031023P: Mathematical Structures for Computer Science, 5 op
031077P: Complex analysis, 5 op
761119P: Electromagnetism 1, 5 op
030005P: Information Skills, 1 op

Compulsory Intermediate Studies

521109A: Electrical Measurement Principles, 5 op
521145A: Human-Computer Interaction, 5 op
521301A: Digital Techniques 1, 8 op
521286A: Computer Systems, 8 op
811312A: Data Structures and Algorithms, 5 op
031080A: Signal Analysis, 5 op
521457A: Software Engineering, 5 op
521150A: Introduction to Internet, 5 op
521453A: Operating Systems, 5 op
521467A: Digital Image Processing, 5 op

Complusory Bachelor's Thesis

900060A: Technical Communication, 2 op
523991A: Bachelor's Thesis / Information Engineering, 8 op
521008A: Computer Science and Engineering, The Maturity Test for Bachelor's Degree, 0 op

Module preparing for the option (15 - 20 op)

Artificial Intelligence

A452127: Module Preparing for the Option, Artificial Intelligence, 20 op

15 ECTS cr

805305A: Introduction to Regression and Analysis of Variance, 5 op
521495A: Artificial Intelligence, 5 op
521157A: Introduction to Social Network Analysis, 5 op

Applied computing

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

15 ECTS cr

521046A: Mobile Computing, 5 op
521293A: Introduction to XR Systems, 5 op
521040A: 3D Virtual Environments and Applications, 5 op

Computer Engineering

A452126: Module Preparing for the Option, Computer Engineering, 20 op

20 ECTS cr

521337A: Digital Filters, 5 op
521495A: Artificial Intelligence, 5 op
521302A: Circuit Theory 1, 5 op
031076P: Differential Equations, 5 op

Supplementary modules

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

Supplementary module primarily consists of a preparatory module of another orientation (Artificial Intelligence, Applied Computing or Computer Engineering). 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.

A452127: Module Preparing for the Option, Artificial Intelligence, 20 op

15 ECTS cr

805305A: Introduction to Regression and Analysis of Variance, 5 op
521495A: Artificial Intelligence, 5 op
521157A: Introduction to Social Network Analysis, 5 op

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

15 ECTS cr

521046A: Mobile Computing, 5 op
521293A: Introduction to XR Systems, 5 op
521040A: 3D Virtual Environments and Applications, 5 op

A452126: Module Preparing for the Option, Computer Engineering, 20 op

20 ECTS cr

521337A: Digital Filters, 5 op
521495A: Artificial Intelligence, 5 op
521302A: Circuit Theory 1, 5 op
031076P: Differential Equations, 5 op

Supplementary Module: Biomedical Engineering, 15 ECTS cr

080925A: Anatomy and Physiology for Biomedical Engineering, 5 op
764327A: Virtual measurement environments, 5 op
080901A: Introduction to Technology in Clinical Medicine, 5 op
521242A: Introduction to Biomedical Engineering, 5 op
080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op

Supplementary Module: Electrical Engineering (15 ECTS cr)

521302A: Circuit Theory 1, 5 op
521330A: Telecommunication Engineering, 5 op
521384A: Basics in Radio Engineering, 5 op
521077P: Introduction to Electronics, 5 op
521329A: Hands-on Course in Wireless Communication, 5 op
521210A: Electronics Materials, 5 op
521303A: Circuit Theory 2, 5 op
521404A: Digital Techniques 2, 5 op
521431A: Principles of Electronics Design, 5 op
521071A: Principles of Semiconductor Devices, 5 op
521432A: Electronics Design I, 5 op
521304A: Filters, 5 op
521092A: Electronic Measurement Techniques, 5 op

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

810136P: Introduction to Information Processing Sciences, 5 op
811168P: Information Security, 5 op
811174P: Introduction to Software Business, 5 op
811325A: Databases, 5 op
811322A: Programming 2, 5 op
811367A: Programming 3, 5 op
811368A: Programming 4, 5 op
811391A: Requirements Engineering, 5 op
811306A: Software Quality and Testing, 5 op
811319A: Data Modeling and Design, 5 op
815345A: Software Architectures, 5 op
811166P: Fundamentals to Information Systems, 5 op
812360A: Information Systems Modelling, Desing and Development, 5 op
812361A: Information Systems Acquisition, Deployment and Management, 5 op
812362A: Business Process Management and Modelling, 5 op
812363A: Human-Centred Design, 5 op
812364A: Data Analytics and Business Intelligence, 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

Working life & Entrepreneurship , 15 ECTS cr

724814P: Introduction to Business Development, 5 op
724813P: Entrepreneurship in Action, 5 op
724815P: Entrepreneurial Assignment, 5 op
724811P: Entrepreneuring for Sustainability, 5 op
724812P: Building Change Through Entrepreneurship, 5 op
724816P: Building Business Through Creativity and Collaboration, 5 op

Supplementary Module: Economics and Management (15 ECTS cr)

ay724110P: Introductory Economics (OPEN UNI), 5 op
ay724102P: Management and Organizations (OPEN UNI), 5 op

ay724111P: Finnish Economy and Economic Policy (OPEN UNI), 5 op
ay724108P: Financial Markets (OPEN UNI), 5 op
ay724105P: Management Accounting (OPEN UNI), 5 op

Basic Business Studies

724835P: Basics of Management and Organizations, 5 op
724836P: Introduction to Corporate Social Responsibility, 5 op
724830P: Introduction to Accounting and Financial Management, 5 op
724832P: Economics and The Business Environment, 5 op
724833P: Introduction to Entrepreneurship, 5 op
724834P: Basics of Marketing and Sales, 5 op
724837P: Understanding and managing a business as a dynamic whole - business simulation game, 5 op
724831P: Introduction to Business Law, 5 op

Statistics

805351A: Linear Regression, 5 op
805353A: Statistical Software, 5 op
805306A: Introduction to Multivariate methods, 5 op
805349A: Likelihood and Bayesian Inference, 5 op
805350A: Estimation and Test Theory, 5 op

Supplementary Module: OAMK, 15 ECTS cr

030009M: Studies in Other Universities/Institutes, 0 - 60 op

Optional Studies

Students can choose optional courses to complete the 15-20 ECTS credit. Practical training, 3 or 5 ECTS credits, can also be included. (521012A Practical Training or Practical training 521019A). You can select optional studies from the list of supplementary module.

MSc. Engineering, Computer Science and Engineering

Tutkintorakenteen tila: published

Lukuvuosi: 2020-21

Lukuvuoden alkamispäivämäärä: 01.08.2020

Specialization Options (37 - 55 op)

Artificial Intelligence, Compulsory Courses 55 ECTS cr

521285S: Affective Computing, 5 op
521283S: Big Data Processing and Applications, 5 op
521273S: Biosignal Processing I, 5 op
521140S: Computer Graphics, 5 op
521153S: Deep Learning, 5 op
031025A: Introduction to Optimization, 5 op
521289S: Machine Learning, 5 op
521466S: Machine Vision, 5 op
521161S: Multi-Modal Data Fusion, 5 op
521158S: Natural Language Processing and Text Mining, 5 op
521156S: Towards Data Mining, 5 op

Applied Computing, Compulsory Courses 50 ECTS cr

521283S: Big Data Processing and Applications, 5 op
521042S: Creative Design, 5 op
521290S: Distributed Systems, 5 op
521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op
521043S: Internet of Things, 5 op

521158S: Natural Language Processing and Text Mining, 5 op
521260S: Programmable Web Project, 5 op
521044A: Social Computing, 5 op
521156S: Towards Data Mining, 5 op
521291S: VR Systems and Humans, 5 op

Computer Engineering, Compulsory Courses 37 ECTS cr

521281S: Application Specific Signal Processors, 5 op
521155S: Computer Security, 5 op
521423S: Embedded System Project, 5 op
521043S: Internet of Things, 5 op
521288S: Multiprocessor Programming, 5 op
521279S: Signal Processing Systems, 5 op
521479S: Software Project, 7 op

Advanced Modules: Artificial Intelligence Orientation (30 op)

A452295: Advanced Module / Artificial Intelligence, 25 - 60 op
Optional Studies:l Artificial Intelligence, Choose f.g. from the following courses total 30 ECTS cr
521155S: Computer Security, 5 op
031051S: Numerical Matrix Analysis, 5 op
521489S: Research Work on Information Processing, 8 op
521348S: Statistical Signal Processing 1, 5 op
521291S: VR Systems and Humans, 5 op
521145A: Human-Computer Interaction, 5 op
521290S: Distributed Systems, 5 op
521337A: Digital Filters, 5 op
521293A: Introduction to XR Systems, 5 op
813621S: Research Methods, 5 op
521260S: Programmable Web Project, 5 op
521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op
521282S: Biosignal Processing II, 5 op
521157A: Introduction to Social Network Analysis, 5 op
521045S: Mobile Computing, 5 op
521495A: Artificial Intelligence, 5 op
521467A: Digital Image Processing, 5 op

Advanced module: Applied Computing Orientation

A452300: Advanced Module / Applied Computing, 23 - 28 op
Optional Studies: Applied Computing, Choose f.g. from the following courses total 35 ECTS cr. You can find more studies in the study guide https://weboodi.oulu.fi/oodi/opasopiskopas.jsp
521479S: Software Project, 7 op
811372A: Software Development, Maintenance and Operations, 5 op
521155S: Computer Security, 5 op
521286A: Computer Systems, 8 op
521423S: Embedded System Project, 5 op
521495S: Artificial Intelligence, 5 op
811607S: Persuasive Systems Design, 5 op
812671S: User Experience (UX) and Usability Evaluation, 5 op
521275A: Embedded Software Project, 8 op
521140S: Computer Graphics, 5 op
812651S: ICT and Behaviour Change, 5 op
521157A: Introduction to Social Network Analysis, 5 op
521489S: Research Work on Information Processing, 8 op
521152S: Applied Computing Project II, 10 op
521154S: UBISS - International UBI Summer School, 5 op
521149S: Special Course in Information Technology, 5 - 8 op
813621S: Research Methods, 5 op
812650S: Advanced Topics in Digital Cultures and Design, 5 op

Advanced Modules: Computer Engineering (vähintään 20 op)

Computer Engineering, Advanced Modules: 1. Hardware

A452297: Advanced Module / Computer Engineering, Hardware, 48 op
Compulsory studies, 22 ECTS cr
521404A: Digital Techniques 2, 5 op
521303A: Circuit Theory 2, 5 op
521406S: Digital Techniques 3, 7 op
521340S: Communications Networks I, 5 op
Optional Courses, Choose f.g. from the following courses total 26 ECTS cr.
521307A: Laboratory Exercises on Analogue Electronics, 5 op
521405A: Electronic System Design, 5 op
521401S: Electronics Design II, 6 op
521395S: Wireless Communications I, 5 op
521088S: Optoelectronics, 5 op
521348S: Statistical Signal Processing 1, 5 op
521489S: Research Work on Information Processing, 8 op
521070A: Introduction to Microfabrication Techniques, 5 op
521328A: Simulations and Tools for Telecommunications, 5 op
521304A: Filters, 5 op
813621S: Research Methods, 5 op

Computer Engineering, Advanced module: 2. Software

A452298: Advanced Module / Computer Engineering, Software, 48 op
Compulsory studies, 20 ECTS cr
521348S: Statistical Signal Processing 1, 5 op
521340S: Communications Networks I, 5 op
521290S: Distributed Systems, 5 op
521395S: Wireless Communications I, 5 op
Optional Courses, Choose f.g. from the following courses total 28 ECTS cr
521156S: Towards Data Mining, 5 op
521307A: Laboratory Exercises on Analogue Electronics, 5 op
521489S: Research Work on Information Processing, 8 op
031025A: Introduction to Optimization, 5 op
521145A: Human-Computer Interaction, 5 op
521273S: Biosignal Processing I, 5 op
521070A: Introduction to Microfabrication Techniques, 5 op
521337A: Digital Filters, 5 op
813621S: Research Methods, 5 op
521260S: Programmable Web Project, 5 op
521466S: Machine Vision, 5 op
521289S: Machine Learning, 5 op
521467A: Digital Image Processing, 5 op
521283S: Big Data Processing and Applications, 5 op
521140S: Computer Graphics, 5 op

Supplementary module

Choose Supplementary studies so that your degree is the minimun of 120 cr.

Supplementary module can include for example courses from the basic module of another orientation.

Advanced Practical Training (5 op)

521027S: Advanced practical training, 5 op

Master's Thesis (30 op)

The Master's Thesis requires a written maturity test.

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

Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

521013A: Advanced Practical Training, 3 op
521014S: Expert Training, 0 - 5 op
521012A: Practical Training, 3 op
521019A: Practical training, 5 op

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits
Language of instruction:
In English
Timing:
Fall, periods 1
Learning outcomes:
After completing the course, student
1. is able to explain the emotion theory and modeling
2. is able to implement algorithms for emotion recognition from visual and audio signals, and the fusion of multi-modalities
3. has the ideas of wide applications of affective computing
Contents:
The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, fusion of multi-modalities; crowdsourcing study; synthesis of emotional behaviors; emotion applications.
Mode of delivery:
Online teaching in Moodle/Zoom.
Moodle: https://moodle.oulu.fi/course/view.php?id=325&section=0
Learning activities and teaching methods:

The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
A prior programming knowledge with Python, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5, zero stands for fail.
Person responsible:
Guoying Zhao, Henglin Shi, Yante Li
Working life cooperation:
No
Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lauri Lovén

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
Upon completion of the course, the student :
1. is able to explain the big data phenomenon, its challenges and opportunities.
2. is able to explain the requirements and common principles for data intensive systems design and implementation, and evaluate the benefits, risks and restrictions of available solutions.
3. can explain the principles of big data management and processing technologies and utilize them on a basic level.

Contents:
General introduction into big data, namely: big data fundatmenals, data storage, batch and stream data processing, data analysis, privacy and security, big data use cases.
Mode of delivery:
Online teaching, exercises and seminars. Independent and group work.
Learning activities and teaching methods:
Lectures, exercises, seminars, independent and group work
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu
Prerequisites and co-requisites:
The Bachelor level studies of Computer science and engineering study programmes or respective knowledge.
Recommended optional programme components:

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

Recommended or required reading:

Lecture slides and exercise material will be provided. Each lecture will include the refernce list for recommended reading. Instructions to necessary installations will be given.

Assessment methods and criteria:

This course assesses students continuously by the completion of small project work, seminar presentations and short reports on a selected topic (group work). Answering two quizzes during the course is optional and provides additional points for final grade. To pass the course, it is enough to get 50 % of available points. No exam.

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

Grading:

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

Person responsible:

Lauri Lovén

Working life cooperation:

The course includes also invited lectures from industry.

Other information:

Course is in Moodle.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen, Zalan Rajna

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the master's degree level.

Learning outcomes:

After completing the course, student:

1. knows about special characteristics of the biosignals and typical signal processing methods
2. can solve small-scale problems related to biosignal analysis
3. implement small-scale MATLAB software for signal processing algorithms.

Contents:

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

Mode of delivery:

Face-to-face teaching and guided laboratory work. The laboratory work can alternatively be performed on an online system (MathWorks Grader). Student can do the lab works remotely or in the lab using the same online system.

Learning activities and teaching methods:

Lectures 12h, Laboratory work 24h, Self-study for laboratory working and examination 99 h.

Target group:

Students interested in digital signal processing applications in biomedical engineering, at their master's level studies.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Face-to-face lectures. Students solve the programming problems in the laboratory work independently, supervised by assistants. The MathWorks Grader online system is used for programming tasks and it also verifies the completed tasks. Written examination.
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.

521140S: Computer Graphics, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521493S	Computer Graphics	7.0 op

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

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clippin
2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling
3. is able to explain the relationship between the 2D and 3D versions of such algorithms
4. possesses the necessary basic skills to use these basic algorithms available in PyOpenGL

Contents:
The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (PyOpenGL) for implementation.
Mode of delivery:
Remote teaching
Learning activities and teaching methods:
Lectures 22 h / Programming lessons 12 hours / Self-study and programming assignments 101 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Programming skills using Python; basic data structures; simple linear algebra.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English)
5) Online PyOpenGL tutorials (e.g. http://pyopengl.sourceforge.net/context/tutorials/index.html)
Assessment methods and criteria:

The assessment of the course is based on the exam (70%) and programming assignments (30%).
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, Tuomas Varanka, Muzammil Behzad.
Working life cooperation:
No
Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521153S: Deep Learning, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Li Liu

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/135 hours of work
Language of instruction:
English
Timing:
autumn, period 2
Learning outcomes:
Upon completion of this course, the students will be able to:

1. learn the theories, models, algorithms, implementation and recent progress of deep learning, and obtain empirical experience on training deep neural networks.
2. will learn about linear classifiers, multilayer neural networks, back propagation and stochastic gradient descent, convolutional neural networks, recurrent neural networks, generative adversarial networks, deep network compression, deep transfer learning techniques and deep reinforcement learning (tentative).
3. know about applications of deep learning to typical computer vision problems such as image classification, object detection and segmentation.
4. learn to implement, train and debug their own neural networks with PyTorch.

Contents:
Students should be comfortable taking derivatives and understanding matrix vector operations and notations.
Basic Probability and Statistics, Linear Algebra, basics of probabilities, Gaussian distributions, mean, standard deviation, etc.
have knowledge of Machine Learning course and digital image processing course

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
20h lectures, 12h exercise sessions, independent studying 95 hours.
Target group:
B.Sc. and M.Sc. students of Computer Science and Engineering. The course fits also for Statistics and Math M.Sc. students interested in learning deep learning techniques.
Prerequisites and co-requisites:
The Bachelor level knowledge of Computer science and engineering study programmes. Good programming skills in a chosen language.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Lecture hand-out, complementary reading list, and exercise material will be provided.
Assessment methods and criteria:

Attending lectures and exercise sessions, and returning the weekly exercises and final project.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Li Liu
Working life cooperation:
The course may include the invited guest lectures from industry and other top universities.

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn, during period 1.
Learning outcomes:
After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.
Contents:
Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h / Group work 14 h / Self-study 93 h.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.
Target group:
Students in Wireless Communication Engineering
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra
Recommended optional programme components:
-
Recommended or required reading:
P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming
Assessment methods and criteria:
The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail
Person responsible:
Keijo Ruotsalainen
Working life cooperation:
-
Other information:
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:
5 ECTS credits.
Language of instruction:
English.
Timing:
The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.
Learning outcomes:
After completing the course, student

1. can design simple optimal classifiers from the basic theory and assess their performance.
2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.
3. can apply regression techniques to practical machine learning problems.

Contents:
Introduction. Bayesian decision theory. Parametric and non-parametric classification. Feature extraction. Classifier design and optimization. Example classifiers. Statistical regression methods.
Mode of delivery:
Online teaching, guided laboratory work and independent assignment. The laboratory works are done on an online system (Mathworks Grader). Student can do the lab works remotely or in the lab using the same online system.
The course is implemented as remote education via the Moodle work space https://moodle.oulu.fi/course/view.php?id=5729
This work space opens to students before the course begins. The student must register to the course in WebOodi in order to participate the course.
Learning activities and teaching methods:
Lectures 16 h, Laboratory work 16 h, and Self-study the rest (Independent task assignment).
Target group:
Students who are interested in machine learning and pattern recognition theory and methods.
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:
Will be informed when the course starts.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also verify that the task assignments are completed properly. The Matworks Grader online system also verifies the completed tasks. The independent task assignment is graded which establishes the grade for the course.
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 the independent task assignment.
Person responsible:
Tapio Seppänen

Working life cooperation:
No

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

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

Contents:
1. Introduction, 2. Imaging and image representations, 3. Light and color, 4. Binary image analysis, 5. Texture, 6. Local features, 7. Recognition, 8. Motion, 9. 2D models and transformations, 10. Perceiving 3D from 2D images, 11. 3D transformations and reconstruction.
Mode of delivery:
Online lectures and exercises, homework assignments.
Learning activities and teaching methods:
Lectures (24 h), exercises (16 h) and programming assignments (32 h), self-studying (61 h)
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
521467A Digital Image Processing or an equivalent course, basic Python programming skills.
Recommended optional programme components:
521289S Machine Learning. This course provides complementary knowledge on machine learning methods needed in machine vision.
Recommended or required reading:
Lecture slides and exercise material. The following books are recommended for further information: 1) Shapiro, L.G. & Stockman, G.C.: Computer Vision, Prentice Hall, 2001. 2) Szeliski, R.: Computer Vision: Algorithms and Applications, Springer, 2011. 3) Forsyth, D.A. & Ponce, J.: Computer Vision: A Modern Approach, Prentice Hall, 2002.
Assessment methods and criteria:
The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5. Zero stands for a fail.
Person responsible:
Janne Heikkilä
Working life cooperation:
No.
Other information:
Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=4317

521161S: Multi-Modal Data Fusion, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jaakko Suutala

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr / 135 hours of work
Language of instruction:
English
Timing:
Autumn / period 2.
Learning outcomes:
Upon completion of the course, the student will be able to

1. understand the problem of combining data of different natures and coming from different sources
2. explain basic principles of combining multi-sensor data
3. know the common types of data fusion techniques
4. understand and utilize Bayesian probabilistic reasoning framework in multi-modal data fusion
5. understand basic principles of machine learning applied to multi-modal data fusion
6. implement basic solutions towards the accomplishment of a given task requiring the integration and combination of data

Contents:
This course will provide a comprehensive introduction to the concepts and ideas of multi-sensor data fusion. We will be concentrated on defining general statistical framework for multi-modal data processing. Using this framework, we will show concepts of common representation and alignments, sequential Bayesian inference, and machine learning approaches to data fusion as well as specific models and algorithms in each category. Furthermore, the course will illustrate many real-life examples taken from a diverse range of applications to show how they can be benefitted from data fusion approaches.
The course will discuss the following topics:

1. Introduction
2. Sensors and architectures
3. Common representation
4. Alignments
5. Bayesian inference and probabilistic reasoning
6. Sequential Bayesian inference
7. Bayesian Decision Theory and ensemble learning
8. Advanced topics

Mode of delivery:
The course will be based on a combination of lectures (face-to-face teaching), exercises, and a final project.
Learning activities and teaching methods:
16 h lectures, 16 h exercises (including programming tasks), 35 h final programming project, home study.
Target group:
The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.
Prerequisites and co-requisites:
The course will be self-contained as much as possible (i.e., no previous knowledge of multi-sensor data fusion is assumed). Basic knowledge on mathematics and statistics as well as related topics like signal processing, and machine learning will be a plus.
The required prerequisite is the completion of the following courses: 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics, 521156S Towards Data Mining, and 521289S Machine Learning.

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 will be based on the following textbook: H.B. Mitchell. Data Fusion: Concepts and Ideas. Springer (2012) and selected recent journal articles.
Assessment methods and criteria:
To pass the course, the student should return the exercises, complete a final programming project. Half of the grade will be based on exercises and half on the final project.
Grading:

The course will utilize a numerical grading scale 1-5. Zero stands for a fail.

Person responsible:
Jaakko Suutala and Markus Harju
Working life cooperation:
-
Other information:
Course uses Moodle platform.

521158S: Natural Language Processing and Text Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 120 hours of works
Language of instruction:
English
Timing:
Period 1. It is recommended to complete the course at the end of period 1
Learning outcomes:
Upon completing the course, the student is expected to i) comprehend, design and implement basic (online) text retrieval and query systems; ii) account for linguistic aspects and perform word sense disambiguation; iii) perform basic (statistical) inferences using corpus; iv) manipulate (statistical) language modelling toolkits, online lexical databases and various natural language processing tools.
Contents:
Foundation of text retrieval systems, Lexical ontologies, word sense disambiguation, Text categorization, Corpus-based inferences and Natural Language Processing tools
Mode of delivery:
Face- to-face teaching and laboratory sessions
Learning activities and teaching methods:
Lectures (24 h), tutorial/laboratory sessions (16h), seminar (6h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.
Target group:
students with (moderate to advanced) programming skills in Python
Prerequisites and co-requisites:
Programming skills (preferably) in Python

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time
Recommended or required reading:
Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze. Cambridge University Press, 2008. (Free from http://nlp.stanford.edu/IR-book/) Foundations of statistical natural language processing, by Manning, Christopher D., Schütze, Hinrich. Cambridge, Mass.: MIT Press, 2000
Assessment methods and criteria:
One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Mourad Oussalah
Working life cooperation:
-

521156S: Towards Data Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Tamminen

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Autumn, period I.
Learning outcomes:
After completing this course, student can recognize data types and perform required pre-processing steps before further analysis:

1. Student can design and implement a data collection process
2. Student can combine data from different sources
3. Student can normalize and transform data, and handle missing or incorrect values
4. Student can ensure generalizability of the results

Contents:
Course provides good ability to start Master's Thesis or graduate studies. Topics at the course include data mining process in general level, data gathering and different data types, quality and reliability of the data, data preparation including the processing of missing values, outliers, and privacy issues, combination of signals from several sources, utilization of data bases in data mining process, and normalization and transformation of data and interdependence of the observations and their distributions. Additionally, topics concerning the generality of the results are covered, as well as, the principles of data division, for example, train-test-validate, cross-validation and leave-one-out methods.
Mode of delivery:
Lectures, independent work, group work
Learning activities and teaching methods:
16 h lectures, 16 h exercises, independent studying.
Target group:
The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.
Prerequisites and co-requisites:
031021P Probability and Mathematical Statistics or similar
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. The material is mostly in English.
Assessment methods and criteria:
Weekly pre-lecture assignment + exercise submissions, and final exam. Half of the grade will be based on the submissions and half on the final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Tamminen Satu
Working life cooperation:
-
Other information:
Moodle: https://moodle.oulu.fi/course/view.php?id=1679
Towards Data Mining 521156S:3

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lauri Lovén

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
Upon completion of the course, the student :

1. is able to explain the big data phenomenon, its challenges and opportunities.
2. is able to explain the requirements and common principles for data intensive systems design and implementation, and evaluate the benefits, risks and restrictions of available solutions.
3. can explain the principles of big data management and processing technologies and utilize them on a basic level.

Contents:
General introduction into big data, namely: big data fundatmenals, data storage, batch and stream data processing, data analysis, privacy and security, big data use cases.
Mode of delivery:
Online teaching, exercises and seminars. Independent and group work.
Learning activities and teaching methods:
Lectures, exercises, seminars, independent and group work
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu
Prerequisites and co-requisites:
The Bachelor level studies of Computer science and engineering study programmes or respective knowledge.
Recommended optional programme components:
Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.
Recommended or required reading:
Lecture slides and exercise material will be provided. Each lecture will include the refernce list for recommended reading. Instructions to necessary installations will be given.
Assessment methods and criteria:
This course assesses students continuously by the completion of small project work, seminar presentations and short reports on a selected topic (group work). Answering two quizzes during the course is optional and provides additional points for final grade. To pass the course, it is enough to get 50 % of available points. No exam.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Lauri Lovén
Working life cooperation:
The course includes also invited lectures from industry.
Other information:
Course is in Moodle.

521042S: Creative Design, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Georgi Georgiev

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/ 135 hours of work
Language of instruction:
English
Timing:
Period 1
Learning outcomes:
Upon completion of this course, students are able to:
- Understand and apply in practice basic creative problem-solving and design thinking approaches.
- Systematically ideate and implement creative solutions to a problem, both independently and within a team.
- Apply creative design thinking and low-resolution prototyping, with emphasis on empathy, iterative strategies, and interactions.

Contents:
The course teaches students of (1) Creative problem-solving; (2) Design thinking and low-resolution prototyping; (3) Teamwork problem-solving; (4) Systematic ideation approaches.
Mode of delivery:
Face-to-face teaching, teamwork/individual work, and independent studying.
Learning activities and teaching methods:
Lectures 21h / Individual work 124h. There are TA hours each week where guidance is available.
Target group:
Primary target group is first year master's level students of computer science and engineering with the applied computing orientation.
Prerequisites and co-requisites:
There are no prerequisites or co-requisites.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
20% attendance of 7 lecture-exercises; 40% exercise completion and performance; 40% individual project outcome.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for fail.
Person responsible:
Georgi Georgiev
Working life cooperation:
-
Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01	Distributed Systems, Exam	0.0 op
521266S-02	Distributed Systems, Exercise Work	0.0 op
521266S	Distributed Systems	6.0 op

ECTS Credits:
5 ECTS cr
Language of instruction:
In English.
Timing:
Spring, period 3.

Learning outcomes:
After completing the course, the student
1. is able to explain the key principles of distributed systems
2. apply the principles in evaluating major design paradigms used in implementing distributed systems
3. solve distributed systems related problems
4. design and implement a small distributed system

Contents:
Introduction, architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, case studies.

Mode of delivery:
Online teaching

Learning activities and teaching methods:
Lectures 22 h, exercises 16 h, project work 50 h, self-study 47 h.

Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:
None.

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:
Required literature: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems – Principles and Paradigms, Third Edition, 2017.

Assessment methods and criteria:

The course uses continuous assessment so that there are 2 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

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

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

Person responsible:
Teemu Leppänen

Working life cooperation:
None.

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

521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Steven LaValle

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 135 hours of work.

Language of instruction:
Primary instruction language is English.

Timing:
The course is held in the spring semester, during period III. It is recommended to complete the course at the 4rd spring semester.

Learning outcomes:
Upon completion of the course the students will be able to:
- Deeply understand the fundamentals common to widely used sensing and filtering systems.
- Design new sensors and filters.
- Apply the material to critical problems in robotics, internet of things, and virtual and augmented reality.
- Understand the links between theory and practice in sensing and filtering systems.

Contents:

Defining sensors; physical vs virtual sensors. Chronometers, cameras, infrared, laser, temperature, IMU. Sensor mappings, resolution, noise, calibration. Preimages, sources of uncertainty, comparing sensors, stochastic modeling. Multiple sensor readings and networks of sensors. Triangulation principles. Motion models: Discrete time, continuous time, event-based. Linear, complementary, Kalman, Bayesian, and combinatorial filters. Localization and mapping; global positioning systems; tracking humans.
Mode of delivery:
Online teaching.
Learning activities and teaching methods:
The course will consist of lectures (28h), individual homework assignments (48h), self-study (56h), final exam (3h).
Target group:
M.Sc. students in CSE, EE, and related areas.
Prerequisites and co-requisites:
Matrix Algebra (mandatory BSc 1st year); Differential Equations (mandatory BSc 1st year); Introduction to Computer Systems (mandatory BSc 2nd year); Mathematical Structures for Computer Science (mandatory BSc 2nd year).
Recommended optional programme components:
The course does not require other courses to be completed simultaneously. This course is the first part of a two-part series, in which the second part would finish tracking and cover autonomy. The course fundamentals complement parts of 521287A Introduction to Computer Systems, which provides experimental practice with sensors. The course is related to 521161S Multi-Modal Data Fusion as applied artificial intelligence, but instead has emphasis on geometric concepts and use cases derived from robotics, IoT, and VR/AR. The course has minor overlap with 521124S Sensors and Measuring Techniques, which focuses on experimentation, data collection, and sensor selection.
Recommended or required reading:
Online-material that is delivered throughout the course.
Assessment methods and criteria:
The students are assessed according to their performance in assignments and the final exam. The assessment criteria are based on the learning goals of the course.
Grading:
Numerical (1-5).
Person responsible:
Steven LaValle
Working life cooperation:
The course does not contain working life cooperation.

521043S: Internet of Things, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ella Peltonen

Opintokohteen kielet: English

Proficiency level:

Status:

ECTS Credits:
5 ECTS / 135 hours of work

Language of instruction:
English

Timing:
Autumn semester during period 2.

Learning outcomes:
Upon completion of the course, the student will be able to:
1. explain application areas of IoT and requirements from such application areas for IoT systems.
2. will be able to explain the state-of-the-art IoT solutions, and understand the basic technologies behind them.
3. learn the principles of the novel IoT technologies and know important directions IoT research towards.

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

Mode of delivery:
The course will be given fully remotely. Please join the Moodle page (https://moodle.oulu.fi/course/view.php?id=5330, password is iot2020) and attend the introduction Zoom lectures in Tue 27.10. 10:15-12 (for general organisation) and Wed 28.10. 14:15-16 (for course project).

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

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

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

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:
Lecture hand-out, complementary reading list, and exercise material will be provided.

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

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

Person responsible:
Ella Peltonen

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

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

521158S: Natural Language Processing and Text Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 120 hours of works
Language of instruction:
English
Timing:
Period 1. It is recommended to complete the course at the end of period 1
Learning outcomes:
Upon completing the course, the student is expected to i) comprehend, design and implement basic (online) text retrieval and query systems; ii) account for linguistic aspects and perform word sense disambiguation; iii) perform basic (statistical) inferences using corpus; iv) manipulate (statistical) language modelling toolkits, online lexical databases and various natural language processing tools.
Contents:
Foundation of text retrieval systems, Lexical ontologies, word sense disambiguation, Text categorization, Corpus-based inferences and Natural Language Processing tools
Mode of delivery:
Face- to-face teaching and laboratory sessions
Learning activities and teaching methods:
Lectures (24 h), tutorial/laboratory sessions (16h), seminar (6h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.
Target group:
students with (moderate to advanced) programming skills in Python
Prerequisites and co-requisites:
Programming skills (preferably) in Python

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time
Recommended or required reading:
Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze. Cambridge University Press, 2008. (Free from http://nlp.stanford.edu/IR-book/) Foundations of statistical natural language processing, by Manning, Christopher D., Schütze, Hinrich. Cambridge, Mass.: MIT Press, 2000
Assessment methods and criteria:

One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Mourad Oussalah
Working life cooperation:
-

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:
The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.
ECTS Credits:
5 ECTS cr
Language of instruction:
In English.
Timing:
Spring, periods 3-4.
Learning outcomes:
Upon completion of this course, students:
- understand what a Web API is and learn different Web API architectures.
- understand the concept of hypermedia and how it is used to build Web APIs.
- are able to design and implement a Web API following REST architectural style principles using existing web frameworks.
- are able to write unit and functional tests to inspect their APIS.
- are able to document their Web APIs using adequate software tools.
- are able to implement simple software applications that make use of the APIs.

Contents:
RESTful Web APIs, Hypermedia and HATEOAS, RESTful Clients
Mode of delivery:
Online learning.
Learning activities and teaching methods:
Lectures 4 h, guided laboratory exercise 15 h, the rest as self-study and group work. Each group implements software and writes a report. Students present their work at least twice in online meetings with the course staff.
Target group:
M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.
Prerequisites and co-requisites:
Elementary programming (521141P) or equivalent Python programming
skills. Applied computing project I is recommended.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O’Reilly Media 2007. ISBN: 978-0-596-52926-0.
Assessment methods and criteria:

Course will be assessed based on project work assignment (functional working software prototype, content of the report…) and the exercises results. More detailed information on assessment will be provided with the course material.

Grading:

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

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

We will use Moodle to provide links to the working tools and information about distance learning: https://moodle.oulu.fi/course/view.php?id=6032

Course material can be found at Lovelace: https://lovelace.oulu.fi/.

521044A: Social Computing, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 135 hours of work

Language of instruction:

English.

Timing:

Autumn semseter, period I.

Learning outcomes:

By the end of the course, students:

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

Contents:

Basics of social computing, computer-mediated human communication, designing social software, analysing social computing projects, crowdsourcing

Mode of delivery:

The course consists of lectures, exercises and individual / group-based assignments.

Learning activities and teaching methods:

The course consists of lectures (12h), exercises (16h), assignments and self-study (102h).

Target group:

M.Sc. and B.Sc. students. The course recommended for anyone who wishes to strengthen their expertise on social aspects of computational systems as well as designing for humans.

Prerequisites and co-requisites:

No recommended or required preparations.

Recommended optional programme components:

The course is an independent entity and does not require additional studies carried out at the same time. The course involves design exercises that demand some experience with computer programs (not programming per se).

Recommended or required reading:

Required reading will be delivered during the course.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Associate Professor Simo Hosio
Assistant Ville Paananen

Working life cooperation:

The course contains optional guest lectures.

Other information:

Uses Moodle as the learning environment: https://moodle.oulu.fi/course/view.php?id=4449

521156S: Towards Data Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Tamminen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Autumn, period I.

Learning outcomes:

After completing this course, student can recognize data types and perform required pre-processing steps before further analysis:

1. Student can design and implement a data collection process
2. Student can combine data from different sources
3. Student can normalize and transform data, and handle missing or incorrect values
4. Student can ensure generalizability of the results

Contents:

Course provides good ability to start Master’s Thesis or graduate studies. Topics at the course include data mining process in general level, data gathering and different data types, quality and reliability of the data, data preparation including the processing of missing values, outliers, and privacy issues, combination of signals from several sources, utilization of data bases in data mining process, and normalization and transformation of data and interdependence of the observations and their distributions. Additionally, topics concerning the generality of the results are covered, as well as, the principles of data division, for example, train-test-validate, cross-validation and leave-one-out methods.

Mode of delivery:

Lectures, independent work, group work

Learning activities and teaching methods:

16 h lectures, 16 h exercises, independent studying.

Target group:

The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.

Prerequisites and co-requisites:

031021P Probability and Mathematical Statistics or similar

Recommended optional programme components:

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

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. The material is mostly in English.

Assessment methods and criteria:

Weekly pre-lecture assignment + exercise submissions, and final exam. Half of the grade will be based on the submissions and half on the final exam.

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

Grading:

Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Tamminen Satu
Working life cooperation:
-
Other information:
Moodle: https://moodle.oulu.fi/course/view.php?id=1679
Towards Data Mining 521156S:3

521291S: VR Systems and Humans, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Paula Alavesa

Opintokohteen kielet: English

ECTS Credits:
5 ECTS / 135 hours of work.
Language of instruction:
Primary instruction language is English.
Timing:
The course is held in the autumn semester, during period II. It is recommended to complete the course at the 4rd autumn semester.
Learning outcomes:
Upon completion of the course, the student will:

- Gain knowledge in human physiology and human perception in relationship to VR.
- Understand common perceptual flaws of modern VR systems related to resolution, latency, frame rates, tracking, lens aberrations, drift, and jitter.
- Be able to critically assess a given VR system or experience, and recommend improvements.
- Formulate a hypothesis about a VR experience, create such a VR experience in Unity3D, and design a human subject experiment testing the hypothesis.

Contents:
Overview of human physiology, neuroscience, and human perception with relationship to VR. Depth and scale perception. Perception of screen resolution, perception of motion. Perceptually optimal parameters for frame rate, latency, and drift in VR systems. Perceptual training. Comfort and VR sickness. Psychophysical experiments. Design of human subjects experiments.
Mode of delivery:
The lectures will be held online in Zoom https://oulu.zoom.us/j/64488083079
The courseMoodle site is at https://moodle.oulu.fi/enrol/index.php?id=3356

For exercise we will have three groups of 12 people that can attend at TS135. If the students do not have their own face masks, those will be provided. The students are expected to finish the exercise that require using VR headsets in two weeks. The students are also allowed to use their own VR headsets at home, and there are few headsets that can be borrowed for two weeks at a time. The exercise groups are held 4.11.-13.11., 18.11.-27.11. and 2.12.-11.12. During the first week of the course the students are expected to signup for one of these exercise groups, or independent work. There will be no exercise session during the first week of the course.
Learning activities and teaching methods:
The course will utilize the VR-ready computer room for both teaching and exercises. The course will consist of lectures (28h), individual lab exercises (28h), team project (28h), self-study (48h), and the final exam (3h). Parts of the exercise lab work will be organized as guided teaching.
Target group:
B.Sc. and M.Sc. students in all areas, especially applied computing and human sciences.
Prerequisites and co-requisites:

It is required that the students complete 521293A, Introduction to XR Systems, prior to enrolling for the course. It is recommended, but not required, that the students also take 521040A, 3D environments and Applications, prior to enrolling for the current course.

Recommended optional programme components:

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

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (0-5). In the numerical scale zero stands for a fail.

Person responsible:

Paula Alavesa

Working life cooperation:

When possible, a guest lecture will be held by a visitor from a VR company.

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mehdi Safarpour

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English.

Timing:

Autumn, period 1

Learning outcomes:

After completing the course, student

1. Can distinguish the main types of signal processors
2. Can design basic customized transport triggered architecture processors
3. Is capable of assembling a signal processor out of basic entities
4. Can match the processor performance and the application requirements
5. Applies the TTA codesign environment and Altera's FPGA tools to synthesize a system

Contents:

Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.

Mode of delivery:

Lectures, exercises, independent work, group work.

Learning activities and teaching methods:

Lectures 12h (participation mandatory); Instructed labs 12h. Independent work 111h

Target group:

Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.

Prerequisites and co-requisites:

521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 521337A digital filters, programming skills

Recommended optional programme components:

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

Recommended or required reading:

Handouts.

Assessment methods and criteria:

Participation in mandatory classes and approved lab exercises and project works.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Mehdi Safarpour
Working life cooperation:
No.

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning, Teemu Tokola

Opintokohteen kielet: English

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

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

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

Mode of delivery:
Contact teaching and independent work
Learning activities and teaching methods:
14 hours of lectures ja 28 hours of laboratory exercises, rest independent work alone or in groups.
Target group:
The course is intended for computer engineering masters students and additionally to any student interested in computer security that has the sufficient technical background to complete the course exercises.

Prerequisites and co-requisites:
As prior knowledge students should have a basic understanding of how computers, operating systems and the Internet work and basic skills in programming. Examples of suitable courses to cover these fundamentals are Operating Systems 521453A, Introduction to Programming 521141P and Computer Engineering 521267A.

Recommended optional programme components:
The course is an independent entity.
Recommended or required reading:
-
Assessment methods and criteria:

Grading of the course is made based on the course practical assignments.
Grading:
Numerical grade 0-5, where 0 stands for a fail.
Person responsible:
Juha Röning, Teemu Tokola

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

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
Lecturing in Finnish, material available in English
Timing:
Spring, periods 3-4.
Learning outcomes:
1. After passing the course, the student is familiar with the design process of an embedded system, from specifying the application leading to the requirement specification for the device, and then to having produced a functional prototype of the defined system.
2. The student is more familiar with the roles of the client and the system developer during the requirement specification, and the role of the iterations as a part of the whole design process. From the specifications, the student is familiar with the process of choosing the suitable hardware components, circuit design and implementation. In the end, the student is also able to know the factors arising from the SW/HW partitioning process of the actual implementation, and the concept of SW/HW dualism. The student can then better utilize the basic development tools used for embedded system design and recognize their possible advantages and disadvantages.
3. The student is more familiar with the testing and problem solving methodology related to the prototype implementation of an embedded system, to have the prototype working correctly according to the specifications.
Contents:
The embedded system design process, from initial specification to implementation of a first functional prototype and demonstrating its functionality in practice. The application can be suggested by the student group, or chosen from the topics suggested by the course organizers. During the work, the students familiarize themselves with modern design tools and methodologies related to embedded system design (according to the microcontroller the student group has chosen to utilize in their work). Most commonly used platforms on the course include STM, Atmel and Microchip based platforms.

Mode of delivery:
Online teaching. Lectures, tutoring and self-study.
Learning activities and teaching methods:
The course is run as a project work in groups of three with progress follow-up reporting meetings. Lectures 10 h, laboratory exercise in period 3-4 120 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
811122P Introduction to Programming
521412A Digital Techniques I
Also recommended; 521275A Embedded Software Project, 521432A Electronics Design I.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
-

Assessment methods and criteria:
Project work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Juha Röning
Working life cooperation:
None.

521043S: Internet of Things, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ella Peltonen

Opintokohteen kielet: English

Proficiency level:

Status:

ECTS Credits:
5 ECTS / 135 hours of work

Language of instruction:
English

Timing:
Autumn semester during period 2.

Learning outcomes:
Upon completion of the course, the student will be able to:
1. explain application areas of IoT and requirements from such application areas for IoT systems.
2. will be able to explain the state-of-the-art IoT solutions, and understand the basic technologies behind them.
3. learn the principles of the novel IoT technologies and know important directions IoT research towards.

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

Mode of delivery:
The course will be given fully remotely. Please join the Moodle page (https://moodle.oulu.fi/course/view.php?id=5330, password is iot2020) and attend the introduction Zoom lectures in Tue 27.10. 10:15-12 (for general organisation) and Wed 28.10. 14:15-16 (for course project).

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

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

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

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:
Lecture hand-out, complementary reading list, and exercise material will be provided.

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

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

Person responsible:
Ella Peltonen

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

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

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Praneeth Susarla

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S	DSP Laboratory Work	5.0 op

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
Spring semester, periods 3-4
Learning outcomes:
Upon completition of the course, the student:

1. has basic understanding of multiprocessor architectures and heterogeneous computing,
2. has basic understanding on how to design and implement algorithms for heterogeneous platforms,
3. understands the possible challenges and shortcomings related to the current heterogeneous systems,
4. is able to use the OpenCL framework for designing, implementing and optimizing signal processing algorithms for heterogeneous platforms

Contents:
Algorithm design, general purpose computing on graphics processing units, heterogeneous computing, OpenCL programming and optimization

Mode of delivery:
Opening lecture and independent exercise project, which is divided into smaller sub-entities. The exercise project is performed using both desktop and mobile platforms. After each sub-entity, a short seminar is held where the students discuss their results and possible ways to optimize the performance of their implementation.
Learning activities and teaching methods:
Opening lecture (2h), seminars (8h) and independent exercise project (125h).
Target group:
Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.
Prerequisites and co-requisites:
Matrix Algebra 031078P, Elementary programming 521141P, Computer Systems 521286A, Digital Filters 521337A
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
-
Assessment methods and criteria:
Students complete the course exercises after the attending to the opening lecture in groups of two students. Assessment is based on the quality of the completed exercises and exercise reports. More detailed information on assessment will be announced at the beginning of the course.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Praneeth Susarla
Working life cooperation:
No.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period II. For master students of Computer Science and Engineering specializing in Computer Engineering, it is recommended to complete the course at the first autumn semester.
Learning outcomes:
Learning outcomes of the course are:

1. The student understands common real number formats used in digital signal processing.
2. The student can implement a digital filter using fixed-point computations. He can optimize word lengths so that the required performance goals are fulfilled.
3. The student knows the CORDIC algorithm and can utilize it in the implementation of function and transform (e. g. DCT) computations.
4. The student knows the principles, which allow computationally efficient implementation of decimation and interpolation operations. Related to this, he can implement narrow-band digital filters.
5. The student can explain how a modulated filter bank works and knows its polyphase decomposition based implementation.
6. The student can implement convolution for long data sequences and filters. He also knows, how the same principles are used in the implementation of correlation.
7. The student can explain the general operational principles of adaptive filters and knows some of their applications. He knows operation of some common adaptive algorithms. He can study behaviour of adaptive filters with simulation.

Some exercise tasks of the course are done in the Matlab environment utilizing also its Simulink tool. The student learns how it can be used in the modelling of signal processing systems.

Contents:
Fixed-point and floating-point arithmetics, fixed-point filter implementation, CORDIC, DCT, FFT, polyphase decomposition, multirate signal processing, modulated filter banks, sectioning, adaptive filters and algorithms, Matlab and Simulink tools in DSP modelling.
Mode of delivery:
The tuition will be implemented as face-to-face teaching and web-based teaching. Moodle is used as the learning environment.
Due to Covid-19 pandemic, teaching in Autumn 2020 will be implemented remotely. Details of arrangement can be found from the course web page, which will be available from October 16 in Moodle.
Learning activities and teaching methods:
Lectures 28 h / Group work 42 h / Self-study 65 h. The group work consists of six weekly design tasks.
Target group:
The course is primarily targeted to the students of Computer Science and Engineering specializing to Computer Engineering.
Prerequisites and co-requisites:
A recommended prerequisite is the completion of "521337A Digital Filters".
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 provides lecture notes for reading. In addition, the following books provide useful information:
E.C. Ifeachor, B.W. Jervis. Digital Signal Processing - A Practical Approach. Second Edition. Prentice-Hall, 2002.
W.T. Padgett, D.V. Anderson. Fixed-Point Signal Processing. Morgan&Claypool Publishers, 2009.
Assessment methods and criteria:
The course uses continuous assessment, which is based on evaluation of the weekly group works and exams arranged during lectures.
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.
Person responsible:
Pekka Sangi
Working life cooperation:

The course does not contain working life cooperation. There may be guest lectures.
Other information:

The web page of the course arranged at Autumn 2020 will be https://moodle.oulu.fi/course/view.php?id=3212

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Christian Wieser

Opintokohteen kielet: English

ECTS Credits:
7
Language of instruction:
Finnish/English, material available in English.
Timing:
Autumn, periods 1-2.
Learning outcomes:
After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.
Contents:
Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.
Mode of delivery:
Face-to-face and independent studies.
Learning activities and teaching methods:
Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.
Assessment methods and criteria:
Project work and documentation.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Christian Wieser
Working life cooperation:
-
Other information:
-

A452295: Advanced Module / Artificial Intelligence, 25 - 60 op

Voimassaolo: 01.08.2018 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional Studies:l Artificial Intelligence, Choose f.g. from the following courses total 30 ECTS cr

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha Röning, Teemu Tokola
Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 135 hours of work

Language of instruction:

English

Timing:

Autumn Semester, period 1.

Learning outcomes:

Upon completion of this course, students know and understand the basics and advanced concepts of the following key areas of the course and cybersecurity, know key terminology and can write about the topics clearly and with justifications:

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

Additionally, students that have attained grades 2 or 3 have demonstrated technical capacity to perform practical work relevant to the course key areas. Students that have attained grades 4 or 5 have additionally demonstrated capacity for independent, ambitious work on the key areas working on advanced and challenging security research questions.

Contents:

The course covers the essential aspects of computer security and computer security research in theory and through practical examples.

Mode of delivery:

Contact teaching and independent work

Learning activities and teaching methods:

14 hours of lectures ja 28 hours of laboratory exercises, rest independent work alone or in groups.

Target group:

The course is intended for computer engineering masters students and additionally to any student interested in computer security that has the sufficient technical background to complete the course exercises.

Prerequisites and co-requisites:

As prior knowledge students should have a basic understanding of how computers, operating systems and the Internet work and basic skills in programming. Examples of suitable courses to cover these fundamentals are Operating Systems 521453A, Introduction to Programming 521141P and Computer Engineering 521267A.

Recommended optional programme components:

The course is an independent entity.

Recommended or required reading:

-

Assessment methods and criteria:

Grading of the course is made based on the course practical assignments.

Grading:

Numerical grade 0-5, where 0 stands for a fail.

Person responsible:

Juha Röning, Teemu Tokola

Working life cooperation:

-

Other information:

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

031051S: Numerical Matrix Analysis, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish or English.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Fall semester, period 1

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra and Numerical analysis

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

ECTS Credits:

8 ECTS credits / 213 hours of work

Language of instruction:

English.

Timing:

Autum and spring, periods 1-4.

Learning outcomes:

Upon completing the course, the student is able to:
1. conduct independent research as a responsible member of a research group;
2. conduct a literature survey;
3. apply theoretical knowledge in solving a practical problem;
4. design, implement and evaluate a prototype;
5. collect and analyze research data;
6. report research results in form of a scientific publication and an oral presentation.

Contents:

The student conducts independently a small-scale research work under the supervision of a senior researcher. Topics for research works can be requested from research group leaders and senior researchers.

Mode of delivery:

Self-study, meetings with the supervisor of the work.

Learning activities and teaching methods:

Independent project work 213 h.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Literature is selected for each research work separately.

Assessment methods and criteria:

Assessment is based on the scientific publication and the oral presentation reporting the research 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:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

521348S: Statistical Signal Processing 1, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes, Janne Lehtomäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521484A	Statistical Signal Processing	5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st semester of the master studies.

Learning outcomes:

Upon completion the student

1. knows the key tools of linear algebra and quadratic optimization and can apply them in solving signal processing problems.
2. understands how to handle complex valued random variables and processes.

3. understands the key concepts in estimation theory such as the classical and Bayesian philosophies.
4. masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators.
5. can derive an estimator for a given criterion and basic data models.
6. can use the methodology of estimation theory to analyze the performance of estimators and compare to performance benchmarks such as the Cramer-Rao lower bound.
7. understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), the Neyman-Pearson and Bayesian detectors.

Contents:

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

Mode of delivery:

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

Learning activities and teaching methods:

Face-to-face-teaching (lectures and exercises) 50h, Matlab simulation exercises in groups 30 h, independent work & passed assignment 50 h.

Target group:

Electrical, communications and computer science and engineering students.

Prerequisites and co-requisites:

The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal Analysis, 031021P Probability and Mathematical Statistics, 031078P Matrix Algebra, 521330A. The recommended prerequisite is the completion of Telecommunication Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Parts from books:
1. Steven M Kay, "Fundamentals of statistical signal processing: estimation theory."vol 1 Prentice Hall 1993.
2. Steven M. Kay, "Fundamentals of statistical signal processing: Detection theory, vol. 2." Prentice Hall 1999.
3. Peter Selinger, “Matrix Theory and Linear Algebra”, Creative Commons.
4. Paolo Prandoni & Martin Vetterli, Martin, “Signal Processing for Communications”, CRC Press 2008.
5. Other literature, lecture notes and material.

Assessment methods and criteria:

Completing the simulation project tasks, and a mid-term exam during the course. The mid-term exams can be retaken by a final exam later. In the final grade of the course, the weight for the examination is 0.7 and that of project report 0.3.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero (0) stands for a fail.

Person responsible:

Janne Lehtomäki and Markku Juntti

Working life cooperation:

No

Other information:

Lecture materials etc. can be found on Moodle https://moodle.oulu.fi/course/view.php?id=4203.

521291S: VR Systems and Humans, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Paula Alavesa

Opintokohteen kielet: English

ECTS Credits:

5 ECTS / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the autumn semester, during period II. It is recommended to complete the course at the 4rd autumn semester.

Learning outcomes:

Upon completion of the course, the student will:

- Gain knowledge in human physiology and human perception in relationship to VR.
- Understand common perceptual flaws of modern VR systems related to resolution, latency, frame rates, tracking, lens aberrations, drift, and jitter.
- Be able to critically assess a given VR system or experience, and recommend improvements.
- Formulate a hypothesis about a VR experience, create such a VR experience in Unity3D, and design a human subject experiment testing the hypothesis.

Contents:

Overview of human physiology, neuroscience, and human perception with relationship to VR. Depth and scale perception. Perception of screen resolution, perception of motion. Perceptually optimal parameters for frame rate, latency, and drift in VR systems. Perceptual training. Comfort and VR sickness. Psychophysical experiments. Design of human subjects experiments.

Mode of delivery:

The lectures will be held online in Zoom https://oulu.zoom.us/j/64488083079
The courseMoodle site is at https://moodle.oulu.fi/enrol/index.php?id=3356

For exercise we will have three groups of 12 people that can attend at TS135. If the students do not have their own face masks, those will be provided. The students are expected to finish the exercise that require using VR headsets in two weeks. The students are also allowed to use their own VR headsets at home, and there are few headsets that can be borrowed for two weeks at a time. The exercise groups are held 4.11.-13.11., 18.11.-27.11. and 2.12.-11.12. During the first week of the course the students are expected to signup for one of these exercise groups, or independent work. There will be no exercise session during the first week of the course.

Learning activities and teaching methods:

The course will utilize the VR-ready computer room for both teaching and exercises. The course will consist of lectures (28h), individual lab exercises (28h), team project (28h), self-study (48h), and the final exam (3h). Parts of the exercise lab work will be organized as guided teaching.

Target group:

B.Sc. and M.Sc. students in all areas, especially applied computing and human sciences.

Prerequisites and co-requisites:

It is required that the students complete 521293A, Introduction to XR Systems, prior to enrolling for the course. It is recommended, but not required, that the students also take 521040A, 3D environments and Applications, prior to enrolling for the current course.

Recommended optional programme components:

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

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (0-5). In the numerical scale zero stands for a fail.

Person responsible:

Paula Alavesa

Working life cooperation:

When possible, a guest lecture will be held by a visitor from a VR company.

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish/English

Timing:

Autumn semester, Period II

Learning outcomes:

Upon completing this course, students will possess:

1. Knowledge of Human Computer Interaction (HCI) fundamentals
2. Knowledge and practical experience of user-centric computer interface and usability evaluation techniques, such as questionnaires and interviewing
3. Knowledge and experience of prototyping techniques (both paper-based as well as digital)
4. Knowledge of how HCI can be incorporated in the software development process

Contents:

Fundamental knowledge of humans, and how that relates to computer systems and interfaces. Learning design in 2-3 different ways, and conducting evaluations of the designs. Evaluation constitutes data collection and analysis, including qualitative and quantitative data.

Mode of delivery:

Online teaching (lectures), group work (labs).

Learning activities and teaching methods:

Lectures (12 h), exercises (16 h), and practical work (105 h). The course is passed with approved classroom/reading package reflections, and an approved group-based practical work (several assignments). The implementation is doable fully in English.

Target group:

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

Prerequisites and co-requisites:

While no specific courses are not required, elementary teamwork skills are required and the capability to provide documentation.

Recommended optional programme components:

All necessary material will be provided by the instructor.

Recommended or required reading:

No required reading.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Associate Professor Simo Hosio

Working life cooperation:

If relevant, guest lectures may be organized (optional).

Other information:

Using Moodle as the teaching platform: https://moodle.oulu.fi/course/view.php?id=5409

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01	Distributed Systems, Exam	0.0 op
521266S-02	Distributed Systems, Exercise Work	0.0 op
521266S	Distributed Systems	6.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, period 3.

Learning outcomes:

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

Contents:

Introduction, architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, case studies.

Mode of delivery:

Online teaching

Learning activities and teaching methods:

Lectures 22 h, exercises 16 h, project work 50 h, self-study 47 h.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

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

Recommended or required reading:

Required literature: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems – Principles and Paradigms, Third Edition, 2017.

Assessment methods and criteria:

The course uses continuous assessment so that there are 2 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

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

Grading:

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

Person responsible:

Teemu Leppänen

Working life cooperation:

None.

Other information:

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

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Olli Silven

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Online teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Online lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silven

Working life cooperation:

None.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Open University students enroll for studies through an open website.

521293A: Introduction to XR Systems, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Paula Alavesa

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the spring semester, during period III. It is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

Upon completion of the course the students will be able to:

- Recall all of the components of modern XR systems
- Understand the interaction between the hardware, software, and human senses during an XR experience.
- Understand how the choices in hardware and software components influence human perception and the quality of XR experiences.
- Identify challenges facing next generation XR systems.
- Develop a basic VR experience using Unity3D.

Contents:

Overview of XR hardware: projectors, screens, light field displays, retinal scanners, waveguides. Overview of XR systems software: rendering systems and methods (gaming engines, panoramas, telepresence) tracking systems and methods (inside-out and inside-in tracking, camera-based methods, lighthouse, natural and artificial markers, IMU integration, sensor fusion. High level overview of human physiology, neuroscience, and human perception in relation to XR hardware and software.

Mode of delivery:

Online

Learning activities and teaching methods:

The course will consist of lectures (28h), individual lab exercises (28h), solo project (28h), self-study (48h), online final exam (3h). Students can borrow equipment from the lab to minimize the need for lab attendance. It is also possible, in small groups (<10), to do the exercise in the lab, however we aim to minimize any need for face to face teaching with other arrangements.

Target group:

B.Sc. students in all areas, especially applied computing and human sciences.

Prerequisites and co-requisites:

No prerequisites.

Recommended optional programme components:

The course is an independent entity, and does not require other additional studies carried out at the same time. It can also be considered as the first in the set of courses on VR and XR. It should be taken before VR Systems and Humans course (521291S) and 3D environments and Applications (521040A).

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (0-5). In the numerical scale zero stands for a fail.

Person responsible:

Anna LaValle.

Working life cooperation:

When possible, a guest lecture will be held by a visitor from a VR company.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will able to:
* explain the general principles of scientific research and the practices of scientific methodology,
* generate research problems in information processing sciences,
* identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem,
* evaluate the methodological quality of a research publication, as well as
* 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:

Blended teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended or required reading:

Lecture slides and specified literature.

Assessment methods and criteria:

Accepted learning diary, active participation

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:

The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

Upon completion of this course, students:

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

Contents:

RESTful Web APIs, Hypermedia and HATEOAS, RESTful Clients

Mode of delivery:

Online learning.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory exercise 15 h, the rest as self-study and group work. Each group implements software and writes a report. Students present their work at least twice in online meetings with the course staff.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming (521141P) or equivalent Python programming skills. Applied computing project I is recommended.

Recommended optional programme components:

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

Recommended or required reading:

Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:

Course will be assessed based on project work assignment (functional working software prototype, content of the report…) and the exercises results. More detailed information on assessment will be provided with the course material.

Grading:

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

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

We will use Moodle to provide links to the working tools and information about distance learning: https://moodle.oulu.fi/course/view.php?id=6032

Course material can be found at Lovelace: https://lovelace.oulu.fi/.

521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op

Voimassaolo: 01.08.2020 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Steven LaValle
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the spring semester, during period III. It is recommended to complete the course at the 4rd spring semester.

Learning outcomes:

Upon completion of the course the students will be able to:

- Deeply understand the fundamentals common to widely used sensing and filtering systems.
- Design new sensors and filters.
- Apply the material to critical problems in robotics, internet of things, and virtual and augmented reality.
- Understand the links between theory and practice in sensing and filtering systems.

Contents:

Defining sensors; physical vs virtual sensors. Chronometers, cameras, infrared, laser, temperature, IMU. Sensor mappings, resolution, noise, calibration. Preimages, sources of uncertainty, comparing sensors, stochastic modeling. Multiple sensor readings and networks of sensors. Triangulation principles. Motion models: Discrete time, continuous time, event-based. Linear, complementary, Kalman, Bayesian, and combinatorial filters. Localization and mapping; global positioning systems; tracking humans.

Mode of delivery:

Online teaching.

Learning activities and teaching methods:

The course will consist of lectures (28h), individual homework assignments (48h), self-study (56h), final exam (3h).

Target group:

M.Sc. students in CSE, EE, and related areas.

Prerequisites and co-requisites:

Matrix Algebra (mandatory BSc 1st year); Differential Equations (mandatory BSc 1st year); Introduction to Computer Systems (mandatory BSc 2nd year); Mathematical Structures for Computer Science (mandatory BSc 2nd year).

Recommended optional programme components:

The course does not require other courses to be completed simultaneously. This course is the first part of a two-part series, in which the second part would finish tracking and cover autonomy. The course fundamentals complement parts of 521287A Introduction to Computer Systems, which provides experimental practice with sensors. The course is related to 521161S Multi-Modal Data Fusion as applied artificial intelligence, but instead has emphasis on geometric concepts and use cases derived from robotics, IoT, and VR/AR. The course has minor overlap with 521124S Sensors and Measuring Techniques, which focuses on experimentation, data collection, and sensor selection.

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (1-5).

Person responsible:

Steven LaValle

Working life cooperation:

The course does not contain working life cooperation.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kortelainen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS cr

Language of instruction:

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

Timing:

Period 4

Learning outcomes:

After completing the course, student
1. knows the special characteristics of neural signals and the typical signal processing methods related to them
2. can solve advanced problems related to the neural signal analysis

Contents:

Introduction to neural signals, artifact removal, anesthesia and natural sleep, topographic analysis and source localization, epilepsy, evoked potentials.

Mode of delivery:

Online teaching / Moodle

Learning activities and teaching methods:

Lectures (8 h) and laboratory work (20 h), written exam.

Target group:

Engineering students, medical and wellness technology students, and other students interested in biomedical engineering. Students of the University of Oulu.

Prerequisites and co-requisites:

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

Recommended optional programme components:

-

Recommended or required reading:

The course is based on selected parts from books "EEG Signal Processing", S. Sanei and J. A. Chambers, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", L. Sörnmo and P. Laguna, and "Neural Engineering", B. He (ed.) as well as lecture slides and task assignment specific material.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kortelainen

Working life cooperation:

-

Other information:

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

521157A: Introduction to Social Network Analysis, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 120 hours of works

Language of instruction:

English

Timing:

Period 4. It is recommended to complete the course at the end of period 4

Learning outcomes:

Upon completing the course, the student is expected to i) understand social aspects of the web; ii) learn to collect, clean and represent social media data; iii) quantify important properties of social media; iv) find and analyze (online) communities; v) understand the diffusion process in social network; vi) familiarize with simple modelling toolkits for social media analysis

Contents:

The course describes basics of social network analysis, allowing the students to understand structure and evolution of the network, while enabling them to use appropriate tools and techniques to draw inferences and discover hidden patterns from the network. The course is designed to accommodate computer science, mathematical and social science student background, which helps in emergence of multi-disciplinary research in the university

Mode of delivery:

Face- to-face teaching and laboratory sessions

Learning activities and teaching methods:

Lectures (24 h), tutorial/laboratory sessions (12h), seminar (6 h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.

Target group:

Students with moderate logical reasoning skills

Prerequisites and co-requisites:

None

Recommended optional programme components:

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

Recommended or required reading:

R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014

Assessment methods and criteria:

One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mourad Oussalah

Working life cooperation:

-

Other information:

We hope to attract students from humanties, economics and political in order to encourage multidisciplinary studies and enforce interesting student projects where each group contains at least one student from computer science and one from another faculty.

521045S: Mobile Computing, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Aku Visuri

Opintokohteen kielet: English

Leikkaavuudet:

521046A	Mobile Computing	5.0 op
521147S	Mobile and Social Computing	5.0 op

Timing:

Person responsible:

Aku Visuri

Other information:

Course is in Moodle
https://moodle.oulu.fi/course/view.php?id=6195
New code and the course is 521046A Mobile Computing.
See course description 521046A Mobile Computing, 5 ECTS cr.

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi, Jaakko Suutala

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course in held in the spring semester, during period III. For bachelor students of Computer Science and Engineering specializing to artificial intelligence, it is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

After completing the course, students

1. know the basic search strategies that can be applied in problem solving and optimization.
2. understand how search-based decisions are made in game-like competitive applications.
3. know the basic principles of probabilistic reasoning in artificial intelligence systems.
4. know how rational decision making under uncertainty can be formulated using utility theory.
5. understand the fundamentals of machine learning and how some of the established methods can be applied to problems in AI.
6. are familiar with advanced AI applications of perception and robotics and how probabilistic inference and machine learning can be used in these settings.

In the course projects, students get some experience in programming and using search methods.

Contents:

intelligent agent types, uninformed search methods, informed (heuristic) search, local search, constraint satisfaction problems, adversarial search, uncertainty handling, probabilistic reasoning, utility, machine learning, decision networks, Markov decision process, reinforcement learning, applications

Mode of delivery:

The tuition is implemented as web-based teaching. Moodle environment is used in the course.
Due to Covid-19 pandemic, teaching in Spring 2021 will be implemented remotely. Course work space can be found from University of Oulu Moodle platform.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211, where details of implementation will be provided. The page will be available from December 21, 2020.
Online lectures will be given with Zoom and link for them will be provided in Moodle.

Learning activities and teaching methods:

Lectures 28 h / Group work (programming projects) 42 h / Self-study 65 h

Target group:

The primary target group is the students of the Computer Science and Engineering specializing in Artificial Intelligence.

Prerequisites and co-requisites:

Completion of the course "521160P Introduction to Artificial Intelligence" (lectured in Finnish) is recommended, but is not a prerequisite. It is also recommended that a student has completed studies related to probability and statistics (e.g. course "031021P Probability and Mathematical Statistics") and Python programming (e.g. course "521141P 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:

The course is based on the book Stuart Russell, Peter Norvig (2010, global edition 2016): Artificial Intelligence: A Modern Approach (3rd Edition), Chapters 1-6, 13-18, 20-21, partly 24-25.
The course utilizes materials of an introductory course on artificial intelligence taught at UC Berkeley (http://ai.berkeley.edu).

Assessment methods and criteria:

The assessment of the course is based on the final exam. Both the final exam and the course projects must be passed. Well-done course projects can increase the grade by one unit.

Grading:

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

Person responsible:

Pekka Sangi, Jaakko Suutala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

Spring, period 4.

Learning outcomes:

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

Contents:

1. Introduction
2. Fundamentals of digital image
3. Intensity transformations and spatial filtering
4. Image processing in frequency domain
5. Restoration
6. Color image processing
7. Wavelets and multi-scale processing
8. Compression
9. Morphological image processing
10. Segmentation

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and homework assignments 30 h. The rest is independent work.

Target group:

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

Prerequisites and co-requisites:

521141P Elementary Programming or equivalent Python programming skills.

Recommended optional programme components:

None.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Third Edition, Prentice-Hall, 2008, Chapters 1-10.
Lecture notes and exercise

Assessment methods and criteria:

The course is completed by passing the exam and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

Other information:

Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=6840

A452300: Advanced Module / Applied Computing, 23 - 28 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional Studies: Applied Computing, Choose f.g. from the following courses total 35 ECTS cr. You can find more studies in the study guide https://weboodi.oulu.fi/oodi/opasopiskopas.jsp

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Christian Wieser

Opintokohteen kielet: English

ECTS Credits:

7

Language of instruction:

Finnish/English, material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.

Mode of delivery:

Face-to-face and independent studies.

Learning activities and teaching methods:

Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.

Target group:

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

Prerequisites and co-requisites:

521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.

Recommended optional programme components:

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

Recommended or required reading:

Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Christian Wieser

Working life cooperation:

-

Other information:

-

811372A: Software Development, Maintenance and Operations, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Mäntylä

Opintokohteen kielet: English

Leikkaavuudet:

ay811372A	Software Development, Maintenance and Operations (OPEN UNI)	5.0 op
815312A	Software Production and Maintenance	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

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

Learning outcomes:

After completing the course, the student will able to:
* explain and utilize theories of software evolution,
* utilize the processes, techniques and tools for software deployment, and operations,
* utilize the processes, techniques and tools for software maintenance, as well as
* utilize the processes, techniques and tools to better understand and maintain large code bases.

Contents:

* Software Maintenance and Evolution
* Software Product Lines
* Software Maintenance and Evolution Models
* DevOps
* Reengineering
* Legacy Systems

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Lectures (Video): 20 h, exercises / assignments 78 h, weekly study 42 h

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and programming.

Recommended or required reading:

Videos, books, exercises

Assessment methods and criteria:

Exercises, assignements

Grading:

Numerical scale 1-5 or fail

Person responsible:

Mika Mäntylä

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning, Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 135 hours of work

Language of instruction:

English

Timing:

Autumn Semester, period 1.

Learning outcomes:

Upon completion of this course, students know and understand the basics and advanced concepts of the following key areas of the course and cybersecurity, know key terminology and can write about the topics clearly and with justifications:

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

Additionally, students that have attained grades 2 or 3 have demonstrated technical capacity to perform practical work relevant to the course key areas. Students that have attained grades 4 or 5 have additionally demonstrated capacity for independent, ambitious work on the key areas working on advanced and challenging security research questions.

Contents:

The course covers the essential aspects of computer security and computer security research in theory and through practical examples.

Mode of delivery:

Contact teaching and independent work

Learning activities and teaching methods:

14 hours of lectures ja 28 hours of laboratory exercises, rest independent work alone or in groups.

Target group:

The course is intended for computer engineering masters students and additionally to any student interested in computer security that has the sufficient technical background to complete the course exercises.

Prerequisites and co-requisites:

As prior knowledge students should have a basic understanding of how computers, operating systems and the Internet work and basic skills in programming. Examples of suitable courses to cover these fundamentals are Operating Systems 521453A, Introduction to Programming 521141P and Computer Engineering 521267A.

Recommended optional programme components:

The course is an independent entity.

Recommended or required reading:

-

Assessment methods and criteria:

Grading of the course is made based on the course practical assignments.

Grading:

Numerical grade 0-5, where 0 stands for a fail.

Person responsible:

Juha Röning, Teemu Tokola

Working life cooperation:

-

Other information:

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

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teemu Leppänen
Opintokohteen kielet: Finnish
Leikkaavuudet:

521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

8 ECTS cr

Language of instruction:

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

Timing:

Autumn, periods 1-2.

Learning outcomes:

Upon completion of the course:
Student understands the basic computer architecture and organization.
Student understands CPU operation and basic datapath operation.
Student knows different 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 is able to implement small assembly language programs.
Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Overview of computer architecture and organization, CPU and datapath, memory hierarchies, data types, interrupts, registers and I/O, basics of the C programming language and basics of assembly language. Embedded systems programming.

Mode of delivery:

Web-based teaching + face-to-face teaching.

Learning activities and teaching methods:

Lectures (32h), course exercises (10-30h), laboratory exercise (3h) and two course projects, one is completed in a group and the other alone.

Target group:

2nd year students of computer science and engineering and 3rd year students of Electronics and Communications 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 and exercise material are available in the course website.
Literature:
Bryant & O'Hallaron, Computer Systems: A Programmer's Perspective, 3rd Edition, Chapters 1-9.
Patterson & Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Chapters 1-2, 4-5.
Patterson & Hennessy, Computer Organization and Design, 5th Edition: The Hardware/Software Interface, 2014.
Bryant & O'Hallaron, Computer Systems: A Programmer's Perspective, 2016.

Assessment methods and criteria:

The assessment criteria is based on the learning outcomes of the course. Students complete the course exercises, participate to the laboratory exercise and complete the course projects. Assessment is based on the exercises and the course projects. More detailed information on assessment is published in the lecture material.

Grading:

Numerical grading scale 1-5, zero stands for fail.

Person responsible:

Teemu Leppänen

Working life cooperation:

Visiting lectures with experts from local industry are possible.

Other information:

The course learning platform is Lovelace (lovelace.oulu.fi).

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Lecturing in Finnish, material available in English

Timing:

Spring, periods 3-4.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Online teaching. Lectures, tutoring and self-study.

Learning activities and teaching methods:

The course is run as a project work in groups of three with progress follow-up reporting meetings. Lectures 10 h, laboratory exercise in period 3-4 120 h.

Target group:

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

Prerequisites and co-requisites:

811122P Introduction to Programming
521412A Digital Techniques I
Also recommended; 521275A Embedded Software Project, 521432A Electronics Design I.

Recommended optional programme components:

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

Recommended or required reading:

-

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Juha Röning

Working life cooperation:

None.

521495S: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2005 - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pietikäinen, Matti

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

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

Timing:

Periods 4-5

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:

25 hours of lectures and a programming exercise (approximately 25 hours) during periods 4-5.
Prerequisites and co-requisites:

Target group:

-

Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

-

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.

Grading:

1-5 / fail.

Person responsible:

Professor Matti Pietikäinen.

Working life cooperation:

-

Other information:

-

811607S: Persuasive Systems Design, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Oinas-Kukkonen, Harri Ilmari

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 1st spring semester of the Master's studies.

Learning outcomes:

After passing the course a student will be able to:
* analyze methods and techniques employed by persuasive systems,
* apply such methods in an ethical manner as design guidelines for developing persuasive ICT solutions, as well as
* apply gamification as persuasive design principles for serious games and other similar solutions.

Contents:

Attitudinal theories from social psychology have been quite extensively applied to the study of user intentions and behaviour. These theories have been developed mostly for predicting user acceptance of information technology rather than for providing systematic analysis and design methods for developing software solutions that aim at attitude or behaviour change. At the same time a growing number of information technology systems and services are being developed for these purposes.
This course will focus on persuasive technology. It will address the process of designing and evaluating persuasive systems, the types of content and software functionality in such systems, the underlying assumptions behind these, methods for analysing the persuasion context, and principles for persuasive system design. The course also looks into the methods and techniques of gamifying persuasive content. The course is primarily geared towards analysis and design tasks using the Persuasive Systems Design model as the main approach. Gamification forms another segment of the course, introducing topics in the role of games and game-like experiences in supporting persuasion.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h, readings before lectures 21h, personal reflective exercises 21h, supervisory meetings 14h, project assignment 48h, other course related activity 10h.

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended optional programme components:

This course offers good groundwork for ICT and Behaviour Change course, but is not compulsory.

Recommended or required reading:

Research articles to be announced more specifcally during the course implementation

Assessment methods and criteria:

Participation in lectures, personal reflection reports, course assignments.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Harri Oinas-Kukkonen

812671S: User Experience (UX) and Usability Evaluation, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Dorina Rajanen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English

Timing:

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

Learning outcomes:

After completing the course, the student will be able to:
* design and follow through a UX/usability evaluation process,

* design test scenarios and tasks,
* select participants,
* plan and follow through the evaluation in laboratory or in the field, as well as
* analyse and report the findings from the evaluations.

Contents:

Basic terms and types of UX and usability testing, usability and UX tests process, usability and UX test tasks and scenarios, test subjects, following through a usability and UX tests, analysing usability and UX test material, reporting the findings from usability and UX tests.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24h, assignment tutoring 13h, assignment 90h, seminar 7h.

Target group:

MSc students

Prerequisites and co-requisites:

The recommended prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Servitisation, Co-Creation and Business Development.

Recommended optional programme components:

Recommended or required reading:

Dumas, J. S. & Redish, J. C. (1993): A Practical Guide to Usability Testing. Ablex Publishing Corporation. Rubin, J. (1994): Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests. Chichester: John Wiley & Sons, Inc.

Assessment methods and criteria:

Assessment of the course is based on the learning outcomes of the course based on the written usability test plan, supervised usability tests, written usability test report and oral seminar presentation

Grading:

Pass or fail

Person responsible:

Mikko Rajanen

Working life cooperation:

Students learn how to collaborate with real customers

Other information:

521275A: Embedded Software Project, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

8

Language of instruction:

Material in English, lectures and guidance of individual groups available in English.

Timing:

Spring, periods 3-4.

Learning outcomes:

1. Can work independently on a non-trivial problem

2. Knows how to write a thesis and has gained lot of experience on refining text

3. Can make a scientific background study on a topic

4. Has increased experience on implementing an embedded software

5. Has improved group work and project skills

Contents:

This course familairizes the student with modern embedded system development with modern methods and tools. Topics: Development tools, practical application program for an embedded system. The students additionally work on the application topic through scientific papers and use their application program to produce a scientific work of their own.

Mode of delivery:

Remote teaching, guidance meetings and independent project work in groups.

Learning activities and teaching methods:

Pair project with monitoring meetings and a compulsory exercise. Lectures 30 h, design exercise in period 3-4 180 h.

Target group:

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

Prerequisites and co-requisites:

521457A Software Engineering, 521286A Computer Systems or 521142A Embedded Systems Programming. In addition, 521453A Operating Systems be beneficial.

Recommended optional programme components:

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

Recommended or required reading:

Course website, hardware data sheets and manuals, scientific publications.

Assessment methods and criteria:

Project report and a demonstrated implementation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Teemu Tokola

Working life cooperation:

The topics of the course are relevant research topics with applications in the industry, and visiting lecturers are occasionally arranged to shed light on how the course topics are applied in the industry.

Other information:

The 521275A course offers the possibility to complete your Bachelor thesis in a structured course environment. The course is suitable also for students who do not use the course for their Bachelor Thesis. Course work space can be found from University of Oulu Moodle platform: https://moodle.oulu.fi/course/view.php?id=5927.

521140S: Computer Graphics, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521493S Computer Graphics 7.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

In English

Timing:

Spring, period 4.

Learning outcomes:

Upon comletion of the course, the student

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clippin
2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling
3. is able to explain the relationship between the 2D and 3D versions of such algorithms
4. possesses the necessary basic skills to use these basic algorithms available in PyOpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (PyOpenGL) for implementation.

Mode of delivery:

Remote teaching

Learning activities and teaching methods:

Lectures 22 h / Programming lessons 12 hours / Self-study and programming assignments 101 h.

Target group:

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

Prerequisites and co-requisites:

Programming skills using Python; basic data structures; simple linear algebra.

Recommended optional programme components:

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

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English)
5) Online PyOpenGL tutorials (e.g. http://pyopengl.sourceforge.net/context/tutorials/index.html)

Assessment methods and criteria:

The assessment of the course is based on the exam (70%) and programming assignments (30%).
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, Tuomas Varanka, Muzammil Behzad.

Working life cooperation:

No

Other information:

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

812651S: ICT and Behaviour Change, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Piiastiina Tikka

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

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

Learning outcomes:

After completing the course, the student will be able to:
* grasp the core theories of behaviour change and how they are/can be applied in goal-oriented behaviour change,
* identify and discuss ethical concerns inherent in behaviour change and persuasive systems, and
* identify and discuss the possible negative effects of ICT use not only as regards persuasive systems, but also with social media and other use.

Contents:

The focus of the course is role of ICT in supporting people with their endeavours to change their habits or lifestyles. The course introduces the main theories and models regarding behaviour change in order to provide students with a solid base for understanding how behaviour change can also work through ICT. The course also introduces some of the more problematic topics in ICT and behaviour, such as the dark side of ICT use and ethics of persuasion.
The course aims at providing existing knowledge and theoretical starting points to the development and use of persuasive systems. With such base, the student will be able to review the field from a broad perspective with the view to applying appropriate theories and approaches when analysing or developing persuasive systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The suggested prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Persuasive Systems Design.

Recommended optional programme components:

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

Recommended or required reading:

Research articles to be announced more specifcally during the course implementation

Assessment methods and criteria:

Course assignment

Grading:

Numerical scale 1-5 or fail

Person responsible:

Piiastiina Tikka

Working life cooperation:

-

521157A: Introduction to Social Network Analysis, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 120 hours of works

Language of instruction:

English

Timing:

Period 4. It is recommended to complete the course at the end of period 4

Learning outcomes:

Upon completing the course, the student is expected to i) understand social aspects of the web; ii) learn to collect, clean and represent social media data; iii) quantify important properties of social media; iv) find and analyze (online) communities; v) understand the diffusion process in social network; vi) familiarize with simple modelling toolkits for social media analysis

Contents:

The course describes basics of social network analysis, allowing the students to understand structure and evolution of the network, while enabling them to use appropriate tools and techniques to draw inferences and discover hidden patterns from the network. The course is designed to accommodate computer science, mathematical and social science student background, which helps in emergence of multi-disciplinary research in the university

Mode of delivery:

Face- to-face teaching and laboratory sessions

Learning activities and teaching methods:

Lectures (24 h), tutorial/laboratory sessions (12h), seminar (6 h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.

Target group:

Students with moderate logical reasoning skills

Prerequisites and co-requisites:

None

Recommended optional programme components:

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

Recommended or required reading:

R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014

Assessment methods and criteria:

One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mourad Oussalah

Working life cooperation:

-

Other information:

We hope to attract students from humanties, economics and political in order to encourage multidisciplinary studies and enforce interesting student projects where each group contains at least one student from computer science and one from another faculty.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

ECTS Credits:

8 ECTS credits / 213 hours of work

Language of instruction:

English.

Timing:

Autum and spring, periods 1-4.

Learning outcomes:

Upon completing the course, the student is able to:
1. conduct independent research as a responsible member of a research group;
2. conduct a literature survey;
3. apply theoretical knowledge in solving a practical problem;
4. design, implement and evaluate a prototype;
5. collect and analyze research data;
6. report research results in form of a scientific publication and an oral presentation.

Contents:

The student conducts independently a small-scale research work under the supervision of a senior researcher. Topics for research works can be requested from research group leaders and senior researchers.

Mode of delivery:

Self-study, meetings with the supervisor of the work.

Learning activities and teaching methods:

Independent project work 213 h.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Literature is selected for each research work separately.

Assessment methods and criteria:

Assessment is based on the scientific publication and the oral presentation reporting the research 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:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

521152S: Applied Computing Project II, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

ECTS Credits:

10 ECTS cr

Language of instruction:

English.

Timing:

Autumn and Spring, periods 1-4.

Learning outcomes:

1. has advanced understanding on how to collaboratively design a medium-scale software project,

2. has advanced understanding on how to implement and evaluate a medium-scale software project,

3. is able to extensively document a medium-scale software project,

4. has advanced skills in presenting and pitching a project work, i.e. give a good, concise presentation of the work,

Contents:

Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.

Mode of delivery:

3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives).

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

While no specific courses are not required, programming and design skills are desired.

Recommended optional programme components:

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

Recommended or required reading:

For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www.hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Timo Ojala

Working life cooperation:

No

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

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English.

Timing:

Summer semester (June).

Learning outcomes:

Summer school comprises of multiple parallel workshops that each have specific learning outcomes.

Contents:

Each workshop has specific contents.

Mode of delivery:

Face-to-face teaching in workshops.

Learning activities and teaching methods:

Lectures, a project completed as group work, self-study.

Target group:

MSc. and doctoral students.

Prerequisites and co-requisites:

Each workshop may have specific prerequisites.

Recommended optional programme components:

None.

Recommended or required reading:

Each workshop has a specific required reading package.

Assessment methods and criteria:

Final exam (50%), project (50%).

Grading:

The summer school uses a numerical grading scale 1-5.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

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

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5-8

Language of instruction:

English

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:

Professor of CSE

Working life cooperation:

-

Other information:

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

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Netta Iivari
Opintokohteen kielet: English
Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will able to:
* explain the general principles of scientific research and the practices of scientific methodology,
* generate research problems in information processing sciences,
* identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem,
* evaluate the methodological quality of a research publication, as well as
* 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:

Blended teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended or required reading:

Lecture slides and specified literature.

Assessment methods and criteria:

Accepted learning diary, active participation

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

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

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Dorina Rajanen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 1st spring semester of the Master's studies.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 20 h, assignments 107 h, seminars 6 h.

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended optional programme components:

Recommended or required reading:

Selected scientific articles.

Assessment methods and criteria:

Assignments

Grading:

Numerical scale 1-5 or fail

Person responsible:

Mikko Rajanen

A452298: Advanced Module / Computer Engineering, Software, 48 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies, 20 ECTS cr

521348S: Statistical Signal Processing 1, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes, Janne Lehtomäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521484A	Statistical Signal Processing	5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st semester of the master studies.

Learning outcomes:

Upon completion the student

1. knows the key tools of linear algebra and quadratic optimization and can apply them in solving signal processing problems.
2. understands how to handle complex valued random variables and processes.
3. understands the key concepts in estimation theory such as the classical and Bayesian philosophies.
4. masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators.

5. can derive an estimator for a given criterion and basic data models.
6. can use the methodology of estimation theory to analyze the performance of estimators and compare to performance benchmarks such as the Cramer-Rao lower bound.
7. understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), the Neyman-Pearson and Bayesian detectors.

Contents:

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

Mode of delivery:

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

Learning activities and teaching methods:

Face-to-face-teaching (lectures and exercises) 50h, Matlab simulation exercises in groups 30 h, independent work & passed assignment 50 h.

Target group:

Electrical, communications and computer science and engineering students.

Prerequisites and co-requisites:

The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal Analysis, 031021P Probability and Mathematical Statistics, 031078P Matrix Algebra, 521330A. The recommended prerequisite is the completion of Telecommunication Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Parts from books:
1. Steven M Kay, "Fundamentals of statistical signal processing: estimation theory."vol 1 Prentice Hall 1993.
2. Steven M. Kay, "Fundamentals of statistical signal processing: Detection theory, vol. 2." Prentice Hall 1999.
3. Peter Selinger, “Matrix Theory and Linear Algebra”, Creative Commons.
4. Paolo Prandoni & Martin Vetterli, Martin, “Signal Processing for Communications”, CRC Press 2008.
5. Other literature, lecture notes and material.

Assessment methods and criteria:

Completing the simulation project tasks, and a mid-term exam during the course. The mid-term exams can be retaken by a final exam later. In the final grade of the course, the weight for the examination is 0.7 and that of project report 0.3.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero (0) stands for a fail.

Person responsible:

Janne Lehtomäki and Markku Juntti

Working life cooperation:

No

Other information:

Lecture materials etc. can be found on Moodle https://moodle.oulu.fi/course/view.php?id=4203.

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ylianttila

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. Students understand how the modern communications networks have evolved and how the architecture has changed through the recent paradigm shift towards software-centric communications.
2. Students are able to describe the basic system architecture elements of mobile networks, and understands the significance of emerging technologies such as Network Function Virtualization (NFV), Software Defined Networking (SDN), and core network functionalities such as Evolved Packet Core (EPC).
3. Students can describe the main principles of mobility management, network management and orchestration, and network security, and can apply and solve related engineering problems.
4. Students know the basic properties of routing algorithms, and can use graph theory to solve network routing problems.
5. Students are able to simulate different types of networks in simulation environments and solve basic network programming problems. Upon completing the required coursework, students understand the basic functionalities in TCP/IP protocol stack.

Contents:

Communications architecture in mobile, wireless local area and personal area networks. Introduction to cloud and edge computing, network function virtualization and software defined networking. Basic principles of mobility management, network security, network management and orchestration. The goal is to present the basics of the modern communications architectures, and their technical implementation.

Mode of delivery:

Due to Covid-19 pandemic, teaching in Autumn 2020 will be implemented remotely. Details of arrangement can be found from the course web page, which will be available in Moodle.
https://moodle.oulu.fi/course/view.php?id=1454

Learning activities and teaching methods:

Lectures 30 h and the compulsory design work (15 h). Design work can be done alternatively either as NS-2 simulation or TCP/IP programming exercise. Design work instructions are provided in digital learning environment (Moodle).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture, M Liyanage, A Gurtov, M Ylianttila – 2015; A comprehensive Guide to 5G Security, M Liyanage, I Ahmad, A Abro, A Gurtov, M Ylianttila – 2018; In addition, selected supportive online reading materials from recent standards and publications are provided in digital learning environment (Optima / Moodle).

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Mika Ylianttila

Working life cooperation:

No

Other information:

-

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01 Distributed Systems, Exam 0.0 op

521266S-02 Distributed Systems, Exercise Work 0.0 op

521266S Distributed Systems 6.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, period 3.

Learning outcomes:

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

Contents:

Introduction, architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, case studies.

Mode of delivery:

Online teaching

Learning activities and teaching methods:

Lectures 22 h, exercises 16 h, project work 50 h, self-study 47 h.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

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

Recommended or required reading:

Required literature: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems – Principles and Paradigms, Third Edition, 2017.

Assessment methods and criteria:

The course uses continuous assessment so that there are 2 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

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

Grading:

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

Person responsible:

Teemu Leppänen

Working life cooperation:

None.

Other information:

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

521395S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Kokkonen, Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 1

Learning outcomes:

Student
1. can analyze the performance of multilevel digital modulation methods in AWGN channel
2. can explain the effect of fading channel on the performance of the modulation method and can analyze the performance
3. recognizes and understand suitable diversity methods for fading channel and related combining methods
4. can understand and explain coding methods for wireless channels
5. recognizes different wideband systems
6. understands the cellular system principle

Contents:

Radio channel models, digital modulation and detection methods, carrier and symbol synchronization, performance of digital modulation in AWGN and fading channel, diversity techniques, coding for wireless channel, multicarrier modulation, spread spectrum, cellular systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and exercise (total 40 hours) and the compulsory design work with a simulation program.

Target group:

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

Prerequisites and co-requisites:

521330A Telecommunication Engineering

Recommended optional programme components:

-

Recommended or required reading:

Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005.

Assessment methods and criteria:

The course is passed with minor exams (only during lecture period) or with final exam; and the accepted design work report. In the final grade of the course, the weight for the examination(s) is 0.6 and that for the design work report 0.4.

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

Grading:

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

Person responsible:

Jari Iinatti / Timo Kokkonen

Working life cooperation:

Visiting lecturers from industry.

Other information:

-

Optional Courses, Choose f.g. from the following courses total 28 ECTS cr

521156S: Towards Data Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Tamminen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Autumn, period I.

Learning outcomes:

After completing this course, student can recognize data types and perform required pre-processing steps before further analysis:

1. Student can design and implement a data collection process
2. Student can combine data from different sources
3. Student can normalize and transform data, and handle missing or incorrect values
4. Student can ensure generalizability of the results

Contents:

Course provides good ability to start Master's Thesis or graduate studies. Topics at the course include data mining process in general level, data gathering and different data types, quality and reliability of the data, data preparation including the processing of missing values, outliers, and privacy issues, combination of signals from several sources, utilization of data bases in data mining process, and normalization and transformation of data and interdependence of the observations and their distributions. Additionally, topics concerning the generality of the results are covered, as well as, the principles of data division, for example, train-test-validate, cross-validation and leave-one-out methods.

Mode of delivery:

Lectures, independent work, group work

Learning activities and teaching methods:

16 h lectures, 16 h exercises, independent studying.

Target group:

The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.

Prerequisites and co-requisites:

031021P Probability and Mathematical Statistics or similar

Recommended optional programme components:

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

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. The material is mostly in English.

Assessment methods and criteria:

Weekly pre-lecture assignment + exercise submissions, and final exam. Half of the grade will be based on the submissions and half on the final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Tamminen Satu

Working life cooperation:

-

Other information:

Moodle: https://moodle.oulu.fi/course/view.php?id=1679
Towards Data Mining 521156S:3

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A	Introduction to Broadband Transmission Techniques	4.0 op
521433A	Laboratory Exercises on Analogue Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, periods 1-2

Learning outcomes:

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

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

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

Contents:

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

Mode of delivery:

Face-to-face teaching, partially independent work

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

No

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

The course unit utilizes verbal grading scale pass or fail

Person responsible:

Kari Määttä

Working life cooperation:

No

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

ECTS Credits:

8 ECTS credits / 213 hours of work

Language of instruction:

English.

Timing:

Autum and spring, periods 1-4.

Learning outcomes:

Upon completing the course, the student is able to:
1. conduct independent research as a responsible member of a research group;
2. conduct a literature survey;
3. apply theoretical knowledge in solving a practical problem;
4. design, implement and evaluate a prototype;
5. collect and analyze research data;
6. report research results in form of a scientific publication and an oral presentation.

Contents:

The student conducts independently a small-scale research work under the supervision of a senior researcher. Topics for research works can be requested from research group leaders and senior researchers.

Mode of delivery:

Self-study, meetings with the supervisor of the work.

Learning activities and teaching methods:

Independent project work 213 h.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Literature is selected for each research work separately.

Assessment methods and criteria:

Assessment is based on the scientific publication and the oral presentation reporting the research 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:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

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

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

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

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail
Opettajat: Simo Hosio
Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish/English

Timing:

Autumn semester, Period II

Learning outcomes:

Upon completing this course, students will possess:
1. Knowledge of Human Computer Interaction (HCI) fundamentals
2. Knowledge and practical experience of user-centric computer interface and usability evaluation techniques, such as questionnaires and interviewing
3. Knowledge and experience of prototyping techniques (both paper-based as well as digital)
4. Knowledge of how HCI can be incorporated in the software development process

Contents:

Fundamental knowledge of humans, and how that relates to computer systems and interfaces. Learning design in 2-3 different ways, and conducting evaluations of the designs. Evaluation constitutes data collection and analysis, including qualitative and quantitative data.

Mode of delivery:

Online teaching (lectures), group work (labs).

Learning activities and teaching methods:

Lectures (12 h), exercises (16 h), and practical work (105 h). The course is passed with approved classroom/reading package reflections, and an approved group-based practical work (several assignments). The implementation is doable fully in English.

Target group:

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

Prerequisites and co-requisites:

While no specific courses are not required, elementary teamwork skills are required and the capability to provide documentation.

Recommended optional programme components:

All necessary material will be provided by the instructor.

Recommended or required reading:

No required reading.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Associate Professor Simo Hosio

Working life cooperation:

If relevant, guest lectures may be organized (optional).

Other information:

Using Moodle as the teaching platform: https://moodle.oulu.fi/course/view.php?id=5409

521273S: Biosignal Processing I, 5 op

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

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the master's degree level.

Learning outcomes:

After completing the course, student:

1. knows about special characteristics of the biosignals and typical signal processing methods
2. can solve small-scale problems related to biosignal analysis
3. implement small-scale MATLAB software for signal processing algorithms.

Contents:

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

Mode of delivery:

Face-to-face teaching and guided laboratory work. The laboratory work can alternatively be performed on an online system (MathWorks Grader). Student can do the lab works remotely or in the lab using the same online system.

Learning activities and teaching methods:

Lectures 12h, Laboratory work 24h, Self-study for laboratory working and examination 99 h.

Target group:

Students interested in digital signal processing applications in biomedical engineering, at their master's level studies.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Face-to-face lectures. Students solve the programming problems in the laboratory work independently, supervised by assistants. The MathWorks Grader online system is used for programming tasks and it also verifies the completed tasks. Written examination.
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.

521070A: Introduction to Microfabrication Techniques, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Niina Halonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521218A	Introduction to Microelectronics and Micromechanics	4.0 op
521218A-02	Introduction to Microelectronics and Micromechanics, demonstration	0.0 op
521218A-03	Introduction to Microelectronics and Micromechanics, exercise	0.0 op
521218A-01	Introduction to microelectronics and micromechanics, exam	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

2nd period

Learning outcomes:

1. Can present the process of source materials used to manufacture micro- and nanoelectronics /mechanics and analyse the required material properties depending of the application

2. Can explain the fabrication methods and discuss the characteristic features of each fabrication method, inculding their utilisation and restrictions.

3. Is capable of designing a fabrication process for a simple microelectronics application and is able to indetify the process steps also in complex application.

Contents:

The content of the course covers fabrication methods of micro-, nano- and optoelectronics as well as MEMS systems. 1. Fabrication methods for silicon based electronics and MEMS systems 2. Additive manufacturing methods 3. Nanomaterials and fabrication.

Mode of delivery:

Face-to face teaching

Learning activities and teaching methods:

Lectures (20 hours) and exercises (10 +10).

Target group:

Electrical engineering bachelor degree students.

Prerequisites and co-requisites:

Course content of 521104P Introduction to Materials Physics and 521071A Principles of Semiconductor Devices.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, Franssila Sami: Introduction to Microfabrication

Assessment methods and criteria:

Final written exam and passes laboratory exercises.

Grading:

Numerical grading 1-5.

Person responsible:

Merja Teirikangas

Working life cooperation:

No

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Olli Silven

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Online teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Online lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silven

Working life cooperation:

None.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Open University students enroll for studies through an open website.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will able to:
* explain the general principles of scientific research and the practices of scientific methodology,
* generate research problems in information processing sciences,
* identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem,
* evaluate the methodological quality of a research publication, as well as
* 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:

Blended teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended or required reading:

Lecture slides and specified literature.

Assessment methods and criteria:

Accepted learning diary, active participation

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:

The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

Upon completion of this course, students:

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

Contents:

RESTful Web APIs, Hypermedia and HATEOAS, RESTful Clients

Mode of delivery:

Online learning.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory exercise 15 h, the rest as self-study and group work. Each group implements software and writes a report. Students present their work at least twice in online meetings with the course staff.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming (521141P) or equivalent Python programming skills. Applied computing project I is recommended.

Recommended optional programme components:

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

Recommended or required reading:

Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:

Course will be assessed based on project work assignment (functional working software prototype, content of the report…) and the exercises results. More detailed information on assessment will be provided with the course material.

Grading:

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

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

We will use Moodle to provide links to the working tools and information about distance learning: https://moodle.oulu.fi/course/view.php?id=6032

Course material can be found at Lovelace: https://lovelace.oulu.fi/.

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Spring, period 3.

Learning outcomes:

Upon completion of the course the student
1. understands the fundamentals of image acquisition, representation and modeling

2. can utilize elementary methods of machine vision for image recognition problems
3. can use 2D transformations in model fitting and image registration
4. can explain the basics of 3D imaging and reconstruction

Contents:

1. Introduction, 2. Imaging and image representations, 3. Light and color, 4. Binary image analysis, 5. Texture, 6. Local features, 7. Recognition, 8. Motion, 9. 2D models and transformations, 10. Perceiving 3D from 2D images, 11. 3D transformations and reconstruction.

Mode of delivery:

Online lectures and exercises, homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (16 h) and programming assignments (32 h), self-studying (61 h)

Target group:

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

Prerequisites and co-requisites:

521467A Digital Image Processing or an equivalent course, basic Python programming skills.

Recommended optional programme components:

521289S Machine Learning. This course provides complementary knowledge on machine learning methods needed in machine vision.

Recommended or required reading:

Lecture slides and exercise material. The following books are recommended for further information: 1) Shapiro, L.G. & Stockman, G.C.: Computer Vision, Prentice Hall, 2001. 2) Szeliski, R.: Computer Vision: Algorithms and Applications, Springer, 2011. 3) Forsyth, D.A. & Ponce, J.: Computer Vision: A Modern Approach, Prentice Hall, 2002.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 1-5. Zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

Other information:

Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=4317

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

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

Learning outcomes:

After completing the course, student

1. can design simple optimal classifiers from the basic theory and assess their performance.
2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.
3. can apply regression techniques to practical machine learning problems.

Contents:

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

Mode of delivery:

Online teaching, guided laboratory work and independent assignment. The laboratory works are done on an online system (Mathworks Grader). Student can do the lab works remotely or in the lab using the same online system.
The course is implemented as remote education via the Moodle work space https://moodle.oulu.fi/course/view.php?id=5729
This work space opens to students before the course begins. The student must register to the course in WebOodi in order to participate the course.

Learning activities and teaching methods:

Lectures 16 h, Laboratory work 16 h, and Self-study the rest (Independent task assignment).

Target group:

Students who are interested in machine learning and pattern recognition theory and methods.

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:

Will be informed when the course starts.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also verify that the task assignments are completed properly. The Matworks Grader online system also verifies the completed tasks. The independent task assignment is graded which establishes the grade for the course.
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 the independent task assignment.

Person responsible:

Tapio Seppänen

Working life cooperation:

No

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

Spring, period 4.

Learning outcomes:

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

Contents:

1. Introduction
2. Fundamentals of digital image
3. Intensity transformations and spatial filtering
4. Image processing in frequency domain
5. Restoration
6. Color image processing
7. Wavelets and multi-scale processing
8. Compression
9. Morphological image processing
10. Segmentation

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and homework assignments 30 h. The rest is independent work.

Target group:

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

Prerequisites and co-requisites:

521141P Elementary Programming or equivalent Python programming skills.

Recommended optional programme components:

None.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Third Edition, Prentice-Hall, 2008, Chapters 1-10.
Lecture notes and exercise

Assessment methods and criteria:

The course is completed by passing the exam and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

Other information:

Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=6840

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Lauri Lovén
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

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

Learning outcomes:

Upon completion of the course, the student :

1. is able to explain the big data phenomenon, its challenges and opportunities.
2. is able to explain the requirements and common principles for data intensive systems design and implementation, and evaluate the benefits, risks and restrictions of available solutions.
3. can explain the principles of big data management and processing technologies and utilize them on a basic level.

Contents:

General introduction into big data, namely: big data fundatmenals, data storage, batch and stream data processing, data analysis, privacy and security, big data use cases.

Mode of delivery:

Online teaching, exercises and seminars. Independent and group work.

Learning activities and teaching methods:

Lectures, exercises, seminars, independent and group work

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge.

Recommended optional programme components:

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

Recommended or required reading:

Lecture slides and exercise material will be provided. Each lecture will include the refernce list for recommended reading. Instructions to necessary installations will be given.

Assessment methods and criteria:

This course assesses students continuously by the completion of small project work, seminar presentations and short reports on a selected topic (group work). Answering two quizzes during the course is optional and provides additional points for final grade. To pass the course, it is enough to get 50 % of available points. No exam.

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

Grading:

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

Person responsible:

Lauri Lovén

Working life cooperation:

The course includes also invited lectures from industry.

Other information:

Course is in Moodle.

521140S: Computer Graphics, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521493S	Computer Graphics	7.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

In English

Timing:

Spring, period 4.

Learning outcomes:

Upon comletion of the course, the student

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clippin
2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling
3. is able to explain the relationship between the 2D and 3D versions of such algorithms
4. possesses the necessary basic skills to use these basic algorithms available in PyOpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (PyOpenGL) for implementation.

Mode of delivery:

Remote teaching

Learning activities and teaching methods:

Lectures 22 h / Programming lessons 12 hours / Self-study and programming assignments 101 h.

Target group:

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

Prerequisites and co-requisites:

Programming skills using Python; basic data structures; simple linear algebra.

Recommended optional programme components:

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

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer

Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English)
5) Online PyOpenGL tutorials (e.g. http://pyopengl.sourceforge.net/context/tutorials/index.html)

Assessment methods and criteria:

The assessment of the course is based on the exam (70%) and programming assignments (30%).
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, Tuomas Varanka, Muzammil Behzad.

Working life cooperation:

No

Other information:

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

900013Y: Beginners' Finnish Course 1, 3 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

Proficiency level:
A1 (target 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; food, drink and transactions in the grocery; accommodation and describing it; colours and adjectives.

The structures studied are: verb types, basics of the change of the consonants k, p and t in verbs and nouns, basics of the partitive and genitive 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, including the final exam) and guided self study (55 h)
Target group:
International degree and post-graduate degree students, exchange students and the staff members of the University.
Prerequisites and co-requisites:
Completion of the Survival Finnish Course
Recommended optional programme components:
-
Recommended or required reading:
Kuparinen, K. & Tapaninen, T. Oma suomi 1 (chapter 2 - 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 or Tuudo. The course will start right after the Survival Finnish course.

900017Y: Survival Finnish, 2 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900017Y	Survival Finnish Course (OPEN UNI)	2.0 op

Proficiency level:
A1.1
Status:
The course is intended for the international students in every faculty at the University of Oulu.
Required proficiency level:
No previous Finnish studies.
ECTS Credits:
2 ECTS cr
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:

Contact teaching, on-line learning and independent work. There will be organized also one on-line group in each semester.

Learning activities and teaching methods:

Lessons 2 times a week (26 h, including the final exam) and guided self study (24 h).

Target group:

International degree and post-graduate degree students, exchange students and the staff members 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 on a pass/fail basis.

Person responsible:

Arja Haapakoski

Working life cooperation:

-

Other information:

Sign-up in WebOodi or in Tuudo.

521027S: Advanced practical training, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish or English

Timing:

This course can be taken in periods I-IV. The recommended time to take this course is during summer of the fourth year.

Learning outcomes:

Student can apply knowledge and skills learned during university studies to complete work assignments in his/her own field.

Student can evaluate and develop himself/herself as a learner and worker.

Student can plan and evaluate his/her time management and working methods.

Student is capable of working in systematic and goal-oriented manner in group as well as independently.

Student can name important factors that direct the actions of work community and the employer.

Student can name duties where he/she can work after graduating from university.

Contents:

Planning and preparation, carrying out work assignments in the students field of studies, documentation of own accomplishments, writing report and reflection.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Student independently finds a place to work to complete the course. To pass the course minimum of two months of full time work is required. Work can also be carried out in multiple periods. The course works includes a) Making a practice plan for the working period 4 h, b) Documentation of progress during working 20 h, c) Learning while working 108 h, d) Final raport and reflection 8 h.
Target group:
Master level students.
Prerequisites and co-requisites:
-
Recommended optional programme components:
The course does not require additional studies carried out at the same time. While carrying out the course working assigments are compared to already completed studies.
Recommended or required reading:
No required material
Assessment methods and criteria:
Course is carried out by working minimum of two months in a work accepted by study program responsible person. Before starting the actual work the student needs to make a plan for the working period and return it to the responsible person. A weekly report is required from every working week. These reports have to turned in before the working period ends. After the working period is over the student writes a final report and returns it to the responsible person. Signed testimonial from the employer is also required with the final report.
Grading:
The course is graded as ”pass/fail”
Person responsible:
Riku Hietaniemi
Working life cooperation:
The course is carried out as practical training.
Other information:
This course is alternative to 521013A Advanced Practical Training, 3 ECTS.
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521009S: Computer Science and Engineering, The Maturity Test for Master`s Degree, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0; The maturity test is integrated in the MSc Thesis credits (30 ECTS).
Language of instruction:
Finnish/Swedish/other
Timing:
Periods 1-4
Learning outcomes:
After the maturity test, the student has demonstrated that his/her language skills meet the requirements of the work life.
Contents:
The aim of the maturity test is to confirm the student's familiarity of the thesis area as well as his/her command of the domestic language of his/her school education.
Mode of delivery:
The maturity test is written in a controlled event, on a topic provided by the thesis supervisor.
Learning activities and teaching methods:
Written essay, approximately 3 pages hand written text or 380 words / 3040 characters.
Target group:
-

Prerequisites and co-requisites:
The maturity test can be written when the thesis is complete or being finished.
Recommended optional programme components:
-
Recommended or required reading:
MSc Thesis.
Assessment methods and criteria:
The maturity test is evaluated and approved by the thesis supervisor.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Thesis supervisor.
Working life cooperation:
-

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

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Computer Science and Engineering DP

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.

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:
https://www.oulu.fi/en/students/thesis-and-graduation/graduation-masters-degree/masters-thesis#177

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

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Basic and Intermediate Studies

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

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: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

901060Y	Second Official Language (Swedish), Written Skills	1.0 op
ay901048Y	Second Official Language (Swedish), Written Skills (OPEN UNI)	1.0 op

Proficiency level:

This course is only for Finnish speaking students with CEFR-level A2 in Swedish language. University of Oulu, Languages and Communication unit don’t offer Beginners courses in Swedish.

901049Y: Second Official Language (Swedish), Oral Skills, 1 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Opintokohteen kielet: Swedish

Leikkaavuudet:

901061Y	Second Official Language (Swedish), Oral Skills	1.0 op
ay901049Y	Second Official Language (Swedish), Oral Skills (OPEN UNI)	1.0 op

Proficiency level:

Please look course description from this course: 901048Y.

900081Y: Second Official Language (Finnish), Written Skills, 1 - 2 op

Voimassaolo: 01.01.2015 -

Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Finnish

900082Y: Second Official Language (Finnish), Oral Skills, 1 - 3 op

Voimassaolo: 01.01.2015 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Opintokohteen kielet: Finnish

Proficiency level:

The course is intended for the students who´s schooling language is Swedish. See 900081Y Second Official Language (Finnish), Written Skills.

English 6 ECTS cr

902150Y: Professional English for Technology, 2 op

Voimassaolo: 01.08.2014 -
Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Leikkaavuudet:

902011P-05	TE3/ Professional English for Technology	2.0 op

Proficiency level:

CEFR B2 - C1

Status:

This course is the first English course for students in the engineering programmes in the Faculty of Technology (TTK) and Faculty of Information Technology and Electrical Engineering (TST).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 credits. The workload is 53 hours.

Language of instruction:

English

Timing:

The course takes place in the autumn semester (periods 1 and 2).

Learning outcomes:

By the end of the course, you can
- create and deliver effective presentations of a product, a company and company processes,
- apply appropriate cultural, linguistic and technical knowledge when presenting a product or company,
- evaluate your own strengths and weaknesses in English-language communication, with a view to developing appropriate skills in future.

Contents:

Scheduled as the first course of your English studies, Professional English for Technology (PET) has a strong focus on developing speaking skills necessary for working life. During PET, you will explore a product or service from your own field, and give a variety of short presentations in connection with your product or service. In addition, PET helps you to develop an awareness of your own language skills, encouraging you to develop strategies and techniques for effective learning.

Mode of delivery:

Contact teaching and independent study

Learning activities and teaching methods:

Lessons 24 hours / independent work 29 hours. Lessons include regular pair and group work in class. Independent homework activities include team work for the preparation of four short presentations, vocabulary study and other small assignments. Active participation is essential.

Target group:

Students in the engineering programmes: TTK (PO1, YMP1, KO1, TuTa1, RaKy), TST (ST2, CSE2).

Prerequisites and co-requisites:

-

Recommended optional programme components:

This course is offered as the first course of your English studies.

Recommended or required reading:

Course materials will be provided by the teacher in electronic form.

Assessment methods and criteria:

The course utilises continuous assessment that is based on the learning outcomes of the course, including full and active participation in class, and the successful completion of module assignments and class presentations.
Lue lisää opintosuoritusten arvostelusta yliopiston verkkosivulta.

Grading:

pass / fail

Person responsible:

Each engineering programme has its own Languages and Communication contact teacher for questions about English studies.

Working life cooperation:

-

Other information:

-

902145Y: Working Life Skills, 2 op

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

CEFR B2 - C1
(Alla levels)

Status:

This course can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK) and Faculty of Information Technology and Electrical Engineering (TST).

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 teachers for your department to discuss individual solutions.

ECTS Credits:

2 ECTS credits. The workload is 53 hours.

Language of instruction:

English

Timing:

The course takes place in both autumn (periods 1 and 2) and spring (periods 3 and 4) semesters. Check the study guide for availability in your department.

Learning outcomes:

By the end of the course, you are expected to

1. have demonstrated a good basic vocabulary related to job applications, meetings and negotiations,
2. have demonstrated an ability to create an effective CV and cover letter for a job application,
3. be able to communicate effectively and with a reasonable degree of fluency at job interviews and in meeting and negotiation contexts.

Contents:

The aim of this course is to help you to develop the English language skills needed to deal with situations related to everyday working life. The course focuses on four basic areas:
i) business communication
ii) social and cultural aspects of English in working life situations,
iii) applying for a job,
iv) a general introduction to the language of meetings and negotiations.

Mode of delivery:

Contact teaching and independent study

Learning activities and teaching methods:

Lessons 26 hours / independent work 27 hours. Active participation is essential. The course includes regular pair and group work in class and independent homework activities.

Target group:

Students in the engineering programmes (TTK and TST).

Prerequisites and co-requisites:

-

Recommended optional programme components:

This is an elective course which can be taken after 902150Y PET by students in the engineering programmes (TTK and TST).

Recommended or required reading:

Course materials will be provided by the teacher in electronic form.

Assessment methods and criteria:

The course utilises continuous assessment that is based on the learning outcomes of the course. In addition, full and active participation is required, course assignments must be completed, and students must achieve a grade of 70% in two tests during the course. Students will be asked to take an end-of course exam if they have not otherwise demonstrated that they have achieved the learning outcomes by the end of the course.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass/fail

Person responsible:

Susan McAnsh

Working life cooperation:

-

Other information:

See contact teachers, https://www.oulu.fi/kielikoulutus/node/56574.)

902147Y: Academic Vocabulary for Science and Technology, 2 op

Opiskelumuoto: Language and Communication Studies
Laji: Course
Vastuuyksikkö: Languages and Communication
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:

CEFR Level: B2-C1 (All levels)

Status:

This course can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK) and Faculty of Information Technology and Electrical Engineering (TST).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 ECTS credits. The workload is 53 hours.

Language of instruction:

English

Timing:

The course takes place in both autumn (periods 1 and 2) and spring (periods 3 and 4) semesters. Check the study guide for availability in your department.

Learning outcomes:

By the end of the course, you are expected to
1) explain and apply general academic / scientific vocabulary from Coxhead's Academic Word List (AWL)
2) differentiate between informal (non-academic) and formal / academic language,
3) demonstrate use of academic vocabulary in a variety of writing and communication contexts.

Contents:

The general aim of this course is to activate and broaden your basic scientific vocabulary, i.e. the core vocabulary of scientific texts, which is principally the same regardless of the field (AWL). During this process, you will become aware of the strategies which best promote your skills to learn and memorise vocabulary. The ultimate aim is to help you gain the skills to read and write academic / scientific text and to discuss related topics. To help you achieve the learning outcomes, you will work on various written and oral activities which focus primarily on practicing vocabulary learning strategies, word formation, and the use of the most frequent academic vocabulary (AWL sublists).

Mode of delivery:

Contact teaching and independent study

Learning activities and teaching methods:

Lessons 26 hours / independent work 27 hours. The independent work includes a written academic essay or report; vocabulary tests; presentations, which will be given in class to small groups of students; and other homework assignments. Active participation is essential.

Target group:

Students in the engineering programmes (TTK and TST)

Prerequisites and co-requisites:

-

Recommended optional programme components:

This is an elective course which can be taken after 902150Y PET by students in the engineering programmes (TTK and TST).

Recommended or required reading:

Course materials will be provided by the teacher in electronic form.

Assessment methods and criteria:

Regular and active participation in the weekly sessions will be observed in continuous assessment that is based on the learning outcomes of the course. Satisfactory completion of the in-class/ homework assignments and the vocabulary tests is required.
See more about assessment criteria, https://www.oulu.fi/forstudents/assesment-criteria.

Grading:

Pass/Fail

Person responsible:

Susan McAnsh. See contact teachers, https://www.oulu.fi/kielikoulutus/node/56574.

Working life cooperation:

-

Other information:

-

902142Y: Business Correspondence, 2 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Language and Communication Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

CEFR B2 - C1 (All Levels)

Status:

This course can be chosen in partial completion of the English language requirement for students in the engineering programmes in the Faculty of Technology (TTK) and Faculty of Information Technology and Electrical Engineering (TST).

Required proficiency level:

English must have been the A1 or A2 language at school or equivalent English skills acquired otherwise. If you need to take English, but lack this background, please get in touch with the Languages and Communication contact teacher for your department to discuss individual solutions.

ECTS Credits:

2 credits. The workload is 53 hours

Language of instruction:

English

Timing:

The course takes place in both autumn (periods 1 and 2) and spring (periods 3 and 4) semesters. Check the study guide for availability in your department.

Learning outcomes:

By the end of the course, you are expected to have demonstrated:

- the ability to write clear and effective business letters conveying information and details accurately,
- the ability to use an appropriate level of formality and style for business communications,
- mastery of the conventional formats and layouts of different types of business letters.

Contents:

The aim of this course is to introduce different types of business correspondence and the format used when communicating in writing. Types of correspondence include communication in business-to-business scenarios and between a business and the public.

Mode of delivery:

Self-access: the course operates within an online workspace, with online support from the teacher.

Learning activities and teaching methods:

Introductory session 2 hours / independent learning 51 hrs / optional text clinics. Assignments, instructions and course resources are available in the online course workspace. Completed assignments are submitted electronically to the teacher. The teacher provides feedback and any problems are discussed either by written electronic communication or at one of the optional text clinics.

Target group:

Students in the engineering programmes (TTK and TST)

Prerequisites and co-requisites:

-

Recommended optional programme components:

This is an elective course which can be taken after 902150Y PET by students in the engineering programmes (TTK and TST).

Recommended or required reading:

Course materials are provided in an electronic form that can be downloaded.

Assessment methods and criteria:

All assignments must be completed to a standard of effective business correspondence based on the learning outcomes of the course. In addition, there is a test at the end of the course.
Lue lisää opintosuoritusten arvostelusta yliopiston verkkosivulta.

Grading:

Pass/Fail

Person responsible:

Susan McAnsh

Working life cooperation:

-

Other information:

-

Compulsory studies

521002P: Orientation to Computer Science and Engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521005P	Orientation Course for New CSE Students	1.0 op

ECTS Credits:

5 ECTS cr / 135 hours of work

Language of instruction:

Finnish

Timing:

Autumn semester, periods I and II. The course should be taken during the first year of bachelor level studies.

Learning outcomes:

After completing the course the student:

1. Recognizes his/her role and responsibilities regarding university studies and is able to study independently in university.
2. Is able to make short and long time study plans and follow the realization of the plans.
3. Has made a personal study plan.
4. Is familiar with some of the important software (Matlab, Linux, agile software development tools) used during computer science and engineering studies.
5. Is familiar with one type of microcontroller-based programmable platform and has created a simple application for it.

Contents:

Degree program structure, academic studying, planning and follow-up of time management and studies, services and information systems to support studies, basic software and hardware related to computer science and engineering.

Mode of delivery:

face-to-face

Learning activities and teaching methods:

Lectures 17 h / Laboratory exercises 20 h / Independend work 98 h.
Independend work consists of web based exercises (40 h), study planning and follow-up homework (40 h) and home essays (18 h).

Target group:

Computer science and engineering bachelor level students.

Prerequisites and co-requisites:

No prerequisites.

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 material will be handed out during the course.

Assessment methods and criteria:

The course consists on eleven parts that need to be accomplished. These are 1) taking part to student tutoring, 2) taking part to teacher tutoring, 3) creating a personal study plan that has been accepted by the teacher tutor, 4) introduction to programmable gadgets, 5) orientation seminars I & II, 6) introduction to agile tools, 7) introduction to Linux, 8) Matlab Onramp, 9) time management and follow-up assignment, 10) study skills and career planning assignment, 11) orientation theme questions.

Grading:

The course utilizes verbal grading scale ”Pass / Fail”.

Person responsible:

Riku Hietaniemi

Working life cooperation:

Visiting lecturers from working life are invited to the course seminars.

Other information:

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

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Pauliina Uusitalo

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031010P Calculus I (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. The course will be lectured also in English.

Timing:

Fall, period 1

Learning outcomes:

Upon completion of the course, the student
- knows how to solve inequalities and equations with absolute value
- identifies the concepts of vector algebra
- can use vector algebra for solving the problems of analytic geometry
- can explain basic characteristics of elementary functions
- is able to analyse the limit and the continuity of the real valued functions of one variable
- can analyse the local minima and maxima of a function
- knows how to find the derivative for a function given with parametric representation
- is able to evaluate the basic calculation of the complex numbers and can rewrite a complex number in its exponential form
- knows the connection between the integral and area
- knows integral techniques such as integration by parts, a substitution method and a partial fraction composition
- can solve problems associated with the differential and integral calculus of the real valued functions of one variable.

Contents:

- Inequalities and absolute value
- Vector algebra and analytic geometry
- Concept of the function and elementary functions
- Monotonicity of the function, the inverse function
- Limit values
- Derivative as limit value of the difference quotient. Derivatives of elementary functions
- The extreme values of a function
- Parameter presentation of the curve, polar coordinates, complex numbers
- Integral function and definite integral, applications
- Integration by parts, substitution method and integration of rational functions

Mode of delivery:

Blended learning, course material is in Moodle learning environment

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h

Target group:

1. year students of technical sciences, mathematics and physics

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Grossman, S.I.: Calculus of One Variable; Grossman, S.I.: Multivariable Calculus, Linear Algebra, and Differential Equations (partly); Adams, R.A.: A Complete Course Calculus (partly)

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is based on the learning outcomes of the course. Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Pauliina Uusitalo

Working life cooperation:

The course does not contain working live cooperation.

Other information:

-

031078P: Matrix Algebra, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031078P	Matrix Algebra (OPEN UNI)	5.0 op
031019P	Matrix Algebra	3.5 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn, during period 2. It is recommended to complete the course at the 1th autumn semester.

Learning outcomes:

The student is able to apply arithmetic operations of matrices and can solve system of linear equations by matrix methods and can apply matrix factorizations to find the solution of the system of linear equations. The student is able to recognize the vector space and understands the concepts of basis and dimension of a vector space and can analyse matrices by the parameters, vectors and vector spaces of matrices. He /She knows how to calculate determinant, eigenvalues and eigenvectors of a square matrix, and is able to diagonalize matrices and apply diagonalization to the simple problems.

Contents:

1. Vectors and matrices 2. Systems of linear equations. 3. Matrix factorizations. 4. Vector spaces. 5. The rank, nullity, row space and the column space of a matrix. 6. The determinant of a matrix. 7. Eigenvalues and eigenvectors of a matrix. 8. The diagonalization with applications.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

1. year students of technical sciences, mathematics and physics.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Recommented literature: Grossman, S.I: Elementary Linear Algebra; David C. Lay: Linear Algebra and Its Applications.

Assessment methods and criteria:

The course can be completed by intermediate exams (2 exams) or by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Matti Peltola

Working life cooperation:

-

Other information:

-

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Oja

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521141P	Elementary Programming (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS Cr

Language of instruction:

Lectures and learning material are in Finnish. The course is not available English.

Timing:

Fall, periods 1-2.

Learning outcomes:

1. Is capable of solving problems in the computer's terms

2. Understands the basic concepts of programming

3. Knows the basics of the Python programming language

4. Is able to implement programs independently

5. Is able to use the internet to find information about programming

Contents:

Problem solving with programming, basic concepts of programming, writing Python code.

Mode of delivery:

Web-based teaching + face-to-face teaching

Learning activities and teaching methods:

30h of exercise groups, 105h self-studying in the web.

Target group:

1 st year students of computer science and engineering, electrical engineering, medical and wellness technology and industrial and engineering management, 2nd year students of physics, and other students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

The course provides a basis for subsequent programming courses.

Recommended or required reading:

Web material in an online learning environment. Address will be announced at the beginning of the course.

Assessment methods and criteria:

The course is completed by passing all learning assignments, programming exercises and a final exercise project. Read more about assessment criteria at the University of Oulu webpage
Read more about assessment criteria at the University of Oulu webpage.

Grading:

pass/fail.

Person responsible:

Mika Oja

Working life cooperation:

-

Other information:

The course learning platform is Lovelace (lovelace.oulu.fi)

031075P: Calculus II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Pauliina Uusitalo

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031075P	Calculus II (OPEN UNI)	5.0 op
031011P	Calculus II	6.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish. The course can be completed in English by intermediate exams or by a final exam.

Timing:

Spring semester, period 3

Learning outcomes:

Upon completion of the course, the student is able to examine the convergence of series and power series of real terms, can explain the use of power series e.g. in calculating limits, 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:

Online teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the course 031010P Calculus I.

Recommended optional programme components:

-

Recommended or required reading:

Kreyszig, E: Advanced Engineering Mathematics; Grossman S.I.: Multivariable Calculus, Linear Algebra, and Differential Equations; Adams, R.A.: A Complete Course Calculus.

Assessment methods and criteria:

Intermediate exams or a final exam. The exams are remote exams. It is possibility to take exams also at the university.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Pauliina Uusitalo

Working life cooperation:

-

Other information:

-

031021P: Probability and Mathematical Statistics, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031021P	Probability and Mathematical Statistics (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Spring semester, period 3

Learning outcomes:

After completing the course the student

1. knows the key concepts of probability and the most important random variables,
2. will be able to use them in calculating probabilities and parameters of probability distributions,
3. is capable of analyzing statistical data by calculating interval and point estimates for the parameters,
4. will be able to formulate statistical hypotheses and test them,
5. knows the basics of linear regression.

Contents:

The key concepts of probability, random variable, parameters of probability distributions, estimation of parameters, hypothesis testing, regression analysis.

Mode of delivery:

Online teaching

Learning activities and teaching methods:

Lectures 28 h/Exercises 20 h/Self study 87 h.

Target group:

The students in the engineering sciences. Other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisities are the course 031010P Calculus I and some parts of the course 031075P Calculus II.

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:

Milton, J.S., Arnold, J.C. (1992): Introduction to Probability and Statistics.

Assessment methods and criteria:

Intermediate exams or a final exam. The exams are remote exams. It is possibility to take exams also at the university.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

521159P: Principles of Digital Fabrication, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Georgi Georgiev

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521159P	Principles of Digital Fabrication (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits/ 135 hours of work

Language of instruction:

Finnish/English

Timing:

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

Learning outcomes:

In this course the students will learn the whole process of digital fabrication in FabLab. They will learn how to create an interactive 3D prototype, design mechanical parts for prototype, create basic electronics, implement a control logic for open hardware embedded board, and work in teams on project.

Contents:

The course teaches students to (1) design mechanical components with solid modeling tools, (2) build necessary electronics, and (3) implement software to a microcontroller, to create in FabLab a physical gadget that interacts with the world around it.

Mode of delivery:

Online (Lectures and TA sessions)/ Individual work towards project.

Learning activities and teaching methods:

Lectures 30h / Individual work 123h. There are sessions each week online where guidance is available (min total 16 h).

Target group:

This course is included in the computer science bachelor degree program. It is also available for all degree programs in the university. The course is offered to high-school students.

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

There is no recommended or required reading. The tutorials for tools and software (or links to such tutorials) will be provided in the course.

Assessment methods and criteria:

The course will be evaluated on the basis of the project delivered by the teams of students. Essential part of this reporting is the documentation of the project.

Grading:

pass/fail

Person responsible:

Georgi Georgiev

Working life cooperation:

-

Other information:

The course is also offered to high-school students with special study right and gives 5 ECTS credits that can be included in some bachelor’s degrees at University of Oulu.
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi

521160P: Introduction to Artificial Intelligence, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

Opintokohteen kielet: English

Leikkaavuudet:

ay521160P	Introduction to Artificial Intelligence (OPEN UNIV)	5.0 op

ECTS Credits:

5 ECTS credits /135 hours of work

Language of instruction:

Finnish, English
Lectures and main material in Finnish. English material for self study available.

Timing:

Period IV in spring semester. Recommended completion year: first or second.

Learning outcomes:

Upon completion the student the student will have the elementary skills to identify the potentially applicable artificial intelligence techniques for solving problems. He/she can recognize search, regression, classification, and clustering problems, and to explain the use of supervised and nonsupervised learning, performance measurements and metrics.

Contents:

- Introduction to artificial intelligence
- Search methods
- Supervised learning
- Regression
- Classification
- Data preprocessing
- Unsupervised learning
- Reinforcement learning
- Neural networks

Mode of delivery:

Face-to-face teaching. Online learning option available.

Learning activities and teaching methods:

Mode of delivery: Online teaching. Lectures 42h / exercise work 70 h / self-study 23 h. The exercises can be completed individually or as group work in multi-disciplinary teams.

Target group:

All Bachelor level students.

Prerequisites and co-requisites:

No prerequisites. Python programming skills are highly recommended.

Recommended optional programme components:

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

Recommended or required reading:

All course material (lectures and exercises) are available in course Moodle space.

Assessment methods and criteria:

The course utilizes continuous assessment. During the course there are five intermediate exams which will be used in final evaluation. The course also includes five exercises of which at least four need to be passed. These exercises can be completed individually or in groups.

Grading:

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

Person responsible:

Riku Hietaniemi

Working life cooperation:

Experts from industry are invited to present real world artificial intelligence solutions.

Other information:

Course learning environment is in Moodle moodle.oulu.fi.

031023P: Mathematical Structures for Computer Science, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn, during period 1. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

The student is able to apply result of logic to find the truth value of logical statement and can express sentences of natural language by symbols of logic.. He/She can use arithmetic operations on different number bases. The student recognize the main types of graphs and understand the basis concepts of graphs and is able to apply formal methods of discrete mathematics to model simple information processing problems.

Contents:

1. Elementary logic 2. Mathematical induction 3. Elementary number theory 4. Set theory 5. Elementary graph theory 6. Elementary theory of formal languages 7. Theory of automata and Turing machines

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

2. year students of computer science.

Prerequisites and co-requisites:

No prerequisites

Recommended optional programme components:

-

Recommended or required reading:

Recommented literature: Rosen K.H.: Discrete Mathematics and Its Applications. Gersting J.L.: Mathematical Structures for Computer Science.

Assessment methods and criteria:

The course can be completed by intermediate exams (2 exams) or by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Matti Peltola

Working life cooperation:

-

031077P: Complex analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kemppainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031077P	Complex analysis (OPEN UNI)	5.0 op

031018P Complex Analysis 4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

Fall semester, period 1.

Learning outcomes:

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

Contents:

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

Mode of delivery:

Face-toface teaching, Stack(web-based too) exercises.

Learning activities and teaching methods:

Lectures 28 h/Exercises 14 h/Self study 93 h.

Target group:

The students in the engineering sciences. The other students are welcome, too.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

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 lecture notes

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kemppainen

Working life cooperation:

-

761119P: Electromagnetism 1, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Field of Physics

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Asikainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

761113P-01 Electricity and magnetism, lectures and exam 0.0 op

761113P-02 Electricity and magnetism, lab. exercises 0.0 op
761113P Electricity and magnetism 5.0 op
766319A Electromagnetism 7.0 op
761103P Electricity and Magnetism 4.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work
- 761119P-01, Lectures and exam (4 cr)
- 761119P-02, Lab. exercises (1 cr)

Language of instruction:

Finnish

Timing:

Second fall term

Learning outcomes:

The student will be able to understand the basic concepts of electromagnetism and can apply this understanding to solve problems related to electromagnetism.

Contents:

Basic principles of electromagnetic phenomena and their physical and geometric interpretation. More detailed contents will be presented later.

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 32 h, 7 exercises (14 h), 2 laboratory exercises (3 hours/exercise), self-study 83 h

Target group:

For the students of the University of Oulu.

Prerequisites and co-requisites:

Knowledge of vector calculus and basics of differential and integral calculus.

Recommended optional programme components:

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

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 13. ed., chapters 21-31. Also other editions can be used. Lecture material in finnish.

Assessment methods and criteria:

Both parts (761119P-01 and 761119P-02) will be graded separately. The final grade of the course is the weighted average of the grades of part 1 (4 cr) and part 2 (1 cr).
761119P-01: Three small midterm exams or final examination
761119P-02: Two laboratory exercises
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Numerical grading scale 0 – 5, where 0 = fail

Person responsible:

Timo Asikainen

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Faculty of Technology
Arvostelu: 1 - 5, pass, fail
Opettajat: Ursula Heinikoski
Opintokohteen kielet: Finnish

Leikkaavuudet:

030004P Introduction to Information Retrieval 0.0 op

ECTS Credits:

1 ECTS credit / 27 hours of work

Language of instruction:

Finnish

Timing:

Architecture 3. spring semester, period III;
biochemistry 3. autumn semester;
biology 3. autumn semester, period I;
chemistry 3. autumn semester, period I;
civil engineering 2. spring semester, period IV;
computer science and engineering 2. spring semester, period IV;
electronics and communications engineering 3. spring semester;
geosciences 2. spring semester, period IV;
geography 3. semester, periods I and III;
industrial engineering and management 3. year;
information processing sciences 1. or 3. year;
mathematics and physics 1. spring semester, period III;
mechanical engineering 3. year;
mining engineering and mineral processing 3. year;
process and environmental engineering 2. year, period II;
Master's degree students in industrial engineering and management 1st year.

Learning outcomes:

Upon completion of the course, the students:
- can search scientific information,
- can use the most important databases of their discipline,
- know how to evaluate search results and information sources,
- can use the reference management tool.

Contents:

Scientific information retrieval process, the most important databases and publication channels of the discipline, evaluation of the reliability of information sources and reference management tool.

Mode of delivery:

Blended teaching: classroom training, web-based learning material and exercises, a group assignment.

Learning activities and teaching methods:

Training sessions 8 h, group working 7 h, self-study 12 h

Target group:

Compulsory for all bachelor degree students of Faculty of information technology and electrical engineering, Faculty of Technology and Faculty of science. Compulsory also for those Master’s degree students in Industrial Engineering and Management who have no earlier studies in the information skills. Optional for the students of biochemistry.

Recommended optional programme components:

In biochemistry the course is completed as a part of 740376A Bachelor’s Thesis.

Recommended or required reading:

Web learning material Tieteellisen tiedonhankinnan opas

Assessment methods and criteria:

Passing the course requires participation in the training sessions and successful completion of the course assignments.

Grading:

pass/fail

Person responsible:

Ursula Heinikoski

521109A: Electrical Measurement Principles, 5 op

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

ECTS Credits:

5 ECTS credits / 136h

Language of instruction:

Course is lectured in Finnish. Lecture notes are available in English. Laboratory exercises and the exam can be done in English.

Timing:

Periods 1-2.

Learning outcomes:

1. is able to measure basic measurements with a multimeter,

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

3. is able to operate signal and function generators.

4. is able to estimate the validity of their measurements.

Contents:

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

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 20h, laboratory exercises 16 h and self-study 100h.

Target group:

Course is compulsory for electrical engineering, information engineering and wellness technology students. Course is open for all students in University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Christian Schuss

Working life cooperation:

None.

Other information:

-

521145A: Human-Computer Interaction, 5 op

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

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish/English

Timing:

Autumn semester, Period II

Learning outcomes:

Upon completing this course, students will possess:

1. Knowledge of Human Computer Interaction (HCI) fundamentals
2. Knowledge and practical experience of user-centric computer interface and usability evaluation techniques, such as questionnaires and interviewing
3. Knowledge and experience of prototyping techniques (both paper-based as well as digital)
4. Knowledge of how HCI can be incorporated in the software development process

Contents:

Fundamental knowledge of humans, and how that relates to computer systems and interfaces. Learning design in 2-3 different ways, and conducting evaluations of the designs. Evaluation constitutes data collection and analysis, including qualitative and quantitative data.

Mode of delivery:

Online teaching (lectures), group work (labs).

Learning activities and teaching methods:

Lectures (12 h), exercises (16 h), and practical work (105 h). The course is passed with approved classroom/reading package reflections, and an approved group-based practical work (several assignments). The implementation is doable fully in English.

Target group:

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

Prerequisites and co-requisites:

While no specific courses are not required, elementary teamwork skills are required and the capability to provide documentation.

Recommended optional programme components:

All necessary material will be provided by the instructor.

Recommended or required reading:

No required reading.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Associate Professor Simo Hosio

Working life cooperation:

If relevant, guest lectures may be organized (optional).

Other information:

Using Moodle as the teaching platform: https://moodle.oulu.fi/course/view.php?id=5409

521301A: Digital Techniques 1, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

Leikkaavuudet:

521412A-02 Digital Techniques 1, Exercise Work 0.0 op

521412A Digital Techniques 1 6.0 op

521412A-01 Digital Techniques, Exam 0.0 op

ECTS Credits:

8

Language of instruction:

Finnish

Timing:

Periods 3-4

Learning outcomes:

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

Contents:

The principles of digital devices, Boolean algebra, numeral systems, operating principle, analysis and synthesis of combinational logic, flip-flops, operating principle, analysis and synthesis of sequential logic (state machines), physical characteristics of CMOS technology, registers and register transfers, computer memory, instruction set architecture, computer design basics, interfaces and data transmission.

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lessons 40 h, weekly home assignments.

Target group:

Primarily 1st year electrical engineering and computer science and engineering BSc students. The course can be taken by the students of the university of Oulu.

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

Text books, MIT OpenCourseWare and execise literature.

Assessment methods and criteria:

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

Grading:

Project work and home assignments are assessed on numerical scale 1-5. The average of project work and home assignments will be the final grade.

Person responsible:

Antti Mäntyniemi

Working life cooperation:

-

Other information:

-

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

8 ECTS cr

Language of instruction:

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

Timing:

Autumn, periods 1-2.

Learning outcomes:

Upon completion of the course:
Student understands the basic computer architecture and organization.
Student understands CPU operation and basic datapath operation.
Student knows different 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 is able to implement small assembly language programs.
Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Overview of computer architecture and organization, CPU and datapath, memory hierarchies, data types, interrupts, registers and I/O, basics of the C programming language and basics of assembly language. Embedded systems programming.

Mode of delivery:

Web-based teaching + face-to-face teaching.

Learning activities and teaching methods:

Lectures (32h), course exercises (10-30h), laboratory exercise (3h) and two course projects, one is completed in a group and the other alone.

Target group:

2nd year students of computer science and engineering and 3rd year students of Electronics and Communications 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 and exercise material are available in the course website.
Literature:
Bryant & O'Hallaron, Computer Systems: A Programmer's Perspective, 3rd Edition, Chapters 1-9.
Patterson & Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Chapters 1-2, 4-5.
Patterson & Hennessy, Computer Organization and Design, 5th Edition: The Hardware/Software Interface, 2014.
Bryant & O'Hallaron, Computer Systems: A Programmer's Perspective, 2016.

Assessment methods and criteria:

The assessment criteria is based on the learning outcomes of the course. Students complete the course exercises, participate to the laboratory exercise and complete the course projects. Assessment is based on the exercises and the course projects. More detailed information on assessment is published in the lecture material.

Grading:

Numerical grading scale 1-5, zero stands for fail.

Person responsible:

Teemu Leppänen

Working life cooperation:

Visiting lectures with experts from local industry are possible.

Other information:

The course learning platform is Lovelace (lovelace.oulu.fi).

811312A: Data Structures and Algorithms, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juustila, Antti Juhani

Opintokohteen kielet: Finnish

Leikkaavuudet:

521144A	Algorithms and Data Structures	6.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd autumn semester of the Bachelor's studies.

Learning outcomes:

After completing the course the student will be able to:
* select data structures and algorithms to an application,
* apply induction when proving algorithm correctness and define recursive algorithms,
* describe trees, graphs and their basic algorithms and apply them in a program,
* describe the most common sorting algorithms, as well as
* analyse the correctness and time complexity of an algorithm implemented in a program.

Contents:

* Basic data structures
* Analysis of algorithms
* Sorting algorithms
* Hash tables
* Binary search trees
* Graphs and their algorithms
* Algorithm design paradigms

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 48 h, exercises 21 h, exercise work 27 h, independent study 39 h.

Target group:

BSc students.

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses are accomplished: Databases

Recommended optional programme components:

Recommended or required reading:

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

Assessment methods and criteria:

1. Exam and assignment OR 2. Mid-term exams (2) and assignment

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Antti Juustila

031080A: Signal Analysis, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Kotila, Vesa Iisakki

Opintokohteen kielet: Finnish

Leikkaavuudet:

031050A	Signal Analysis	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish.
The course can be completed in English by a final exam.

Timing:

The course is held in the autumn semester, during period II. It is recommended to complete the course at the 2nd autumn semester.

Learning outcomes:

Upon completion of the course, the student:
-is able to calculate the energy, the power, the convolution and the frequency spectrum of discrete and analog, periodic and non-periodic deterministic signals
-is able to study the effect of sampling on the signal
-is able to calculate the Hilbert transform and the complex envelope of a signal
-is able to study the stationarity, the mutual dependence and the frequency content of random signals by means of the auto- and cross-correlation functions, and the power- and cross-power spectral densities
-is able to study the effect of an LTI system on a signal

Contents:

Signals, classification, frequency. Fourier analysis, analog and digital signal, fast Fourier transform. LTI system. Hilbert transform. AM- FM- and PM-modulation. Random variable. Covariance matrix. Random signal. Stationarity, autocorrelation. Power spectral density. Random signal in LTI system. Signal estimation.

Mode of delivery:

The lectures and exercise classes will be arranged as distance learning via Zoom. The Zoom-links, directions and other material (in Finnish) will be made available in the Moodle-workspace for the course, which can be found at https://moodle.oulu.fi/course/view.php?id=5361

Learning activities and teaching methods:

Lectures 28 h / Exercises 14 h / Self-study privately or in a group 93 h. The independent work includes individual STACK-assignments as online work.

Target group:

-

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the courses 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics and 031077P Complex 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. Additional reading: Proakis, J.G., Manolakis, D.K.: Introduction to Digital Signal Processing. Shanmugan, K.S., Breipohl, A.M.: Random Signals, Detection, Estimation and Data Analysis.

Assessment methods and criteria:

The course is completed with mid-term exams or a final exam. When completed with mid-term exams, exercise assignments are part of the continuous assessment. The assessment of the course is 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:

Vesa Kotila

Working life cooperation:

-

521457A: Software Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Leikkaavuudet:

ay521457A	Software Engineering (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Material available in English.

Timing:

Spring, period 3.

Learning outcomes:

1. After finishing the course, the student knows the basic concepts of software engineering
2. The student also knows the different areas of project management, the phases of software development
3. The student can defines goals and tasks for each phase of development
4. The student knows the principles of secure software development
5. The student knows the metrics used in software engineering and is able to apply them
6. The student is familiar with tools commonly used in software engineering.

Contents:

Problematics of software development and the special features of real-time systems in this regard. Software development is viewed in regard to project management and actual implementation: 1. process models, 2. requirements specification, 3. project management basics: design, metrics, risk management, resource management, follow up, quality control, product control, 4. software testing methods and strategies, 5. introduction to object-oriented analysis and design. 6. Agile software development. 7. Secure software engineering

Mode of delivery:

Online course

Learning activities and teaching methods:

The course consists of lectures and independent practical exercises. The course is completed by a final exam or learning diaries and successfully completed practical exercises. Lectures 30 h, laboratory design (in period 3) 8 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. Eight Edition. McGraw-Hill 2010. Older editions (6. and 7.) can also be used with some additional material.

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:

-

521150A: Introduction to Internet, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Erkki Harjula
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

All materials are in English, lectures are given in Finnish.

Timing:

Spring, period 4.

Learning outcomes:

Upon completion of this course, students know and understand the basic concepts, know the key terminology and can write clearly with justifications about the following key areas of the course, which are:

1. The design principles of the Internet, its architecture, functionality and challenges
2. The role of the data link layer and the most important access network technologies
3. The structure and the most important protocols of the TCP/IP protocol stack
4. The most important internet applications and their protocols
5. The basic principles of internet security and multimedia applications

Additionally, students who have attained grades 2 or 3 have demonstrated satisfactory capability to perform practical software implementation work and/or solving Internet-related problems relevant to most centric course key areas. Students who have attained grades 4 or 5 have demonstrated solid capability to perform practical software implementation work and analytical skills for solving technical and research problems relevant to the course key areas.

Contents:

The design principles and architecture of the Internet, data link layer and most important access network technologies, TCP/IP protocol stack and its most important protocols, most important Internet applications, principles of Internet security and multimedia, internet's challenges and Future Internet.

Mode of delivery:

Remote teaching.

Learning activities and teaching methods:

Remote teaching: Lectures 32h, exercices 16h, laboratory exercises 12h, course work 25h, independent work 48h. Work is done in groups or independently.
Details of arrangement can be found from the course web page in Moodle: https://moodle.oulu.fi/course/view.php?id=4029

Target group:

Communications Engineering, Computer Science and Engineering students, Information Processing Science students, other students of the University of Oulu.

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Announced at the beginning of the course.

Assessment methods and criteria:

Passing the course requires mastery of the essential core content of the course. Continuous assessment and exams are provided for students to show that they have attained this level. Higher grades are attained by participating in and completing, either alone or in groups, to non-mandatory exercises and exams on advanced course topics. More detailed information on assessment is published yearly in the lecture material.

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:

D.Sc. Erkki Harjula

Working life cooperation:

None.

521453A: Operating Systems, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Leikkaavuudet:

ay521453A	Operating Systems (OPEN UNI)	5.0 op

ECTS Credits:

5

Language of instruction:

In Finnish, material available in English

Timing:

Spring, period 4

Learning outcomes:

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

2. is able to point the problems related to process management and synchronization as well as is able to apply learned methods to solve basic problems

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

4. is able to explain the basics of memory management, the use of virtual memory in modern operating systems as well as the structure of the most common file-systems.

Contents:

Operating system structure and services, process management, process synchronization, deadlocks, memory management, virtual memory, file-systems

Mode of delivery:

Face-to-face.

Learning activities and teaching methods:

Lectures 36 h, laboratory exercise 4 h, the rest as independent work. The laboratory work, including pre-exercise and guided exercise performed in a group of one or two students in the unix environment, covers core topics of the course.

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes (in Finnish) and exercise material. Silberschatz A., Galvin P., and Gagne G.: Operating System Concepts, 6th edition (or newer), John Wiley & Sons, Inc., 2003. Chapters 1-12.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Juha Röning (lectures)
Anna-Mari Wartiainen (exercises)

Working life cooperation:

-

Other information:

-

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

Spring, period 4.

Learning outcomes:

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

Contents:

1. Introduction
2. Fundamentals of digital image
3. Intensity transformations and spatial filtering
4. Image processing in frequency domain
5. Restoration

6. Color image processing
7. Wavelets and multi-scale processing
8. Compression
9. Morphological image processing
10. Segmentation

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and homework assignments 30 h. The rest is independent work.

Target group:

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

Prerequisites and co-requisites:

521141P Elementary Programming or equivalent Python programming skills.

Recommended optional programme components:

None.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Third Edition, Prentice-Hall, 2008, Chapters 1-10.
Lecture notes and exercise

Assessment methods and criteria:

The course is completed by passing the exam and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

Other information:

Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=6840

Complusory Bachelor's Thesis

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Languages and Communication

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

Proficiency level:

This course is not offered in English. It is only Finnish-speaking students.

Status:

This course unit is compulsory for students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.

Required proficiency level:

-

ECTS Credits:

2 credits

Language of instruction:

Finnish

Timing:

1st year: Process and Environmental Engineering
2nd year: Communications Technologies
3rd year: Geoscience; Mechanical Engineering; Electrical Engineering, Computer Science and Engineering Technologies

Mode of delivery:

Multimodal teaching

Learning activities and teaching methods:

Contact hours ca. 20 h and independent group work or self-study ca. 34 h.

Target group:

Bachelors students of Electrical Engineering, Computer Science, Communications Technologies and Engineering Mechanical Engineering, Process and Environmental Engineering.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Kauppinen, Anneli & Nummi, Jyrki & Savola, Tea: Tekniikan viestintä: kirjoittamisen ja puhumisen käsikirja (EDITA); Nykänen, Olli: Toimivaa tekstiä: Opas tekniikasta kirjoittaville (TEK) and material in Moodle 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

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.

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

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

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

521008A: Computer Science and Engineering, The Maturity Test for Bachelor's Degree, 0 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

0; The maturity test is integrated in the BSc Thesis credits (8 ECTS).

Language of instruction:

Finnish/Swedish/other

Timing:

periods 1-4

Learning outcomes:

After the maturity test, the student has demonstrated that his/her language skills meet the requirements of the work life.

Contents:

The aim of the maturity test is to confirm the student's familiary of the thesis area as well as his/her command of the domestic language of his/her school education.

Mode of delivery:

The maturity test is written in a controlled event, on a topic provided by the thesis supervisor.

Learning activities and teaching methods:

Written essay, approximately 3 pages hand written text or 380 words / 3040 characters.

Target group:

-

Prerequisites and co-requisites:

The maturity test can be written after all other components of the BSc thesis are completed.

Recommended optional programme components:

-

Recommended or required reading:

BSc Thesis.

Assessment methods and criteria:

The maturity test is evaluated and approved by the thesis supervisor.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Pass/fail.

Person responsible:

Thesis supervisor.

Working life cooperation:

-

A452127: Module Preparing for the Option, Artificial Intelligence, 20 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

15 ECTS cr

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi, Jaakko Suutala

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course in held in the spring semester, during period III. For bachelor students of Computer Science and Engineering specializing to artificial intelligence, it is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

After completing the course, students

1. know the basic search strategies that can be applied in problem solving and optimization.
2. understand how search-based decisions are made in game-like competitive applications.
3. know the basic principles of probabilistic reasoning in artificial intelligence systems.
4. know how rational decision making under uncertainty can be formulated using utility theory.
5. understand the fundamentals of machine learning and how some of the established methods can be applied to problems in AI.
6. are familiar with advanced AI applications of perception and robotics and how probabilistic inference and machine learning can be used in these settings.

In the course projects, students get some experience in programming and using search methods.

Contents:

intelligent agent types, uninformed search methods, informed (heuristic) search, local search, constraint satisfaction problems, adversarial search, uncertainty handling, probabilistic reasoning, utility, machine learning, decision networks, Markov decision process, reinforcement learning, applications

Mode of delivery:

The tuition is implemented as web-based teaching. Moodle environment is used in the course.
Due to Covid-19 pandemic, teaching in Spring 2021 will be implemented remotely. Course work space can be found from University of Oulu Moodle platform.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211, where details of implementation will be provided. The page will be available from December 21, 2020.
Online lectures will be given with Zoom and link for them will be provided in Moodle.

Learning activities and teaching methods:

Lectures 28 h / Group work (programming projects) 42 h / Self-study 65 h

Target group:

The primary target group is the students of the Computer Science and Engineering specializing in Artificial Intelligence.

Prerequisites and co-requisites:

Completion of the course "521160P Introduction to Artificial Intelligence" (lectured in Finnish) is recommended, but is not a prerequisite. It is also recommended that a student has completed studies related to probability and statistics (e.g. course "031021P Probability and Mathematical Statistics") and Python programming (e.g. course "521141P 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:

The course is based on the book Stuart Russell, Peter Norvig (2010, global edition 2016): Artificial Intelligence: A Modern Approach (3rd Edition), Chapters 1-6, 13-18, 20-21, partly 24-25.
The course utilizes materials of an introductory course on artificial intelligence taught at UC Berkeley (http://ai.berkeley.edu).

Assessment methods and criteria:

The assessment of the course is based on the final exam. Both the final exam and the course projects must be passed. Well-done course projects can increase the grade by one unit.

Grading:

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

Person responsible:

Pekka Sangi, Jaakko Suutala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211

521157A: Introduction to Social Network Analysis, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 120 hours of works

Language of instruction:

English

Timing:

Period 4. It is recommended to complete the course at the end of period 4

Learning outcomes:

Upon completing the course, the student is expected to i) understand social aspects of the web; ii) learn to collect, clean and represent social media data; iii) quantify important properties of social media; iv) find and analyze (online) communities; v) understand the diffusion process in social network; vi) familiarize with simple modelling toolkits for social media analysis

Contents:

The course describes basics of social network analysis, allowing the students to understand structure and evolution of the network, while enabling them to use appropriate tools and techniques to draw inferences and discover hidden patterns from the network. The course is designed to accommodate computer science, mathematical and social science student background, which helps in emergence of multi-disciplinary research in the university

Mode of delivery:

Face- to-face teaching and laboratory sessions

Learning activities and teaching methods:

Lectures (24 h), tutorial/laboratory sessions (12h), seminar (6 h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.

Target group:

Students with moderate logical reasoning skills

Prerequisites and co-requisites:

None

Recommended optional programme components:

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

Recommended or required reading:

R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014

Assessment methods and criteria:

One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mourad Oussalah

Working life cooperation:

-

Other information:

We hope to attract students from humanties, economics and political in order to encourage multidisciplinary studies and enforce interesting student projects where each group contains at least one student from computer science and one from another faculty.

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

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

15 ECTS cr

521046A: Mobile Computing, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Aku Visuri

Opintokohteen kielet: English

Leikkaavuudet:

521045S	Mobile Computing	5.0 op
521147S	Mobile and Social Computing	5.0 op

ECTS Credits:

5 ECTS credits / 138 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period 3.

Learning outcomes:

This course focuses on one of the core demands of the industry today: an understanding of mobile user interaction, computing constraints, an introduction to mobile development (Android) covering multiple aspects of the platform. This is a 5 ECTS course, with both lectures and practical sessions (labs).
After this class, students can:

- design and prototype a mobile user interface taking into account usability aspects of interaction on smaller displays
- explain and leverage the fundamental concepts of context-awareness using smartphone hardware, software and human sensors
- understand and implement from scratch a mobile application that leverages both usability and context to create engaging mobile experiences
- use GitHub for managing mobile application development.

Contents:

Lecture 1: Introduction to Mobile Computing
Lecture 2: Interacting with the user
Lecture 3: Introduction to Kotlin
Lecture 4: Sensing the world
Lecture 5: Multitasking on the go
Lecture 6: Context-aware mobile services
Lecture 7: Multimodal interaction: voice, touch, haptic, vision

Mode of delivery:

Remote teaching (online lectures and online 1-on-1 help if required)

Learning activities and teaching methods:

This course leverages on the iterative learning protocol. Students will iterate a pre-determined app, which they will develop independently at home. Guidance will be provided in the lab sessions. In each iteration, feedback is given to improve the followed implementation and we collaboratively learn in the process. A grade is given (0-100%, a pass is 50%) on how much was successfully implemented by the student at the end of Period 3-

Target group:

Computer Science and Engineering students and others related (ICT)

Prerequisites and co-requisites:

Recommended to have experience with object-oriented programming (Java, Python, C#, etc).

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:

This course utilizes a continuous assessment. During the course there are 5 homework assignments during Period 3 and 7 Lecture assignments which grant points (max 100) towards course completion. 50 points are required for a passing grade.

Grading:

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

Person responsible:

Aku Visuri

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course is in Moodle
https://moodle.oulu.fi/course/view.php?id=6195

521293A: Introduction to XR Systems, 5 op

Voimassaolo: 01.08.2020 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Paula Alavesa
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the spring semester, during period III. It is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

Upon completion of the course the students will be able to:

- Recall all of the components of modern XR systems
- Understand the interaction between the hardware, software, and human senses during an XR experience.
- Understand how the choices in hardware and software components influence human perception and the quality of XR experiences.
- Identify challenges facing next generation XR systems.
- Develop a basic VR experience using Unity3D.

Contents:

Overview of XR hardware: projectors, screens, light field displays, retinal scanners, waveguides. Overview of XR systems software: rendering systems and methods (gaming engines, panoramas, telepresence) tracking systems and methods (inside-out and inside-in tracking, camera-based methods, lighthouse, natural and artificial markers, IMU integration, sensor fusion. High level overview of human physiology, neuroscience, and human perception in relation to XR hardware and software.

Mode of delivery:

Online

Learning activities and teaching methods:

The course will consist of lectures (28h), individual lab exercises (28h), solo project (28h), self-study (48h), online final exam (3h). Students can borrow equipment from the lab to minimize the need for lab attendance. It is also possible, in small groups (<10), to do the exercise in the lab, however we aim to minimize any need for face to face teaching with other arrangements.

Target group:

B.Sc. students in all areas, especially applied computing and human sciences.

Prerequisites and co-requisites:

No prerequisites.

Recommended optional programme components:

The course is an independent entity, and does not require other additional studies carried out at the same time. It can also be considered as the first in the set of courses on VR and XR. It should be taken before VR Systems and Humans course (521291S) and 3D environments and Applications (521040A).

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (0-5). In the numerical scale zero stands for a fail.

Person responsible:

Anna LaValle.

Working life cooperation:

When possible, a guest lecture will be held by a visitor from a VR company.

521040A: 3D Virtual Environments and Applications, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Pouke

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS / 135 hours of work.

Language of instruction:

Primary instruction language is Finnish. The course can also be completed in English.

Timing:

The course is held in the spring semester, during period IV. It is recommended to complete the course during the 3rd year.

Learning outcomes:

Upon completion of the course, the student will be able to: Upon completion of the course, the student will be able to:

- Independently develop 3D applications containing an interactive environment utilizing contemporary game engines
- Develop game-engine compatible 3D objects utilizing low-polygon modeling
- Develop game-engine compatible materials utilizing Physically Based Rendering workflow
- Understand the principles of 3D application design for different platforms (mobile, desktop, VR)

Contents:

Game engine architecture, basics of 3D graphics, 3D modeling and animation, textures and materials, audio, interaction, multiplayer, game AI, performance and profiling, virtual reality.

Mode of delivery:

Online teaching.
The course consists of online lectures, exercises and a independent assignment.

Learning activities and teaching methods:

The course consists of online lectures (20h), exercises (16h), a group assignment (60), self-study (35h) and a seminar (4h).

Target group:

B.Sc. students from applied computing. The course might also be useful for students of Information processing science and students taking VR and XR related studies.

Prerequisites and co-requisites:

No prerequisites. Programming experience is an advantage.

Recommended optional programme components:

The course is an independent entity, and does not require other simultaneous courses from the student.

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed accorging to the quality of the group assignment (an interactive 3D application and related documentation) that is presented at the seminar. The assessment criteria of the application is based on the learning goals of the course.

Grading:

Numerical (1-5).

Person responsible:

Matti Pouke

Working life cooperation:

When possible, one or multiple visiting lectures by local companies are organized. The topic of the guest lecture can be related to the special knowledge of the visitor, or industry needs for 3D application development.

Other information:

This course uses Moodle learning environment (moodle.oulu.fi).

A452126: Module Preparing for the Option, Computer Engineering, 20 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

20 ECTS cr

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Olli Silven

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Online teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Online lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silven

Working life cooperation:

None.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Open University students enroll for studies through an open website.

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi, Jaakko Suutala

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course in held in the spring semester, during period III. For bachelor students of Computer Science and Engineering specializing to artificial intelligence, it is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

After completing the course, students

1. know the basic search strategies that can be applied in problem solving and optimization.
2. understand how search-based decisions are made in game-like competitive applications.
3. know the basic principles of probabilistic reasoning in artificial intelligence systems.
4. know how rational decision making under uncertainty can be formulated using utility theory.
5. understand the fundamentals of machine learning and how some of the established methods can be applied to problems in AI.
6. are familiar with advanced AI applications of perception and robotics and how probabilistic inference and machine learning can be used in these settings.

In the course projects, students get some experience in programming and using search methods.

Contents:

intelligent agent types, uninformed search methods, informed (heuristic) search, local search, constraint satisfaction problems, adversarial search, uncertainty handling, probabilistic reasoning, utility, machine learning, decision networks, Markov decision process, reinforcement learning, applications

Mode of delivery:

The tuition is implemented as web-based teaching. Moodle environment is used in the course.
Due to Covid-19 pandemic, teaching in Spring 2021 will be implemented remotely. Course work space can be found from University of Oulu Moodle platform.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211, where details of implementation will be provided. The page will be available from December 21, 2020.
Online lectures will be given with Zoom and link for them will be provided in Moodle.

Learning activities and teaching methods:

Lectures 28 h / Group work (programming projects) 42 h / Self-study 65 h

Target group:

The primary target group is the students of the Computer Science and Engineering specializing in Artificial Intelligence.

Prerequisites and co-requisites:

Completion of the course "521160P Introduction to Artificial Intelligence" (lectured in Finnish) is recommended, but is not a prerequisite. It is also recommended that a student has completed studies related to probability and statistics (e.g. course "031021P Probability and Mathematical Statistics") and Python programming (e.g. course "521141P 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:

The course is based on the book Stuart Russell, Peter Norvig (2010, global edition 2016): Artificial Intelligence: A Modern Approach (3rd Edition), Chapters 1-6, 13-18, 20-21, partly 24-25.
The course utilizes materials of an introductory course on artificial intelligence taught at UC Berkeley (http://ai.berkeley.edu).

Assessment methods and criteria:

The assessment of the course is based on the final exam. Both the final exam and the course projects must be passed. Well-done course projects can increase the grade by one unit.

Grading:

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

Person responsible:

Pekka Sangi, Jaakko Suutala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211

521302A: Circuit Theory 1, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

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

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed
Read more about assessment criteria at the University of Oulu webpage..

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

Other information:

-

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031076P	Differential Equations (OPEN UNI)	5.0 op
800320A	Differential equations	5.0 op
031017P	Differential Equations	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring, during period 4. It is recommended to complete the course at the 1th spring semester.

Learning outcomes:

The students can apply differential equations as a mathematical model. They can identify and solve various differential equations and they have knowledge on basic solvability of differential equations. The student can use the Laplace transform as a solution method.

Contents:

Ordinary differential equations of first and higher order.
Laplace transform with applications to differential equations.

Mode of delivery:

Online teaching, Stack/Moodle digital learning environment

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

1. year students of engineering, mathematics and physics.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the course Calculus I.

Recommended optional programme components:

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Recommended or required reading:

Recommended literature: Kreyszig, E: Advanced Engineering Mathematics;

Assessment methods and criteria:

The course can be completed by intermediate exams (2 exams) or by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

No

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

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Supplementary Module / Bachelor's Degree

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

Supplementary module primarily consists of a preparatory module of another orientation (Artificial Intelligence, Applied Computing or Computer Engineering). 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.

A452127: Module Preparing for the Option, Artificial Intelligence, 20 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

15 ECTS cr

805305A: Introduction to Regression and Analysis of Variance, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

Leikkaavuudet:

806112P	Basic Methods of Data Analysis	10.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of regression and variance analysis with one or several explanatory variables, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Linear regression and analysis of variance models for continuous outcomes; Formulation of the model and interpretation of parameters; Fitting the models, estimation of parameters, and prediction with the method of least squares: Basic methods of model criticism and diagnostics; Use of R environment in modelling.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics or corresponding abilities acquired otherwise.

Recommended optional programme components:

Is assumed as preliminary knowledge in the course 805306A Introduction to Multivariate Methods.

Recommended or required reading:

Lecture notes and material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 1-3. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5

Person responsible:

Jari Päkkilä

Working life cooperation:

No

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi, Jaakko Suutala

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A Artificial Intellig (OPEN UNI) 5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course in held in the spring semester, during period III. For bachelor students of Computer Science and Engineering specializing to artificial intelligence, it is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

After completing the course, students

1. know the basic search strategies that can be applied in problem solving and optimization.
2. understand how search-based decisions are made in game-like competitive applications.
3. know the basic principles of probabilistic reasoning in artificial intelligence systems.
4. know how rational decision making under uncertainty can be formulated using utility theory.
5. understand the fundamentals of machine learning and how some of the established methods can be applied to problems in AI.
6. are familiar with advanced AI applications of perception and robotics and how probabilistic inference and machine learning can be used in these settings.

In the course projects, students get some experience in programming and using search methods.

Contents:

intelligent agent types, uninformed search methods, informed (heuristic) search, local search, constraint satisfaction problems, adversarial search, uncertainty handling, probabilistic reasoning, utility, machine learning, decision networks, Markov decision process, reinforcement learning, applications

Mode of delivery:

The tuition is implemented as web-based teaching. Moodle environment is used in the course.
Due to Covid-19 pandemic, teaching in Spring 2021 will be implemented remotely. Course work space can be found from University of Oulu Moodle platform.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211, where details of implementation will be provided. The page will be available from December 21, 2020.
Online lectures will be given with Zoom and link for them will be provided in Moodle.

Learning activities and teaching methods:

Lectures 28 h / Group work (programming projects) 42 h / Self-study 65 h

Target group:

The primary target group is the students of the Computer Science and Engineering specializing in Artificial Intelligence.

Prerequisites and co-requisites:

Completion of the course "521160P Introduction to Artificial Intelligence" (lectured in Finnish) is recommended, but is not a prerequisite. It is also recommended that a student has completed studies related to probability and statistics (e.g. course "031021P Probability and Mathematical Statistics") and Python programming (e.g. course "521141P 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:

The course is based on the book Stuart Russell, Peter Norvig (2010, global edition 2016): Artificial Intelligence: A Modern Approach (3rd Edition), Chapters 1-6, 13-18, 20-21, partly 24-25.
The course utilizes materials of an introductory course on artificial intelligence taught at UC Berkeley (http://ai.berkeley.edu).

Assessment methods and criteria:

The assessment of the course is based on the final exam. Both the final exam and the course projects must be passed. Well-done course projects can increase the grade by one unit.

Grading:

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

Person responsible:

Pekka Sangi, Jaakko Suutala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211

521157A: Introduction to Social Network Analysis, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 120 hours of works

Language of instruction:

English

Timing:

Period 4. It is recommended to complete the course at the end of period 4

Learning outcomes:

Upon completing the course, the student is expected to i) understand social aspects of the web; ii) learn to
collect, clean and represent social media data; iii) quantify important properties of social media; iv) find
and analyze (online) communities; v) understand the diffusion process in social network; vi) familiarize with
simple modelling toolkits for social media analysis

Contents:

The course describes basics of social network analysis, allowing the students to understand structure and evolution of the network, while enabling them to use appropriate tools and techniques to draw inferences and discover hidden patterns from the network. The course is designed to accommodate computer science, mathematical and social science student background, which helps in emergence of
multi-disciplinary research in the university

Mode of delivery:

Face- to-face teaching and laboratory sessions

Learning activities and teaching methods:

Lectures (24 h), tutorial/laboratory sessions (12h), seminar (6 h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.

Target group:

Students with moderate logical reasoning skills

Prerequisites and co-requisites:

None

Recommended optional programme components:

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

Recommended or required reading:

R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014

Assessment methods and criteria:

One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mourad Oussalah

Working life cooperation:

-

Other information:

We hope to attract students from humanties, economics and political in order to encourage multidisciplinary studies and enforce interesting student projects where each group contains at least one student from computer science and one from another faculty.

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

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

15 ECTS cr

521046A: Mobile Computing, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Aku Visuri

Opintokohteen kielet: English

Leikkaavuudet:

521045S	Mobile Computing	5.0 op
521147S	Mobile and Social Computing	5.0 op

ECTS Credits:

5 ECTS credits / 138 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period 3.

Learning outcomes:

This course focuses on one of the core demands of the industry today: an understanding of mobile user interaction, computing constraints, an introduction to mobile development (Android) covering multiple aspects of the platform. This is a 5 ECTS course, with both lectures and practical sessions (labs).
After this class, students can:

- design and prototype a mobile user interface taking into account usability aspects of interaction on smaller displays
- explain and leverage the fundamental concepts of context-awareness using smartphone hardware, software and human sensors
- understand and implement from scratch a mobile application that leverages both usability and context to create engaging mobile experiences
- use GitHub for managing mobile application development.

Contents:

Lecture 1: Introduction to Mobile Computing
Lecture 2: Interacting with the user
Lecture 3: Introduction to Kotlin
Lecture 4: Sensing the world
Lecture 5: Multitasking on the go
Lecture 6: Context-aware mobile services
Lecture 7: Multimodal interaction: voice, touch, haptic, vision

Mode of delivery:

Remote teaching (online lectures and online 1-on-1 help if required)

Learning activities and teaching methods:

This course leverages on the iterative learning protocol. Students will iterate a pre-determined app, which they will develop independently at home. Guidance will be provided in the lab sessions. In each iteration, feedback is given to improve the followed implementation and we collaboratively learn in the process. A grade is given (0-100%, a pass is 50%) on how much was successfully implemented by the student at the end of Period 3-

Target group:

Computer Science and Engineering students and others related (ICT)

Prerequisites and co-requisites:

Recommended to have experience with object-oriented programming (Java, Python, C#, etc).

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:

This course utilizes a continuous assessment. During the course there are 5 homework assignments during Period 3 and 7 Lecture assignments which grant points (max 100) towards course completion. 50 points are required for a passing grade.

Grading:

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

Person responsible:

Aku Visuri

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course is in Moodle
https://moodle.oulu.fi/course/view.php?id=6195

521293A: Introduction to XR Systems, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Paula Alavesa

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the spring semester, during period III. It is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

Upon completion of the course the students will be able to:

- Recall all of the components of modern XR systems
- Understand the interaction between the hardware, software, and human senses during an XR experience.
- Understand how the choices in hardware and software components influence human perception and the quality of XR experiences.
- Identify challenges facing next generation XR systems.
- Develop a basic VR experience using Unity3D.

Contents:

Overview of XR hardware: projectors, screens, light field displays, retinal scanners, waveguides. Overview of XR systems software: rendering systems and methods (gaming engines, panoramas, telepresence) tracking systems and methods (inside-out and inside-in tracking, camera-based methods, lighthouse, natural and artificial markers, IMU integration, sensor fusion. High level overview of human physiology, neuroscience, and human perception in relation to XR hardware and software.

Mode of delivery:

Online

Learning activities and teaching methods:

The course will consist of lectures (28h), individual lab exercises (28h), solo project (28h), self-study (48h), online final exam (3h). Students can borrow equipment from the lab to minimize the need for lab attendance. It is also possible, in small groups (<10), to do the exercise in the lab, however we aim to minimize any need for face to face teaching with other arrangements.

Target group:

B.Sc. students in all areas, especially applied computing and human sciences.

Prerequisites and co-requisites:

No prerequisites.

Recommended optional programme components:

The course is an independent entity, and does not require other additional studies carried out at the same time. It can also be considered as the first in the set of courses on VR and XR. It should be taken before VR Systems and Humans course (521291S) and 3D environments and Applications (521040A).

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (0-5). In the numerical scale zero stands for a fail.

Person responsible:

Anna LaValle.

Working life cooperation:

When possible, a guest lecture will be held by a visitor from a VR company.

521040A: 3D Virtual Environments and Applications, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Pouke

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS / 135 hours of work.

Language of instruction:

Primary instruction language is Finnish. The course can also be completed in English.

Timing:

The course is held in the spring semester, during period IV. It is recommended to complete the course during the 3rd year.

Learning outcomes:

Upon completion of the course, the student will be able to: Upon completion of the course, the student will be able to:

- Independently develop 3D applications containing an interactive environment utilizing contemporary game engines
- Develop game-engine compatible 3D objects utilizing low-polygon modeling
- Develop game-engine compatible materials utilizing Physically Based Rendering workflow
- Understand the principles of 3D application design for different platforms (mobile, desktop, VR)

Contents:

Game engine architecture, basics of 3D graphics, 3D modeling and animation, textures and materials, audio, interaction, multiplayer, game AI, performance and profiling, virtual reality.

Mode of delivery:

Online teaching.
The course consists of online lectures, exercises and a independent assignment.

Learning activities and teaching methods:

The course consists of online lectures (20h), exercises (16h), a group assignment (60), self-study (35h) and a seminar (4h).

Target group:

B.Sc. students from applied computing. The course might also be useful for students of Information processing science and students taking VR and XR related studies.

Prerequisites and co-requisites:

No prerequisites. Programming experience is an advantage.

Recommended optional programme components:

The course is an independent entity, and does not require other simultaneous courses from the student.

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed accorging to the quality of the group assignment (an interactive 3D application and related documentation) that is presented at the seminar. The assessment criteria of the application is based on the learning goals of the course.

Grading:

Numerical (1-5).

Person responsible:

Matti Pouke

Working life cooperation:

When possible, one or multiple visiting lectures by local companies are organized. The topic of the guest lecture can be related to the special knowledge of the visitor, or industry needs for 3D application development.

Other information:

This course uses Moodle learning environment (moodle.oulu.fi).

A452126: Module Preparing for the Option, Computer Engineering, 20 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

20 ECTS cr

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Olli Silven

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Online teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Online lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silven

Working life cooperation:

None.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Open University students enroll for studies through an open website.

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi, Jaakko Suutala

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course in held in the spring semester, during period III. For bachelor students of Computer Science and Engineering specializing to artificial intelligence, it is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

After completing the course, students

1. know the basic search strategies that can be applied in problem solving and optimization.
2. understand how search-based decisions are made in game-like competitive applications.
3. know the basic principles of probabilistic reasoning in artificial intelligence systems.
4. know how rational decision making under uncertainty can be formulated using utility theory.
5. understand the fundamentals of machine learning and how some of the established methods can be applied to problems in AI.
6. are familiar with advanced AI applications of perception and robotics and how probabilistic inference and machine learning can be used in these settings.

In the course projects, students get some experience in programming and using search methods.

Contents:

intelligent agent types, uninformed search methods, informed (heuristic) search, local search, constraint satisfaction problems, adversarial search, uncertainty handling, probabilistic reasoning, utility, machine learning, decision networks, Markov decision process, reinforcement learning, applications

Mode of delivery:

The tuition is implemented as web-based teaching. Moodle environment is used in the course.
Due to Covid-19 pandemic, teaching in Spring 2021 will be implemented remotely. Course work space can be found from University of Oulu Moodle platform.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211, where details of implementation will be provided. The page will be available from December 21, 2020.
Online lectures will be given with Zoom and link for them will be provided in Moodle.

Learning activities and teaching methods:

Lectures 28 h / Group work (programming projects) 42 h / Self-study 65 h

Target group:

The primary target group is the students of the Computer Science and Engineering specializing in Artificial Intelligence.

Prerequisites and co-requisites:

Completion of the course "521160P Introduction to Artificial Intelligence" (lectured in Finnish) is recommended, but is not a prerequisite. It is also recommended that a student has completed studies related to probability and statistics (e.g. course "031021P Probability and Mathematical Statistics") and Python programming (e.g. course "521141P 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:

The course is based on the book Stuart Russell, Peter Norvig (2010, global edition 2016): Artificial Intelligence: A Modern Approach (3rd Edition), Chapters 1-6, 13-18, 20-21, partly 24-25.
The course utilizes materials of an introductory course on artificial intelligence taught at UC Berkeley (http://ai.berkeley.edu).

Assessment methods and criteria:

The assessment of the course is based on the final exam. Both the final exam and the course projects must be passed. Well-done course projects can increase the grade by one unit.

Grading:

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

Person responsible:

Pekka Sangi, Jaakko Suutala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi. Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211

521302A: Circuit Theory 1, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

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

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed
Read more about assessment criteria at the University of Oulu webpage..

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

Other information:

-

031076P: Differential Equations, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031076P	Differential Equations (OPEN UNI)	5.0 op
800320A	Differential equations	5.0 op
031017P	Differential Equations	4.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring, during period 4. It is recommended to complete the course at the 1th spring semester.

Learning outcomes:

The students can apply differential equations as a mathematical model. They can identify and solve various differential equations and they have knowledge on basic solvability of differential equations. The student can use the Laplace transform as a solution method.

Contents:

Ordinary differential equations of first and higher order.
Laplace transform with applications to differential equations.

Mode of delivery:

Online teaching, Stack/Moodle digital learning environment

Learning activities and teaching methods:

Lectures 28 h / Group work 22 h / Self-study 85 h.

Target group:

1. year students of engineering, mathematics and physics.

Prerequisites and co-requisites:

The recommended prerequisite is the completion of the course Calculus I.

Recommended optional programme components:

-

Recommended or required reading:

Recommended literature: Kreyszig, E: Advanced Engineering Mathematics;

Assessment methods and criteria:

The course can be completed by intermediate exams (2 exams) or by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

No

Supplementary Module: Biomedical Engineering, 15 ECTS cr

080925A: Anatomy and Physiology for Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

English

Timing:

Master studies, autumn term 1st period – THE COURSE WILL BE ORGANIZED NEXT TIME IN AUTUMN 2021

Learning outcomes:

-

Contents:

-

Mode of delivery:

-

Learning activities and teaching methods:

-

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

-

Grading:

-

Person responsible:

University lecturer Mikko Finnilä

Working life cooperation:

-

Other information:

THE DESCRIPTION WILL BE UPDATED FOR STUDY GUIDE 2021-2022

764327A: Virtual measurement environments, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Health Sciences
Arvostelu: 1 - 5, pass, fail
Opettajat: Jämsä, Timo Jaakko
Opintokohteen kielet: Finnish
Leikkaavuudet:

764627S	Virtual measurement environments	5.0 op

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

Finnish (or English)

Timing:

Bachelor studies, autumn term, 2nd period

Learning outcomes:

The student will learn how to construct software environments for measurements and data analysis important in biomedical engineering and physics

Contents:

The course gives basic skills to use measuring and analyzing programmes applied not only in academic research but also in R&D of the companies, and their programming environments (Matlab, LabView).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 12 h, project work 65 h, self-study 58 h

Target group:

Bachelor students of Medical and Wellness Technology and Physics. Also for other students of the University of Oulu.

Prerequisites and co-requisites:

Basics / basic skills in programming

Recommended optional programme components:

The course is independent entity and does not require additional studies carried out at the same time. The course can also be completed as a part of advanced studies with the course code 764327S.

Recommended or required reading:

Lecture and exercise notes, other given material

Assessment methods and criteria:

Completion of projects. Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5 or fail. In the numerical grading scale zero stands for a fail. Grading is made based on the projects.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

-

Other information:

-

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

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jämsä, Timo Jaakko

Opintokohteen kielet: Finnish

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

5 ECTS, 135 hours of work

Language of instruction:

Finnish

Timing:

Bachelor or Master studies, autumn term, 1st and 2nd periods

Learning outcomes:

The student can identify technologies in different fields of clinical medicine, can describe operating principles behind these technologies and evaluate the advantages and limitations of the technologies.

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Initial exam. Lectures, demonstrations, course assignment and self-study. Final exam which is based on lectures and all given materials.

Target group:

Students of medical and wellness technology, information technology, electrical engineering, mechanical engineering, industrial engineering and management, physics or of other related degree programmes interested in biomedical engineering and medical technologies.

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

T. Sora, P. Antikainen, M. Laisalmi, S. Vierula: Sairaanhoidon teknologia, WSOY 2002.
P. Pölönen, T. Ala-Kokko et al.: Akuuttihoidon laitteet, Duodecim 2013. Available as an e-print: http://www.terveysportti.fi/dtk/aho/koti
The material addressed during the lectures.

Assessment methods and criteria:

Initial exam with multiple-choice questions. Taking part in the lectures and demos. Learning assignment. Final exam, which includes essays. Before participation in the final exam, the student must complete and pass the initial exam and learning assignment.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5 or fail. Grading is based on the final exam.

Person responsible:

Professor Timo Jämsä

Working life cooperation:

The course will be mainly organized in the hospital, and lectures are given by clinical specialists.

Other information:

-

521242A: Introduction to Biomedical Engineering, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Myllylä

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Period 1

Learning outcomes:

After completing the course, the student has a basic knowledge of the biomedical engineering discipline and the applications of engineering science to biomedical problems.

Contents:

Biomedical engineering is a multidisciplinary field of study that ranges from theory to applications at the interface between engineering, medicine and biology. This course will introduce the subdisciplines within biomedical engineering, including such as systems physiology, bioinstrumentation, bioimaging, biophotonics and biomedical signal analysis. General issues of the subdisciplines will be presented together with selected examples and clinical applications. A number of lectures will be given by professionals working in health tech companies, University of Oulu and Oulu University Hospital, presenting different fields of the biomedical engineering. In addition, course offerings of biomedical engineering at the University of Oulu are introduced.

Mode of delivery:

Face-to-face teaching. Under some circumstances distance learning using online material is possible (please, ask the teacher).

Learning activities and teaching methods:

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

Target group:

-

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

-

Assessment methods and criteria:

Participation in lectures or using the online material and writing a work report.

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

Grading:

1 - 5, pass, fail

Person responsible:

Teemu Myllylä

Working life cooperation:

Guest lecturers

Other information:

-

080926A: Introduction to Biomedical Imaging Methods, 1 - 3 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Lassi Rieppo

Opintokohteen kielet: English

Proficiency level:

-

Status:

-

Required proficiency level:

-

ECTS Credits:

1-3 ECTS credit points / 27-81 hours of work

Language of instruction:

English

Timing:

Master studies, spring term 4th period

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 and Raman imaging spectroscopy.
Micro-computed tomography.
Basics of image analysis and interpretation

Mode of delivery:

Face-to-face teaching. Compulsory participation in lectures.

Learning activities and teaching methods:

Number of ECTS cr of the course and the methods of implementation vary. The course includes lectures 19h, demonstrations 8h and final exam 3 h. Number of hours left for independent study depends on the number of the ECTS cr the student wishes to complete and is from 8 to 51 hours.

Target group:

All Bachelor´s, Master´s and postgraduate students interested in methods of biomedical imaging.

Prerequisites and co-requisites:

-

Recommended optional programme components:

-

Recommended or required reading:

Handouts and literature given in the lectures

Assessment methods and criteria:

In this field, write with which method the teacher will monitor/
Participation in the lectures and demonstrations. Exam. The course can be completed with 1, 2 or 3 ECTS cr.
1 ECTS ¬# compulsory participation in lectures
2 ECTS ¬# compulsory participation in lectures and demonstrations
3 ECTS ¬# compulsory participation in lectures, demonstrations and final exam
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Dr Lassi Rieppo

Working life cooperation:

-

Other information:

-

Supplementary Module: Electrical Engineering (15 ECTS cr)

521302A: Circuit Theory 1, 5 op

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

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 4

Learning outcomes:

After the course the student can

1. write and solve the equations describing the operation of a given electrical circuit

2. solve the sinusoidal steady-state solution using complex phasor arithmetics

3. solve time responses of electric circuits

4. simplify electrical circuits e.g. using equivalent circuits

5. simulate simple circuits and choose an appropriate circuit simulation method

Contents:

Equation of basic circuit elements, circuit laws and systematic building of network equations. Calculation of time and frequency responses. Use of complex phasor arithmetics. Basics of the use of circuit simulators.

Mode of delivery:

Classroom.

Learning activities and teaching methods:

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

Target group:

Finnish BSc students.

Prerequisites and co-requisites:

Matrix algebra, complex arithmetics, differential equations.

Recommended optional programme components:

Background to all analog electronics cources.

Recommended or required reading:

Nilsson, Riedel: Electric Circuits (6th or 7th ed., Prentice-Hall 1996), Chapters 1-11.

Assessment methods and criteria:

Final exam. Also the simulation exercise must be passed
Read more about assessment criteria at the University of Oulu webpage..

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

Other information:

-

521330A: Telecommunication Engineering, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521357A	Telecommunication Engineering 1	3.0 op
521361A	Telecommunication Engineering II	3.0 op

ECTS Credits:

5 ECTS, equals 125 hours of student's work

Language of instruction:

Finnish. The course can be completed in other languages e.g. in English as a book examination of specified pages of course book specified pages of course book shown below.

Timing:

The course is lectured on period 4. Recommended for second study year.

Learning outcomes:

1. can tell and explain the essential blocks and their operation in time & frequency domains for frequently used analog and digital carrier and pulse modulation methods.
2. understands essential differences both between linear and non-linear modulations, and between coherenr and non-coherent modulations.
3. understands in which system applications each analog or digital modulation is typically used.
4. can tell limitations on system performance caused by noise interference and various transmission channels, and can propose methods to suppress interference both in analog and digital transmission.
5. can perform system analysis, and can calculate performances of analog and digital modulations based on simple assumptions regarding channel models.
6. can compare modulations from the standpoints of resource use (transmitted power and bandwidth needed) and implementation complexity.
7. understands the meanings of various equalizing, diversity and coding methods from the standpoint of improvement for digital transmission reliability.
8. understands various standards and specifications of new digital transmission systems.
9. can apply gained knowledge in working life to design of systems and their sub-system units, and can also perform computer simulations.
10. understands the principles of information theory, source coding and error-control coding, and masters various most commonly used coding methods.

Contents:

Essential and optional blocks of coherent and non-coherent analog and digital transmission systems and their operation principles. Linear (amplitude modulation) and non-linear (angle modulation) modulation principles, and differences in their performance and operation. Carrier and pulse modulation principles and their differences. The most important analog (DSB, AM, SSB, VSB, PM, FM, PAM, PWM, PPM) and digital (ASK/MASK, PSK/MPSK, FSK/MFSK, DPSK, QPSK/OQPSK, MSK/GMSK, QAM, MCM/OFDM, TCM, DM, PCM) carrier and pulse modulation methods and their performance analysis (SNR, BEP) and comparison based on the AWGN channel model. Influence of single-tone carrier radiofrequency interference (RFI) in the case of analog modulations. The threshold effect in the case of non-linear modulations and non-linear detectors. Mixing-principle and superheterodyne receiver. Phase-lock loop techniques, and FDM, TDM and QM-multiplexing methods. Matcher filter and correlation receiver principles. Basic characteristics and modelling of radio channels. Influence of band-limiting channel and multi-path propagation: inter-symbol interference (ISI) and fading, and their influence on system performance. Diversity, channel equalizing and MCM/OFDM methods for reducing channel interference. Spread-spectrum technique in brief, and benefits & limitations & applications of that principle. Cellular system idea. Basics of information theory, source coding and error-control coding methods.

Mode of delivery:

Distance learning teaching with Zoom lectures on spring 2021.

Learning activities and teaching methods:

Online teaching 52 h (Zoom). No separate times for class-exercises. Exercises have been integrated as part of face-to-face teaching event. Self-study 73 h. Total 125 h.
The lectures are keep as distance lectures by Zoomin and links to them will be distributed in March on the Moodle course page.

Target group:

Second year B.Sc.(Tech.) students both in electronics and telecommunication engineering (ECE) degree programme, and in some specialization options of computer science and engineering (CSE) degree programme.

Prerequisites and co-requisites:

031080A Signal analysis course.

Recommended optional programme components:

No connections to other courses.

Recommended or required reading:

Lecture slides in Finnish are stored into digital learning environment (Optima / Moodle). The course and lecture slides are based on the book: R.E. Ziemer & W.H. Tranter: Principles of Communications: Systems, Modulation and Noise, 7th edition, 2015, John Wiley & Sons, Partially chapters: Ch 1 (ss. 1-16), Ch 3 (112-151), Ch 4 (ss. 156-184, 194-209), Ch 5 (ss. 215-216, 225-239), Ch 8 (ss. 349-361, 370-380, 384-390), Ch 9 (ss. 396-468), Ch 10 (ss. 477-516, 528-532, 540-546, 553-557), Ch 12 (ss. 615-647, 657-664, 668-670, 679-683).

Assessment methods and criteria:

Course can be passed either with four mid-term exams, or with final exam. Course does not contain discrete exercise work. Candidate-level course 521329A Hands-on course in wireless communications is recommended to be taken on 3rd study year as a sequel for this course to practice modulation principles in real life using NI USRP-2900 software radio platform.
1st midterm exam Thursday, March 25, 2021 from 10:15 a.m to 12:00 p.m. The Moodle distance exam will appear in the spring of 2021 to the Moodle course page.
2nd midterm exam Thursday, April 8, 2021 from 10:15 a.m to 12:00 p.m. The Moodle distance exam will appear in the spring of 2021 to the Moodle course page.
3rd midterm Thursday, April 22, 2021 from 10:15 a.m to 12:00 p.m. The Moodle distance exam will appear in the spring of 2021 to the Moodle course page.
4th midterm exam Thursday, May 6, 2021 from 10:15 a.m to 12:00 p.m. The Moodle distance exam will appear in the spring of 2021 to the Moodle course page.
Final exam Thursday 20.5.2021 from 4:15 p.m. -7:15 p.m. Moodle distance exam will be published in the spring of 2021 to the Moodle course page.

Grading:

The course 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:

Kari Kärkkäinen

Working life cooperation:

No

Other information:

This course replaces the following candidate level courses: 521357A Telecommunication Engineering I (3 ECTS) and 521361A Telecommunication Engineering II (3 ECTS).

The course uses the Moole environment:
https://moodle.oulu.fi/course/view.php?id=691

521384A: Basics in Radio Engineering, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Aarno Pärssinen, Risto Vuohtoniemi
Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, 1st period

Learning outcomes:

1. can define what radio engineering is and list its separate areas and applications from FM-radio to 5G systems.

2. understands the meaning of Maxwell's equations and can solve the propagation of radio waves in a homogeneous medium.

3. can solve EM-fields at an interface of two lossless media.

4. knows main properties of most common transmission line types and can solve EM-fields for coaxial lines and rectangular waveguides.

5. can utilize the methods based on the Smith chart for the impedance matching of microwave circuits and antennas.

6. understands the meaning of Y-, Z-, and S-matrix and can use S-parameters for solving characteristics of microwave circuits.

7. can describe the operation of passive transmission line devices, resonators, filters and circuits based on the semiconductor devices.

8. knows the terms to describe antenna characteristics and can define radiation patterns of simple antennas and antenna arrays.

9. knows different propagation phenomena and can evaluate, which phenomena are relevant in different radio systems in different frequency bands.

10. can describe the structure of a typical radio system and can calculate the S/N-ratio link budget for a radio system on a free-space radio link.

Contents:

Introduction to radio waves and radio engineering. Maxwell’s equations. 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.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 26 h and exercises 16 h including graded exercise problems.

Target group:

3 rd year bachelor's degree students.

Prerequisites and co-requisites:

Elementary knowledge of the electromagnetic theory.

Recommended optional programme components:

-

Recommended or required reading:

In Finnish: Antti Räisänen & Arto Lehto: Radiotekniikan perusteet. Otatieto, 2011; also older versions of the book can be used as a course book.
Additional reading in Finnish: Jyrki Louhi & Arto Lehto: Radiotekniikan harjoituksia. Otatieto, 1995.
In English: Antti V. Räisänen & Arto Lehto: Radio Engineering for Wireless Communication and Sensor Applications, Artech House, 2003.
Additional literature in english: D.M. Pozar: Microwave Engineering, 4th edition, John Wiley & Sons, Inc., 2012.

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:

Risto Vuohtoniemi, Aarno Pärssinen.

Working life cooperation:

No

Other information:

-

521077P: Introduction to Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Hannu

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521077P	Introduction to Electronics (OPEN UNI)	5.0 op
521209A	Electronics Components and Materials	2.0 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the 1st period. It is recommended to complete the course at the 1st autumn semester.

Learning outcomes:

1. Student understands the block structures of electronic devices and their signal processing paths.

2. Student can identify the interfaces of analog and digital electronics and the software operations.

3. Student is able to identify and classify electronics components and compare their properties.

4. Students can describe electric conductivity and apply the phenomenon on designing and choosing resistors

5. Student is able to estimate the difference between dielectric materials and how they affect the properties of a capacitor.

6. Student can compare properties of magnetic materials and how identify they effect on inductive components.

7. Student can identify semiconductivity and is able to list typical semiconductor components.

8. Student can classify different circuit board techniques and is able to choose proper coupling techniques.

9. Student can identify the future technologies of electronics materials.

Contents:

Structures and interfaces of electronic devices. Electromagnetic properties of materials (conductivity, dielectricity, magnetism and semiconductivity).Electronics components (resistors, capacitors, inductive components and semiconductors). Interconnection technologies and circuit board technologies. The future of electronic materials and application areas.

Mode of delivery:

Face-to-face teaching and independent work.

Learning activities and teaching methods:

The implementation methods of the course vary. The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 48 hours of guided teaching events and 84.5 hours of teaching without guidance either privately or in a group.

Target group:

First year electrical engineering students.

Prerequisites and co-requisites:

No prerequisites.

Recommended optional programme components:

-

Recommended or required reading:

Lecture material; Materials science and engineering: an introduction / Willam D. Callister, chapters 1, 18 and 20; Electronic components and technology / S. J. Sangwine. Chapters 1,2,3,5 and 7

Assessment methods and criteria:

This course utilizes continuous assessment. During the course, there are two intermediate exams. In addition students will make course work which are graded. The assessment of the course is based on the learning outcomes of the course. Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Jari Hannu

Working life cooperation:

No

Other information:

-

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

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A Introduction to Broadband Transmission Techniques 4.0 op

ECTS Credits:

5 ECTS, equals 125 hours of student's work

Language of instruction:

Finnish

Timing:

The course is organized in the autumn semester during tehe 1st period. It is recommended to complete the course at the 3rd year autumn semester.

Learning outcomes:

After completing course a student

1. is acquainted with the principles of universal software radio peripheral (USRP) technologies and their implementation and understands the basic idea of software radio concept. That is obtained with the aid of small laboratory exercise work tasks which require understanding theories of basic analog and digital carrier modulation methods learned before this course.
2. understands the idea of complex-valued I&Q vecor-signals, which exist behind software radios and measurement techniques, and understands how such signals are linked to real-valued RF-signals.
3. has learned how to use universal software radio peripheral transceivers, and how to observe them in laboratory environment. Student also understands how to control these FGPA-based (field-programmable gate array) devices with the aid of control software platforms (e.g. Matlab-Simulink, LabVIEW, GNU Radio) and understands their limitations in real engineering work.
4. has implemented and tested various basic modulation methods both in radio channel and coaxial cable channel, and has made real observations and measurements in time-frequency domain using USRP control software.
5. has learned to find and deduct radio signal spectras and time waveforms with the aid of time-frequency analysis.
6. can test and model in laboratory environment during course and later in work life various problems and solutions dealing with wireless communication before construction of a prototype device.

Contents:

Students are introduced to the wireless communication systems and their phenomena with the aid of guided laboratory exercises. The course utilizes National Instruments USRP-2900 universal software radio peripheral tranceiver.

Mode of delivery:

Face-to-face contact teaching for theory lectures and guided laboratory exercises in a classroom. Self-studying at home between work themes of each week. Writing of exercise work report for each conducted work task.

Learning activities and teaching methods:

Course consist of small wireless communication tasks using various analog and digital carrier modulations. Total number of exercise works is 8. The course utilizes mainly National Instruments USRP-2900 universal software radio peripheral tranceiver which is controlled via laptop computer's USB connection. Transmission and receiving of I&Q signals are controlled with Matlab. Students are required to have competent laptop with Matlab-Simulink campus licence. Students have to participate in short briefing lectures. Exercise works are done by a group of 2 students. Results are summarized in a written report for each task according to given instructions. Students have to return report two weeks after each work session.

Course contains 14 hours lectures for work instructions and 32 hours of measurement work. In addition, students perform 79 hours of self-study and reporting at home. Total 125 hours.

Target group:

Third year bachelor level students in electronics and communications engineering degree programme.

Prerequisites and co-requisites:

031080A Signal analysis and 521330A Telecommunication engineering

Recommended optional programme components:

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

Recommended or required reading:

No course book. Lecture slides, and problem assignments together with work instruction are given during the course. Materials will be placed into Moodle environment. In addition, some NI USRP-2900 related material will be placed into Moodle.

Assessment methods and criteria:

All students of a group have to participate in introductory face-to-face teaching and briefing lecture, and will prepare a final report according teacher's instructions. Before student's mandatory absence, a student has to negotiate that with a teacher. Participation in all introductory lectures and laboratory exercises is mandatory for all members of a group. Presence of each student is monitored by a teacher. In addition, final report has to be in form required by a course teacher, and the content has to be satisfying from acceptance standpoint. Course does not contain final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

Course grading is done with the numbers 0…5. Grade 0 is interpreted as failed. Student group has to get acceptable number of points for each task. Final grade is based on the total number of points from each sub-work theme using standard rounding techniques.

Person responsible:

Kari Kärkkäinen

Working life cooperation:

No

Other information:

-

521210A: Electronics Materials, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521303A: Circuit Theory 2, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521306A	Circuit Theory 2	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, period 2

Learning outcomes:

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

Contents:

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

Mode of delivery:

Classroom

Learning activities and teaching methods:

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

Target group:

Finnish BSc students

Prerequisites and co-requisites:

Basics of circuit theory, differential equations.

Recommended optional programme components:

Continuation for Circuit theory 1. Needed in most analog electronics courses.

Recommended or required reading:

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

Assessment methods and criteria:

Final exam. Also the 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:

-

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

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

Timing:

Autumn, period 2

Learning outcomes:

1. knows the common architectures of synchronous digital logic circuits, and the building blocks they consist of, and can design digital circuits that realize complex data and signal processing functions.
2. knows most common combinational and sequential logic based buildning blocks, and can use them to design and realize complex digital circuits.
3. knows digital logic design methods, such as use of hardware description languages, functional verification using simulation, realization of logic with a logic synthesis program, and functional and timing verification of gate-level models.

Contents:

1. Logical and physical properties of digital logic components. 2. Representation of digital designs. 3. Combination logic design. 4. Sequential logic design. 5. Digital artithmetics. 6. Semiconductor memories. 7. Register transfer level architecture design. 8. Register transfer level modeling and synthesis. 9. Timing design. 10. Digital interface design. 11. Design verification

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 24h/ exercises 30h (group work)/independent work 84h.

Target group:

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

Prerequisites and co-requisites:

Digital techniques 1

Recommended optional programme components:

No

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Lahti

Working life cooperation:

No

Other information:

-

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Nissinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 3

Learning outcomes:

1. should be able to analyze and design such electronic building blocks as rectifiers, clamping circuits, amplifiers and CMOS logic elements using diodes, operational amplifiers and MOS and bipolar junction transistors.

Contents:

Analogue and digital circuits, basic amplifier related concepts, 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, operational amplifier.

Mode of delivery:

Remote teaching.

Learning activities and teaching methods:

Lectures 30 h and exercises 20 h. Link to Moodle https://moodle.oulu.fi/course/view.php?id=5894.

Target group:

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

Prerequisites and co-requisites:

Circuit Theory I

Recommended optional programme components:

Recommended course Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes and Behzad Razavi, “Microelectronics”, 2nd Edition, ISBN 9781-118-16506-5
John Wiley & Sons 2015

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:

Respon responsible: Ilkka Nissinen
Lecturer: Juha Häkkinen
Assistant: Tuomo Talala

Working life cooperation:

-

521071A: Principles of Semiconductor Devices, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Hagberg, Jani Peräntie

Opintokohteen kielet: Finnish

Leikkaavuudet:

521205A	Principles of Semiconductor Devices	4.5 op

ECTS Credits:

5 ECTS credits / 132,5 hours of work

Language of instruction:

Finnish

Timing:

Spring semester period 3

Learning outcomes:

1. will be able to explain physical phenomena in semiconductor materials and junctions; describe main types and characteristics of semiconductor diodes and transistors
2. will be able to explain physical principles of operation and to estimate ideal characteristics of the devices

Contents:

Junctions. Semiconductor diodes and lasers. Bipolar junction transistors. Field effect transistors. Switching devices.

Mode of delivery:

Will be notified in the beginning of lectures.

Learning activities and teaching methods:

Spring term 2021, distance learning, Moodle and Zoom used.
Moodle link will be send for students registered the course. First lecture 11.1.2021 at 14:15-16:00

Target group:

Second year electrical engineering students

Prerequisites and co-requisites:

521104P Introduction to materials physics.

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes (in Finnish). Book: Streetman, B.: Solid state electronic devices, Prentice-Hall, New Jersey, 2000 (chapters 5 - 8, 11).

Assessment methods and criteria:

Will be notified in the beginning of lectures.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Juha Hagberg

Working life cooperation:

No.

Other information:

-

521432A: Electronics Design I, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Nissinen

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish.

Timing:

Spring, period 4.

Learning outcomes:

1. should be able to recount the principles covering the design of multistage amplifiers

2. should be able to analyze and set the frequency response of a transistor amplifier

3. should be able to make use of feedback to improve the properties of an amplifier in the desired manner

4. should be able to analyze the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability

5. should be able to describe the principles governing the design of power amplifiers

6. should be able to make widespread use of operational amplifiers for realizing electronic circuits and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers

7. should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and tuned amplifiers

Contents:

Frequency response of a transistor amplifier, differential amplifier, feedback, power amplifiers, oscillators and tuned amplifiers, non-idealities of an operational amplifier, applications of operational amplifiers.

Mode of delivery:

Remote teaching.

Learning activities and teaching methods:

Link to Moodle will be given later. Lectures 30 h and exercises 20 h.

Target group:

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

Prerequisites and co-requisites:

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, book: Behzad Razavi, “Microelectronics”, 2nd Edition, ISBN 9781-118-16506-5
John Wiley & Sons 2015

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:

Ilkka Nissinen

Working life cooperation:

-

Other information:

-

521304A: Filters, 5 op

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

521331A	Filters	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 3

Learning outcomes:

After the course the student can:
1. draw a pole-zero map for a given transfer function;
2. perform impedance and frequency scaling for component values;
3. choose an appropriate prototype filter and filter degree;
4. synthesize passive RLC filters;
5. synthesize active opamp based filters;
6. can compare various filter technologies;
7. understands the basics of scaling the dynamic range of active filters

Contents:

Filter types and prototypes, component scaling. Synthesis of active and passive filters. Sensitivity analysis and scaling of the dynamic range.

Mode of delivery:

Lectures, excercise and design excercise

Learning activities and teaching methods:

30 h lectures, 16 h exercises. A design excercise.

Target group:

Finnish electrical engineering students

Prerequisites and co-requisites:

Basics of circuit theory, Bode plots and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

van Valkenburg: Analog Filter Design, 1982, chapters1-14, 18 ja 20 ; or year 2001 edition chapters 1-13.

Assessment methods and criteria:

Circuit is examined by a final exam. Also the obligatory design exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

Other information:

-

521092A: Electronic Measurement Techniques, 5 op

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

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

ECTS Credits:

5 ECTS credits / 132 h

Language of instruction:

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

Timing:

Period 4 academic year 20-21 and 21-22. Period I from academic year 22-23 forward.

Learning outcomes:

1. remembers the electrical measurement technique terminology associated to measurement systems, sensors and buses.
2. can name most important analog signal conditioning structures
3. can plan and implement basic measurements with electrical thermometers
4. can plan and implement basic measurements with optical meters
5. can name common sources of noise and interference and means to control them
6. can name methods to realize electrical quantities

Contents:

Broad view to electronic measurements.

Mode of delivery:

Pure face-to-face teaching.

Learning activities and teaching methods:

Lectures 28h and self-study 100h.

Target group:

Course is compulsory for electrical engineering students. Course is open for all students in University of Oulu.

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 Moodle.

Assessment methods and criteria:

The course is passed with a final exam.

Grading:

Numerical grading scale 1-5.

Person responsible:

Christian Schuss

Working life cooperation:

None.

Other information:

-

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

810136P: Introduction to Information Processing Sciences, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Henrik Hedberg

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st autumn semester of the Bachelor's studies. Another implementation, targeted especially for Open University and minor students, is held in the spring semester, during period 4.

Learning outcomes:

After passing the course, a student will be able to:
* describe the disciplines of Information Processing Science,
* explain the essential Information Processing Science concepts,
* name historically significant and current research topics in Information Processing Science,
* identify the characteristics and requirements of work tasks in the field of Information Processing,
* describe the principles of responsible conduct of research and professional ethics in Information Processing Science,
* retrieve, analyse, contest and classify information related to those, as well as
* discuss and report in written form on those using one reference convention of the scientific discipline.

Contents:

The course consists of lectures on disciplines, essential concepts, historically significant and current research, practical work life as well as responsible conduct of research and professional ethics in Information Processing Science. In addition, the student will familiarize with scientific work skills by listening, discussing, reading, thinking critically and creatively, retrieving data, classifying and presenting in written form.

Mode of delivery:

Distance or blended teaching

Learning activities and teaching methods:

Distance and potentially blended studies 133 h

Target group:

BSc students

Recommended optional programme components:

Recommended or required reading:

Digital study material, material searched by students themselves.

Assessment methods and criteria:

Exercise tasks.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Henrik Hedberg

Working life cooperation:

Cooperation with persons studied Information Processing Science and currently working.

811168P: Information Security, 5 op

Voimassaolo: 01.08.2010 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tero Päivärinta

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811168P	Information Security (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st spring semester of the Bachelor's studies.

Learning outcomes:

After completing the course, the student will be able able to:
* define essential information security concepts and components of information systems security,
* recognize the common types of security threats, and their managerial and technical protection mechanisms,
* describe the tasks and responsibilities of information security professionals,
* explain the different phases of secure systems development/acquisition,
* recognize the fundamental characteristics of risk management and evaluate information security risks,
* recognize basics of technical information security methods and cryptography, as well as
* explain areas of behavioral information security research and their practical implications.

Contents:

* Basic concepts of information security
* Information security threats, vulnerabilities, and risks
* Legal issues and information security frameworks
* Risk management
* Cryptography
* Information security technologies
* Behavioral information security research

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Lectures and related quizzes or final exam 26 h, weekly assignments and scientific essay 107 h

Target group:

BSc students.

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses are accomplished: Introduction to Information Processing Science as well as Devices and Data Network

Recommended optional programme components:

Recommended or required reading:

Lecture materials, selected articles, and book: Whitman & Mattord (2015). Principles of information security.

Assessment methods and criteria:

Weekly assignments. Group or individual assignment.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Tero Päivärinta

811174P: Introduction to Software Business, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

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 / 133 hours of work.

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 1st spring semester of the Bachelor's studies.

Learning outcomes:

After completing the course, a student will be able to:
* 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; as well as
* describe legal issues related to 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.

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Blended teaching 100 h, home essay 30 h

Target group:

BSc students.

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses are accomplished: Introduction to Information Processing Science

Recommended optional programme components:

-

Recommended or required reading:

Course material and related literature.

Assessment methods and criteria:

Assignments, take home examination.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Marianne Kinnula

811325A: Databases, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

811395A	Basics of Databases	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 2nd year autumn semester of the Bachelor's studies.

Learning outcomes:

After completing the course, the student will be able to:
* apply the theory of the relational databases and the basics of the set theory,
* build a good quality relational database and use queries,
* use a relational database for storing persistent objects,
* use conceptual modelling for designing databases, as well as
* normalise a database and assess its quality.

Contents:

* Conceptual modelling
* Relational model and database
* SQL
* Quality of database
* Storing objects to the relational database

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Lectures 24 h, exercises 16 h, computer exercises 25 h, self-study 68 h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Programming 2.

Recommended or required reading:

Coronel C & Morris S (2018), Database systems : design, implementation, and management, Australia: Cengage Learning

Assessment methods and criteria:

Continuous evaluation. The course will be divided to parts. Every part will be evaluated and all parts must pass.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Juha Iisakka

811322A: Programming 2, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Päivi Raulamo-Jurvanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811322A	Programming 2 (OPEN UNI)	5.0 op
812341A	Object-Oriented Programming	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course at the 1st spring semester of the Bachelor's studies.

Learning outcomes:

After completion of this course, the student will be able to:
* describe the principles of object paradigm (encapsulation, polymorphism, inheritance, composition), generics, and design patterns and is able to utilise these concepts when creating software,
* describe exception and error management and create fault tolerant programs,
* explain the connection between the UML models and the source code,
* test an application and interpret the structure and functionality of the source code, as well as
* use basic programming tools, such as a version control system, an IDE, and code analysis tools.

Contents:

The concept of an object, encapsulation, composition, inheritance, polymorphism, exceptions, UML charts and code, generics (templates), libraries, containers, design patterns, development tools, version control, documenting, unit testing.

Mode of delivery:

Face-to-face teaching, can also be implemented as blended teaching

Learning activities and teaching methods:

Lectures 32 h and laboratory exercises 24 h (or an equivalent amount of independent learning) plus weekly assignments and independent work 72 h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses are accomplished: Programming 1

Recommended or required reading:

Timothy Budd: Introduction to object-oriented programming, 3rd edition, and other material announced in the beginning of the course.

Assessment methods and criteria:

The weekly assignments (preferred) or a final exam in Examinarium + a programming assignment.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Päivi Raulamo-Jurvanen

811367A: Programming 3, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Kelanti

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 2nd spring semester of the Bachelor's studies.

Learning outcomes:

After completion of this course, the student will be able to:
* recognise the influence and requirements of the interface specification on the server development and is able to apply them in his/her own work.
* implement and document a good quality database and use it in an application.
* iImplement and document the server functionality of a client-server application and apply concurrency when appropriate.
* use existing programming interfaces and message passing protocols in a server application
* test a server application and interpret code written by someone else.
* use programming tools, such as a version control system, an IDE, and code analysis tools in the server development.

Contents:

Databases, database programming, data formats, the design, implementation, and testing of a server interface, the safety and security of a server, concurrency.

Mode of delivery:

Face-to-face teaching, may also be implemented as blended teaching

Learning activities and teaching methods:

Lectures 32 h and laboratory exercises 24 h (or an equivalent amount of independent learning) plus weekly assignments and independent work 72 h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses are accomplished: Data Structures and Algorithms

Recommended or required reading:

Announced in the beginning of the course.

Assessment methods and criteria:

Programming assignments and coursework defined during the course.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Markus Kelanti

811368A: Programming 4, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lappalainen, Jouni Esko Antero

Opintokohteen kielet: Finnish

Leikkaavuudet:

811375A	User Interface Programming	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course at the 2nd spring semester of the Bachelor's studies.

Learning outcomes:

After completion of this course, the student will be able to:
* recognise the influence and requirements of the design/implementation interface on the user interface development process and is able to apply them in his/her own work,
* utilize UI libraries and frameworks in his/her application,
* implement and document the client functionality of a client-server application,
* test the application and test and interpret the code and the application structure with its effects to testing, maintenance and further development,
* use programming tools, such as a version control system, an IDE, and code analysis tools, as well as
* act as a member of a software development team.

Contents:

User interface elements, foundations of user interface libraries, user interface design principles, user interface layout, the relationship between user interfaces and software architectures, web usability, web user interfaces, web programming.

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Exercise 24h, coursework 75h, independent study 35h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses are accomplished: Programming 3

Recommended or required reading:

Provided reading material during the course. 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 with the student during the course), as well as answers to given study questions.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Jouni Lappalainen

811391A: Requirements Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Markus Kelanti

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811391A	Requirements Engineering (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

Finnish

Timing:

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

Learning outcomes:

After completing the course, the student will be able to:
* apply requirements engineering skills and techniques individually and in teams, and understands the requirements fundamentals,
* choose and apply some of the requirements elicitation techniques,
* choose and apply some of requirements specification and documentation techniques, as well as
* apply appropriate requirements validation techniques, as well as learn new requirements engineering methods and techniques.

Contents:

* Requirements traceability
* Different stakeholder viewpoints and requirement categories
* Requirements change
* Problem structuring methods
* Requirements engineering skills and techniques in iterative development environment
* Requirements identification, elicitation, specification and documentation techniques
* Requirements prioritization and validation techniques

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Lectures and exercises 32h; independent work, group project and individual work 101h. Alternatively, independend study and book exam 133h.

Target group:

B.Sc. students.

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Introduction to Software Engineering

Recommended optional programme components:

Recommended or required reading:

Wiegers, Karl & Beatty, Joy (2013). Software Requirements, 3rd Edition.

Assessment methods and criteria:

Active participation (lectures, weekly assignments, group project and individual project), or alternatively book exam

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Markus Kelanti

Working life cooperation:

Guest lectures

811306A: Software Quality and Testing, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Mäntylä

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course at the 2nd autumn semester of the Bachelor's studies.

Learning outcomes:

After passing the course, the student will be able to:
* describe of different views on software quality and the role of testing in software engineering,
* detect defects in software using different techniques,
* describe testing levels, and techniques,
* create test cases and conduct unit testing with appropriate testing tools,
* describe the basics of test-driven development and test automation, as well as
* define the scope of software testing and quality assurance projects.

Contents:

1. Why Testing and Software quality are important
2. Testing as a process
3. Testing as a technique
4. Designing tests (using testing techniques and domain knowledge)
5. Oracles and Coverage
6. Unit testing and TDD

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Independent work, Group exercise sessions, Lectures, Project Based Learning, Visiting Lectures from Industry

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses are accomplished: Software Modeling and Design

Assessment methods and criteria:

Lab Exercises, Quiz, Final exam, Student project

Grading:

Numerical scale 1-5 or fail

Person responsible:

Mika Mäntylä

Working life cooperation:

Guest lectures when available

811319A: Data Modeling and Design, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 2nd spring semester of the Bachelor's studies.

Learning outcomes:

After completing the course, the student will be able to:
• compare traditional relational database to modern distributed databases, as well consider the influence of CAP-theorem to distributed databases,
• identify features affecting the quality of non relational databases and choose appropriate implementation of non relational database for use,
• explain data persistency concepts and can apply database transaction management principles while using databse systems, as well as
• describe (typical) contemporary database solutions and their role in large-scale software systems (such as ERP).

Contents:

Modern database solutions and the use of them as well transactions, concurrency and recovery.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 4 h, Exercises 12 h, Study groups 8 h (+preparation 32 h), online assignments 36 h, litterature reviews 40 h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Software Quality and Testing, Databases

Recommended or required reading:

Will be anounced in the course. Scientific articles.

Assessment methods and criteria:

Continuous evaluation.
Study groups, online assignments, litterature reviews

Grading:

Numerical scale 1-5 or fail

Person responsible:

Juha Iisakka

815345A: Software Architectures, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pertti Seppänen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course at the 2nd spring semester of the Bachelor's studies.

Learning outcomes:

After passing the course, the student is able to:
* describe the concepts and techniques of the software architecture design – especially in case of object-oriented design,
* describe typical architecture solutions of main-stream modern software solutions – for instance apps of smart devices and server-based systems,
* identify and analyze the pros and cons of different software architectures from the viewpoints of software design & implementation, software execution, software quality and software maintainability,
* use UML modeling techniques to describe different perspectives of a software architecture,
* create different optional architectural solutions for a software based on its functional and non-functional requirements and evaluate the applicability of the optional architectures to the problem in question, as well as
* describe the role of architectural design in agile and iterative software development processes.

Contents:

The fundamentals of software architectures. Documenting software architectures. Components and interfaces, Software dependencies. Design patterns. Architectural styles. Evaluation methods of software architectures. Agile and iterative software development processes and software archteture desing.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 20 h, exercise work as group work 90 h.

Target group:

BSc students.

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Data Modeling and Design

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 Third Edition. Addison-Wesley 2013; Agile Software Architecture 1st Edition Aligning Agile Processes and Software Architectures (2013) to an applicable extend.

Assessment methods and criteria:

The course is passed by participating in the course assignments as well as by evaluation of the exercise work.

Grading:

Numerical scale 1-5 or fail.

Person responsible:

Pertti Seppänen

Working life cooperation:

Guest lectures

811166P: Fundamentals to Information Systems, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karppinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay811166P	Fundamentals to Information Systems (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 1st year autumn semester of the Bachelor's studies.

Learning outcomes:

After completing the course, the student will be able to:
* use basic concepts of information systems,
* recognize challenges regarding the use of information systems and users,
* describe the basics of organisation, e.g. its structure and function,
* recognize different types of information systems and their roles in an organisation,
* describe how organizational knowledge is formed and recognizes challenges of managing it,
* recognize ethical and social challenges related to information systems,
* describe the role of information systems in leadership and decision making,
* recognize the possibilities of information systems renewal and financial impact of it, as well as
* describe the basics of the history of information systems discipline, its research methods and scientific journals.

Contents:

* Basic terms and concepts of information systems.
* Challenges regarding the use of information systems and its users.
* Basics of organisation.
* Types of information systems and their roles in an organisation.
* How knowledge is formed in organizations.
* Ethical and social challenges related to information systems.
* Information systems in decision making process.
* Possibilities of information systems renewal and financial impact of it.
* The history of information systems discipline, its research methods and scientific journals.

Mode of delivery:

Online teaching
Covid-19 pandemian vuoksi opetus on kokonaan etäopetuksena syksyllä 2020./ Due to Covid-19 pandemic, teaching in Autumn 2020 will be implemented remotely. Details of arrangement can be found from the course web page, which will be available in Moodle. https://moodle.oulu.fi/course/view.php?id=4498(opens before the start of the course)

Learning activities and teaching methods:

Familiarizing lecture material, independent study of the course literature, weekly tasks and scientific essay. Total 133h.

Target group:

BSc students

Recommended or required reading:

Lecture materials and Laudon, K. C. (2018). Management information systems: Managing the digital firm (Fifteenth
edition, global edition.). Harlow, England: Pearson.
Management Information Systems: Managing the Digital Firm, Global Edition
Kenneth C. Laudon; Jane P. Laudon
Pearson International Content
2020

Assessment methods and criteria:

Active participation in lectures or online environment. Weekly tasks and scientific essay.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Liisa Kuonanoja

Working life cooperation:

Possibly visiting lecturers from companies and other organizations

812360A: Information Systems Modelling, Desing and Development, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mikko Rajanen

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay812360A	Information Systems Modelling, Desing and Development (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course in the 1st year spring semester of the Bachelor's studies.

Learning outcomes:

After completing the course, the student will be able to:
* describe the basics of modelling,
* describe the importance of modelling when designing information systems,
* use different kinds of modelling types to represent and design information systems from different points of view,
* use modelling in definition phase of information system design,
* recognize and model stakeholder groups for information system design,
* recognize and model use cases for information system design,
* use modelling in the final parts of the information system design,
* describe the connections between design, modelling and implementation,
* use prototyping and modelling as communication method towards stakeholders, as part of requirement specification and as part of evaluating design concepts, as well as
* recognizes the ethical issues in information system desing and the designer responsibility.

Contents:

* Basics of modelling
* Importance of modelling when designing information systems
* Modelling types to represent and design informationsystems from different points of view
* Modelling in definition phase of information system design
* Modelling stakeholder groupsfor information system design
* Modelling use cases for information system design
* Modelling in the final parts of the informationsystem design
* Connections between design, modelling and implementation
* Prototyping and modelling as communication method towards stakeholders, as part of requirement specification and as part of evaluating design concepts
* Ethical issues in information system desing and the designer responsibility.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 27 h, exercises 21 h, assignment 85 h, tasks 3 h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Fundamentals of Information Systems.

Recommended or required reading:

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

Assessment methods and criteria:

Group assignment which is done and presented in exercises. Tasks that replace exam.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Mikko Rajanen

Working life cooperation:

Possibly visiting lecturers from companies and other organizations

812361A: Information Systems Acquisition, Deployment and Management, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pasi Karppinen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd year spring semester of the Bachelor's studies. The course is not implemented in Academic year 2020-2021.

Learning outcomes:

After completing the course, the student will be able to:
* describe the basics of the procurement process,
* recognize procurement process in the public sector,
* describe how to manage information systems acquisition in an organisation,
* create procurement policies for an organisation,
* create plans and processes to manage information systems' risks,
* understand how important it is to prepare for information system recovery, and how to ensure vital processes in an organisation in a crisis situation. as well as
* create policies how to monitor and control information systems.

Contents:

* Procurement process
* Procurement process in the public sector
* Information systems acquisition in an organisation
* Creating procurement policies for an organisation. Plans and processes to manage information systems' risks
* Information system recovery, and how to ensure vital processes in an organisation in a crisis situation
* Creation of policies how to monitor and control information systems

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Independent study of the course literature, learning diary and scientific essay 133 h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Human-Centred Design.

Recommended or required reading:

Selected scientific articles and lecture material

Assessment methods and criteria:

Active participation in lectures. Weekly tasks and scientific essay.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Pasi Karppinen

Working life cooperation:

Possibly visiting lecturers from companies and other organizations

812362A: Business Process Management and Modelling, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Karin Väyrynen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 2nd spring semester of the Bachelor's studies. The course is not implemented in Academic year 2020-2021.

Learning outcomes:

After completing the course, the student will be able to:
* describe the phases and challenges related to the management and modelling of business processes,
* describe how business process are related to teach other,
* make use of different frameworks related to IT process planning,
* identify process-related problems,
* make use of KPI (key performance indicator) thinking when managing and modelling business processes,
* model simple business process on a company-level and process-level, and
* identify most common mistakes related to process modelling.

Contents:

Stages of business process management. Aligning business processes with company strategy. Syntax for modellng business processes. Business process modelling tools. Frameworks to support business process management and planning. Business process KPI.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 26 h (or exam), exercises 13 h, individual assignments 34 h, team assignment 60 h.

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Information Systems Acquisition, Deployment and Management.

Recommended or required reading:

Lecture material, exercise material and other material and literature announced in the course.

Assessment methods and criteria:

Active lecture participation (or exam), exercises, individual and team assignments

Grading:

Numerical scale 1-5 or fail

Person responsible:

Karin Väyrynen

812363A: Human-Centred Design, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 2nd autumn semester of the Bachelor's studies. The course is not implemented in Academic year 2020-2021.

Learning outcomes:

After completing the course, the student will be able to:
* describe the principles and central concepts of human-centered design,
* identify the basic phases and central analysis, design and evaluation methods of human-centered design,
* apply the method in user interface design from the perspective of specific user group and system,
* describe the significance and design of user support,
* descibe the significance of usability, accessibility and universal design, as well as
* identify variety involved in human-centered design

Contents:

The principles and central concepts of human-centered design,the basic phases and central analysis, design and evaluation methods of human-centered design, user support, usability, accessibility, universal design, variety involved in human-centered design

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures, exercises, groupwork, individual assignments, seminar

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Information Systems Modelling, Design and Development.

Recommended or required reading:

Dix et al. (2003, third or later edition) Human-Computer Interaction, Benyon (2014) Designing Interactive Systems, and lecture and assignment materials.

Assessment methods and criteria:

During the course, the students will be carrying out a groupwork assignments and individual tasks. These will be assessed based on the learning outcomes of the course. The assessment criteria and the requirements will be explained in detail during the opening lecture of the course.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Netta Iivari

Working life cooperation:

Guest lectures

812364A: Data Analytics and Business Intelligence, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period 4. It is recommended to complete the course at the 3rd spring semester of the Bachelor's studies. The course is not implemented in Academic year 2020-2021

Learning outcomes:

After completing the course, the student will be able to:
* explain key data and information concepts and the data and information management lifecycle,
* capture and structure data and information requirements using appropriate conceptual modeling technques,
* develop a logical level represenation of data based on a conceptual model, as well as
* identify the significance of data analytics in business.

Contents:

* Key data and information concepts
* Data and information management lifecycle
* Capturing and structuring data and information requirements
* Conceptual modeling techniques

Mode of delivery:

face-to-face teaching

Learning activities and teaching methods:

Lectures 20 h, independent study of the course literature, weekly tasks and scientific essay 110 h

Target group:

BSc students

Prerequisites and co-requisites:

The required prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Business Process Management and Modelling.

Recommended or required reading:

Scientific articles given during the course and other lecture material

Assessment methods and criteria:

Active participation in lectures. Weekly tasks. Scientific essay.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Nataliya Shevchuk

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: Elina Jääskä

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

ECTS Credits:

5 ECTS credits.

Language of instruction:

Finnish. English material is also used.

Timing:

Period 1.

Learning outcomes:

Upon completion of the course, the student will be able to:

- describe what industrial engineering and management (or operations management) means
- explain the core concepts of business operations and utilise these concepts in describing and analysing operations of an organisation
- explain in general terms the factors that affect economic performance of organisations
- utilise the terminology used in industrial engineering and management (operations management), describe the financial processes of companies and based on this describe the use of cost accounting in organisational decision-making
- 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, accounting and cost accounting, investments and financial planning, 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:

Web-based teaching 20 hours / practices 14 hours / Independent studying 100 hours.

Learning activities and teaching methods:

Web-based lectures 20 h / exercises 14 h / self-study 100 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. In addition, recommended materials include Martinsuo, M. et al. (2016) Teollisuustalous kehittyvässä liiketoiminnassa chapters 7-9, 16 and 26.

Assessment methods and criteria:

This course utilises continuous assessment. During the course, there are seven mandatory weekly assignments.

Grading:

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

Person responsible:

MSc (Tech.) Elina Jääskä

Working life cooperation:

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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

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. Check the course in English 555288A Project Management.

Timing:

Period 2.

Learning outcomes:

Upon completion of the course, the student will be able to:

- describe explain the essential concepts and methods related to project management
- apply project management methods to create a schedule for a project and calculate critical path
- understand essential concepts related to project cost management and able to apply earned value method and three point estimate to manage project costs
- recognises the essential tasks of project risk management

Contents:

Defining project management, project goals and objectives, project phases and project life-cycle management, project planning, organising and scope management, schedule management, cost management, earned value calculation and project risk management, project stakeholder management, project communications management, the role of project manager, new modes of project delivery

Mode of delivery:

The tuition will be implemented as web-based teaching.

Learning activities and teaching methods:

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 includes555225P 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, Artto, Martinsuo & Kujala 2006. Projektiliiketoiminta. WSOY

Assessment methods and criteria:

Weekly assignments and final online exam

Grading:

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

Person responsible:

Assistant professor Kirsi Aaltonen

Working life cooperation:

Videos from the industry's projects

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:

Periods 1-2.

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, the student will be able to

- explain the role of product development as a company function

- understand the difference between innovation activities and systematic product development, and knows the difference between different phases of product development process and its activities
- transform customer needs into requirements for product development process and finally into product features
- 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 face-to-face 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 supply chain management (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:

Exam and group work.

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 of the course, the student will be able to:

- explain the role of process and quality management in a business organisation
- develop business processes based on the principles of quality management and appropriate tool

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

Target group:

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

Prerequisites and co-requisites:

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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 weekly course exercises (50 % of the course grade) and an exam (50 %).

Grading:

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

Person responsible:

University lecturer 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

Opettajat: Arto Reiman

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. English material is also used.

Timing:

Periods 3-4.

Learning outcomes:

Upon completion of the course, the student will be able to:

- set targets and choose appropriate methods of developing well-being at work both at personal and organizational levels
- develop well-being at work in the contexts of labor legislation, good practices, productivity, occupational safety expertise, management and human resources
- know the key sources of information, typical goal-setting and management practices and the methods for assessing the performance at individual and organizational levels
- assess the economic impacts of well-being at work, especially in cases of work ability, occupational health, job satisfaction, occupational safety, productivity and the overall quality of working life
- know essential national and international regulation and strategic goal setting practices, good practices of the case companies, current trends, and methods in research.

Contents:

The course gives the student a vision of building sustainable, productive and satisfactory career. 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 10 h / self-study 70 h / group work & exercises 42 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:

Applicable parts of Arnold, J. et al. (2010), Work Psychology; Understanding Human Behaviour in the Workplace. 5th Edition. Financial Times/Prentice Hall and Aura, O. & Ahonen, G. Strate-gisen hyvinvoinnin johtaminen, Alma Talent. Other literature will be informed during the course.

Assessment methods and criteria:

This course utilises continuous assessment including exercises during the lectures (weight 20 %), group work (weight 40 %) and examination (weight 40 %).

Grading:

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

Person responsible:

Dr. Arto Reiman

Working life cooperation:

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Other information:

Substitutes courses 555261A Basic Course in Occupational Psychology + 555262A Usability and Safety in Product Development.

Working life & Entrepreneurship , 15 ECTS cr

724814P: Introduction to Business Development, 5 op

Voimassaolo: 01.08.2017 - 31.07.2021

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Antti Muhos

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

Period 1

Learning outcomes:

Students are familiar with basic business concepts and theories in SME context. On successful completion of the course, students understand the business development process from opportunity recognition to a launch and development of a sustainable business. The students are able to identify basic business processes in practice.

Contents:

The course focuses on the basic concepts of SME business management and development including opportunity recognition, experimentation and testing of a new business idea, strategy, business model development and business planning, financing and planning and management of growth and change.

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Face-to-face teaching including lectures, guest lectures, company visit/s and variable action-based learning methods (36h). Individual assignment (20h) and reading of course materials (76 h).

Target group:

Open to all university students

Prerequisites and co-requisites:

No

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:

Selected readings from e.g.: Spinelli & Adams. 2012, 2016. New Venture Creation: Entrepreneurship for the 21st Century. McGraw-Hill, New York. Allen, K. 2012. New venture creation. South-Western. Moreover, additional materials are provided during the course.

Assessment methods and criteria:

Learning diary, group assignment/s

Grading:

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

Person responsible:

Matti Muhos

Working life cooperation:

This course is designed as an integral part of entrepreneurship studies. This course will include real life case studies of established and emerging businesses by company visits.

Other information:

The number of students is limited

724813P: Entrepreneurship in Action, 5 op

Voimassaolo: 01.08.2017 - 31.12.2020

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Niina Karvinen

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

Periods 1-4

Learning outcomes:

Upon completion of the course, the students can apply the core competencies of his/her studies in a real-life entrepreneurship context. Students can realize and start working with a business opportunity or social problem in practice to find a solution. The student will improve his/her entrepreneurial skills; multicultural group working, problem solving, communicating and presenting.

Contents:

In these studies students generally co-operate in workshops where they learn practical methods of entrepreneurship like business model creation and validation processes, lean methodology, marketing, branding, basic financial management and presenting ideas e.g. pitching.

Mode of delivery:

Face-to-face teaching and coaching.

Learning activities and teaching methods:

Bootcamps, workshops, group work, individual guidance. Most of the exercises are completed as group work (132 h).

Target group:

Open to all University Students

Prerequisites and co-requisites:

No

Recommended optional programme components:

No

Recommended or required reading:

Selected readings are provided during the course

Assessment methods and criteria:

Programme specific assessment that may include both group and individual assessment methods.

Grading:

The course utilizes grading scale “pass/fail”

Person responsible:

Niina Karvinen ja Anne Keränen

Working life cooperation:

The programs of this course are run in close co-operation with relevant business partners or applied to practice. Students also learn practical entrepreneurship skills.

Other information:

The number of students is limited

724815P: Entrepreneurial Assignment, 5 op

Voimassaolo: 01.06.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Sari Perätalo

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

The schedule for the course is dependent on the entrepreneurial event or training in which student takes part in.

Learning outcomes:

Upon completion of the course the students are familiarized with entrepreneurial activity in society and possess skills that help to solve entrepreneurial problems and make change. Students will have an insight into the diversity of entrepreneurship and gain understanding of the specific aspects of entrepreneurship.

Contents:

Studies are tailored upon acceptance by the course instructor. The course consists of two parts: practice, and theory. Students compile the course through participating in different entrepreneurship supporting activities. The students can for example participate in Tellus boot camps, events or volunteering program. In addition, students can include activities organized by other stakeholders (e.g. faculties, public organizations or third sector organizations). In addition, the students reflect their learning in a report.

Mode of delivery:

Face-to-face teaching including entrepreneurial project, event, workshop, etc. Individual written assignment and reading the agreed materials.

Learning activities and teaching methods:

Individual and group work (132h). Teaching methods vary depending on the entrepreneurial project, event, workshop, etc. a student has participated in.

Target group:

Open to all university students

Prerequisites and co-requisites:

No

Recommended optional programme components:

The course does not require additional studies carried out at the same time.

Recommended or required reading:

Materials will be provided during the course.

Assessment methods and criteria:

Assessment is based on an individual report that a student is expected to deliver after participating in an entrepreneurship-related event, workshop, project, etc.

Grading:

The course utilizes verbal grading scale “pass/fail”.

Person responsible:

Sari Perätalo

Working life cooperation:

The course allows the students to gain first-hand entrepreneurial experience in various forms.

Other information:

Contact the responsible teacher to enroll in the course.

724811P: Entrepreneuring for Sustainability, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Anne Keränen

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

Period 2

Learning outcomes:

After the course the students should:
Understand the roles of entrepreneurship in creating socially responsible change in society, know how to map and analyze alternative sustainable entrepreneurial business ideas based on individual strengths, values and the UN SDGs, know creative problem solving assessment methods, know how to communicate about entrepreneurial ideas.

Contents:

Course description
The course outlines interdisciplinary skills and knowledge that foster the creation of a sustainable entrepreneurial mindset. These skills include problem solving, creativity, networking, communications, risk-taking and adaptability. Entrepreneurship is approached through its different forms and roles in various contexts of society, ecosystems, and businesses. The focus is on entrepreneurial mindsets, responsible business and what entrepreneurship requires from individuals and teams, especially from the “me/us as entrepreneur” standpoint. During the course students familiarize themselves with the role of business and entrepreneurship in building sustainable societies. In addition, students have the opportunity to present their sustainable business ideas to responsible business experts.
Course objectives
Students develop skills for creative problem solving; students understand that entrepreneurial behavior can take place within many contexts (new ventures, associations, government agencies, and existing businesses); students identify their alternative roles, opportunities, and viewpoints regarding entrepreneurial choices they can make; students strengthen their skills of responsible business and are

able to assess choices for business as promotor of social change based on the UN Sustainable Development Goals; students are able to define and assess alternative contexts for entrepreneurial action and to create and assess alternative business scenarios for their future; students are able to recognize and analyze business opportunities and social/customer problems and challenges; students are able to create and evaluate alternative solutions to the identified opportunities, problems, and challenges of responsible business; students are able to communicate effectively about their entrepreneurial ideas.

Mode of delivery:

Lectures, workshops and online learning

Learning activities and teaching methods:

Learning takes place mostly in groups by means of intensive lectures and workshops, visitor presentations and discussions, both in class and via online learning platform. The course includes 36 contact hours. Reading the course literature (20 h), Groupwork (80 h) and learning diary report (35 h).

Target group:

Open to all University Students

Prerequisites and co-requisites:

No

Recommended optional programme components:

No

Recommended or required reading:

Selected readings are provided during the course

Assessment methods and criteria:

Further details will be provided by the responsible persons in the first session.

Grading:

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

Person responsible:

Anne Keränen and Jan Hermes

Working life cooperation:

The course incorporates real life case examples and meetings with sustainable entrepreneurship practitioners and experts. Students learn interdisciplinary skills that can be applied in real working life.

Other information:

The number of students is limited.

724812P: Building Change Through Entrepreneurship, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opettajat: Ahmad Arslan

Opintokohteen kielet: English

Leikkaavuudet:

ay724812P	Building Change Through Entrepreneurship (OPEN UNI)	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

Period 3

Learning outcomes:

After the course completion, the students should:
1. Have the basic knowledge about start-ups and new business creation
2. Have the ability to find and utilize information for new business creation
3. Have the knowledge how to analyze own business-case
4. Have the knowledge how the to plan a new start-up
5. Have the ability to present own business-case

Contents:

Lectures will focus on the following themes:
Introduction to Entrepreneurship
Recognizing Opportunities and Generating Ideas
Feasibility Analysis
Industry and Competitor Analysis
Developing an Effective Business Model
Building a New Venture Team
Assessing New Venture's Financial Strength and Viability
Writing a Business Plan
Getting Finance or Funding
Preparing for and Evaluating Challenges of Growth

Mode of delivery:

Face-to-face teaching complemented with online resources

Learning activities and teaching methods:

The course consists of lectures and workshops (32 h), preparation for lectures and workshops (18 h), and, reading the literature and preparation for assignments (50 h), and writing the assignments (40 h).

Target group:

B.Sc. and M.Sc. students from different faculties in the university as well as exchange students

Prerequisites and co-requisites:

None

Recommended optional programme components:

None

Recommended or required reading:

- Bruce R. Barringer and R. Duane Ireland (2006). Entrepreneurship: Successfully Launching New Ventures. Pearson Education.
- Slides and relevant online resources

Assessment methods and criteria:

Individually written assignments. Completion of 10 assignments correspond to revving grade 5, while minimum two are needed to get 1 in order to pass the course

Grading:

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

Person responsible:

Ahmad Arslan and Anne Keränen

Working life cooperation:

Practical insights to new business creation tested through several assignments addressing different aspects associated with it.

Other information:

The student number is limited to 50.

724816P: Building Business Through Creativity and Collaboration, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail
Opettajat: Anne Keränen
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

Period 4

Learning outcomes:

During the course the student will explore entrepreneurship from the perspective of an artistic process and learn the process of designing improbable solutions. The students are challenged to question mainstream values, assumptions taken for granted, and ways of doing things. The course gives the student tools that are needed in developing improbable business models and solutions that can shift paradigms.
During the intensive workshops of the course, the student will work in teams and learn to regulate emotions, such as uncertainty, frustration, enthusiasm, and joy.
Upon completion of the course, the student will:
- develop entrepreneurial leadership
- increase abilities to build new inspiring visions
- master agile methods of creation to deal with uncertainty and risks
- learn how to use diversity and improbable encounters to develop business
- connect passion and convictions with a project which creates value
- leverage failure to increase creativity and resilience

Contents:

Entrepreneurs develop activities that aim to challenge the status quo, break rules and subvert systems. Furthermore conflicts, emotional strains and uncertainties are often part of entrepreneurship. But how can such things be taught/learnt?
The course introduces Art Thinking, an agile method to create improbable outcomes with certainty. The method enables out-of-the-box thinking and creative productions where encounters of all sorts are key resources. Instead of writing business plans, the participants create during the Improbable workshops artistic prototypes and organize an art exhibition.
During the Improbable workshops students will are taught the Art-Thinking Method which involves 6 main activities. The students will:
(1) engage in gift-giving practices which foster new and unusual partnerships (Donate);
(2) “steal” from others to create unique propositions (Deviation);
(3) follow a journey without a clear goal but which will eventually make a lot of sense (Drift);
(4) challenge existing rules and values as well as their taken-for-granted assumptions (Destruction);
(5) accept criticism to learn from others (Dialogue), and
(6) exhibit their work to get feedback and find new partners (Display).

Mode of delivery:

Face-to-face sessions and workshops

Learning activities and teaching methods:

Participation in the workshops. Producing a piece of art and presenting it at an art exhibition together with others. Completion of the group work and individuals tasks, such as reading course materials and reflecting the learning experiences.

Target group:

Open to all University Sstudents

Prerequisites and co-requisites:

No

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:

Materials will be provided during the course

Assessment methods and criteria:

Compulsory participation and commitment to the teamwork. Assessment of the course tasks.

Grading:

The course utilizes verbal grading scale “pass/fail”

Person responsible:

Mia Kemppaala, Anne Keränen

Working life cooperation:

Students learn practical entrepreneurial skills through artistic process.

Other information:

The number of students is limited

Supplementary Module: Economics and Management (15 ECTS cr)

ay724110P: Introductory Economics (OPEN UNI), 5 op

Voimassaolo: 01.01.2014 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: University of Oulu, Open University
Arvostelu: 1 - 5, pass, fail
Opetus suunnattu: University of Oulu, Open University
Opintokohteen kielet: Finnish
Leikkaavuudet:

724110P	Introductory 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). Mid-term exams (2)or Final exam (3 h).

Target group:

Sivuaineopiskelijat ja avoimen yliopiston opiskelijat

Recommended or required reading:

Material posted at the webpage.
Textbook: Acemoglu, D., Laibson D. and List, J.A., Economics, 2015
and 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.
Robert P. Murphy, Lessons for the Young Economist. Ludvig 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:

University lecturer Marko Korhonen

Working life cooperation:

Students learn relevant and useful facts about the operation of the markets, and the aggregate economy to an extent that they can reasonably utilize those facts and knowledge in the decision making of the business they are working at.

Other information:

Ilmoittautuminen ja lisätiedot: Pohjois-Pohjanmaan kesäyliopisto https://www.ppkyo.fi/fi/kauppatieteiden-sivuaineopinnot-perusopinnot-25-op-oy-aya633707/

ay724102P: Management and Organizations (OPEN UNI), 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: University of Oulu, Open University

Arvostelu: 1 - 5, pass, fail

Opetus suunnattu: University of Oulu, Open University

Opintokohteen kielet: Finnish

Leikkaavuudet:

724102P	Management and Organizations	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Learning outcomes:

Upon completion of the course, the student will be able to distinguish the concepts related to organization, organizing as well as managerial and entrepreneurial work. This understanding helps the student#s ability to identify organizational processes in everyday work-life interventions and to list the possible change factors within a chosen organization. The student is also able to identify different kinds of organizations and can define the different principles of management styles. The student is able to understand various ongoing functions within organizations and their requirements for the organizations# management. The student understands the role of organizational development and learns to register the most essential challenges of management in the current organizations.

Contents:

The course covers the topics and questions of organizations and management, human organizing and processes as well as change management. The premises of the course are the traditional management schools of thought (scientific management, human relations school of thought, Hawthorne-studies, etc.) that the course goes through thoroughly. The course builds the newest questions of organizational theoretical approaches (change, processuality, etc.) on this understanding. In the course the students are introduced with the development of organizations and management, by presenting different organization types and management styles as well as the ways how those issues affect organization functioning.

Mode of delivery:

lectures, visiting lecturers, case-practices and group works.

Learning activities and teaching methods:

lectures (36 hours, including case-practices and group work of 9 hours), reading the course material (45 hours), preparation for the exam (52 hours).

Recommended or required reading:

Gareth Morgan (1997 tai uudempi). Images of organization. London: Sage Publications.
Hannele Seeck (2012 tai uudempi). Johtamisopit Suomessa. Helsinki: Gaudeamus.
Luentomateriaali.

Assessment methods and criteria:

Written exam of lectures and literature.

Grading:

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

Other information:

Ilmoittautuminen ja lisätiedot: Pohjois-Pohjanmaan kesäyliopisto https://www.ppkyo.fi/fi/kauppatieteiden-sivuaineopinnot-perusopinnot-25-op-oy-aya633707/

ay724111P: Finnish Economy and Economic Policy (OPEN UNI), 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: University of Oulu, Open University

Arvostelu: 1 - 5, pass, fail

Opetus suunnattu: University of Oulu, Open University

Opintokohteen kielet: Finnish

Leikkaavuudet:

724111P	Finnish Economy and Economic Policy	5.0 op

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

Learning outcomes:

After the course the student is capable of outlining the economic history of Finland, to describe the position of Finland in the global economy and to evaluate the challenges of the Finnish economy now and the future. In addition, the student can describe the main features of the different areas in the Finnish economy.

Contents:

The course provides an overview of the Finnish economy and economic history, its current state and future development. The course deals with the activities of the Finnish economy and development, such as globalization, regional economy and general economic policy.
Lectures will include the following themes

1. The Finnish economy from the late 1800s to the early 2000s

2. Productivity and economic growth
3. Globalisation and Finland
4. Regional development and regional policy in Finland
5. Fiscal policy
6. Public economics and challenges of welfare state
7. Finance and economic development in communes
8. Innovations and innovation policy

Mode of delivery:

Face to face teaching

Learning activities and teaching methods:

36 h lectures, reading the course literature (93 h) and exam (4 h).

Recommended or required reading:

Announced by the lecturer.

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.

Other information:

Ilmoittautuminen ja lisätiedot: Pohjois-Pohjanmaan kesäyliopisto https://www.ppkyo.fi/fi/kauppatieteiden-sivuaineopinnot-perusopinnot-25-op-oy-aya633707/

ay724108P: Financial Markets (OPEN UNI), 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: University of Oulu, Open University

Arvostelu: 1 - 5, pass, fail

Opetus suunnattu: University of Oulu, Open University

Opintokohteen kielet: Finnish

Leikkaavuudet:

724108P	Financial Markets	5.0 op

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

Period 4

Learning outcomes:

The course is an introduction to the role and functions of financial markets and institutions. Upon successful completion of the course, the student will be able to describe the basic structure and operational principles of financial markets and to identify different types of financial instruments and their characteristics.

Contents:

1) the role of financial markets and institutions in the economy, 2) main types of financial assets, their properties, and basics of pricing, 3) stock markets, bond markets, markets for bank obligations, treasury securities markets, derivative markets, mutual funds, private equity

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (26 h), visiting lectures (10 h), self-study (94 h), exam (3h)

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:

Pilbeam: Finance & Financial Markets (3rd edition), Palgrave Macmillan
Other material announced during the lectures

Assessment methods and criteria:

Examination, lecture diaries

Grading:

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

Person responsible:

Prof. Juha-Pekka Kallunki

Working life cooperation:

General knowledge of the functions of financial markets and the various market participants

Other information:

The number of students is limited.

ay724105P: Management Accounting (OPEN UNI), 5 op

Voimassaolo: 01.08.2014 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: University of Oulu, Open University

Arvostelu: 1 - 5, pass, fail

Opetus suunnattu: University of Oulu, Open University

Opintokohteen kielet: Finnish

Leikkaavuudet:

724105P	Management Accounting	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits / 133 hours of work

Language of instruction:

Finnish

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.

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

Recommended or required reading:

Drury, C.: Management and cost accounting, 7th or 8th ed. Cengage Learning EMEA. Chapters 1-11 (8th ed.);
Supplementary material: Järvenpää, M.- Länsiluoto, A - Partanen, V. – Pellinen, J.: Talousohjaus ja kustannuslaskenta, WSOYpro, chapters 1-8.

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.

Working life cooperation:

Understanding of management accounting systems is typically an important part of work for graduates in economics and business administration and an essential part of occupations like management accountant or controller.

Other information:

Ilmoittautuminen ja lisätiedot: Pohjois-Pohjanmaan kesäyliopisto https://www.ppkyo.fi/fi/kauppatieteiden-sivuaineopinnot-perusopinnot-25-op-oy-aya633707/

Basic Business Studies

724835P: Basics of Management and Organizations, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

The course material and assignments are in English. The individual assignments may be completed in Finnish if a student wishes to do so.

Timing:

February– mid-April 2021 (weeks 6–14) + exam resits

Learning outcomes:

Upon successful completion of the course, the student will be able to:
· name the key concepts and theories in the areas of organization, management and leadership,
· name the key concepts and evaluate the functions of human resource management,
· understand the major tools of strategic management,
· understand business in the network of global interactions, and
· apply theory on practical leadership and management situations.

Contents:

· Management and leadership
o Development of leadership thinking and leadership theory
o Key concepts of management leading culture, innovation and change
· Organizations and organizational behaviour
o Organizational structure
o Organizational culture
o Organizational life
· Human resource management
o Human resource management
o Leading individuals, teams and groups
o Motivation and coaching
· Strategic thinking and strategic tools

- o Development of strategic thinking and strategy
- o Strategic tools
- o Strategic management in a global environment

Mode of delivery:

Online teaching
· Individual assignments
· Electronic exam
The deadline for the weekly assignments is flexible; students can submit them at their convenience. The exams are open for a period of one week, during which, the exam can be taken at a time of the student's choice.

Learning activities and teaching methods:

	Hours
Online lectures	10 hours
Individual assignments and exam	60 hours
Literature (268 pages)	64 hours
Total	**134 hours (5 ECTS)**

Prerequisites and co-requisites:

No prerequisites.

Recommended or required reading:

Robbins, Stephen P. – Judge, Timothy A. – Campbell, Timothy T. (2017) Organizational Behavior. 2nd edition. Pearson.
The course instructors may ask students to read additional literature (e.g. articles). The details of additional readings are indicated in the course program.

Assessment methods and criteria:

The grade comprises an exam and individual assignments.
The dates for taking the exam and submission of assignments are given in the course instructions on the course platform.

Grading:

Students are graded on a scale from 1 to 5.

Person responsible:

Teachers 2020-21; Mirjami Ikonen (UEF), Hilpi Kangas (University of Vaasa) and Ida Okkonen (University of Jyväskylä)
Contact persons: Autumn term 2020, Minna Liikanen (minna.liikanen@jyu.fi) and Spring term 2021, Ida Oksanen (University of Jyväskylä)
Organizing university: University of Jyväskylä (academic year 2020-21)

Other information:

No restrictions for the number of students admitted. **Proper registration for the course at the home university is obligatory and required for credit. Late registrations will not be accepted.**
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi.

724836P: Introduction to Corporate Social Responsibility, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

English

Timing:

25 January–22 March 2021 (weeks 4–12).

Learning outcomes:

Upon completion of the course, the students will be able to:
· define and apply key concepts and perspectives regarding CSR,
· identify relevant issues and analyse the challenges related to corporate responsibility in selected industries,
· describe the role of CSR in business and in relation to wider international political and economic issues,
· describe the different aspects through which organizational practices can be CSR-oriented, and
· apply key concepts of CSR in their daily work.

Contents:

· Definitions and historical roots
o Historical roots – sustainable development
o Definitions of CSR
o Why CSR matters – the business case
o Stakeholder salience
· Regulatory aspects
o Political CSR
o CSPs and CSR
o MSIs and CSR
o CSR and human rights
· Human resource, supply and consumption
o HRM and CSR
o CSR and supply chain
o CSR and sustainable consumption
o CSR – minimum wage and living wage
· Relational aspects
o CSR and communication
o CSR and corruption
o CSR and leadership
o CSR and responsible investment

Mode of delivery:

Online teaching

Learning activities and teaching methods:

· Weekly assignments: There are four weekly assignments in the course; one for each week for the first four weeks of the course. These assignments measure the students' understanding of the reading materials.
· Final assignment: The final assignment can be completed in a group or individually. The deadline for submitting the final assignment is the middle of the sixth week of the course.
133 hrs (5 ECTS)

Prerequisites and co-requisites:

No prerequisites

Recommended or required reading:

The link to primary reading materials will be provided on the learning platform.

Assessment methods and criteria:

The grade is composed of:

- weekly assignments/short essays (60 %)
- case analysis: final assignment (40%)

Grading:

Students are graded on a scale from 1 to 5.

Person responsible:

Yewondwossen Tesfaye Gemechu
E-mail yewondwossen.tesfaye@hanken.fi
Organizing university: Hanken School of Economics

Other information:

No restrictions for the number of students admitted, except for Åbo Akademi, for which the number of participants is limited to 30 students. **Proper registration for the course at the home university is obligatory and required for credit. Late registrations will not be accepted.**
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi.

724830P: Introduction to Accounting and Financial Management, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

The course site opens on 15 September 2020. The graded course assignments are open between 15 September and 9 November 2020.
Exam dates: 16–23 November 2020
1st resit: 7–14 December 2020
2nd resit: 18–25 January 2021

Learning outcomes:

After completing the course, students will be able to:
· identify the role of accounting in organizations and society,
· understand the content and structure of financial statements and the purposes for which the statements can be used,
· read financial statements and calculate and interpret key financial ratios,
· understand the key role of accounting systems in providing information for decision-making within organizations and how this information can be used to manage both the organization and the behaviour of individuals within the organization,
· evaluate and assess the financial profitability of products, services, customers and investments and make sound business decisions based on this information,
· identify the role of corporate governance in organizations and society,
· be familiar with the basic questions of corporate finance and able to identify the answers, and
· use the basic functions of Excel.

Contents:

- Financial management: an overall view
- Concept of accounting and what it means for companies and society
- Substance of and differences in management and financial accounting
- Basic functions of Excel
- Financial accounting
  - o Goals, content and structure of statements, central accounting principles, basics of bookkeeping
  - o Balance sheets, income statements, cash flow statements and their connections
  - o International Financial Reporting Standards (IFRS), principles of group accounts
  - o Connections between income statements and taxation
  - o Financial statement analysis
- Management accounting
  - o Accounting for strategic management; implementing strategy, scorecards
  - o Management of a profit centre organization (including Economic Value Added and WACC)
  - o Budgeting and budgetary system
  - o Cost accounting tasks and cost concepts, product, service and customer profitability
  - o Ad hoc calculations, cost-volume-profit analysis and pricing
  - o Estimating the profitability of investments
- Key concepts of corporate governance and corporate finance
  - o Key issues in corporate governance (incl. ownership, board of directors, rewarding systems)
  - o Key issues in managing capital structure (equity and non-equity capital, capital cost)
  - o Key issues in managing working capital (inventory and cash management, sales receivables and accounts payable)

Mode of delivery:

Online course
Most themes contain short videos, reading material and exercises. Some themes have graded assignments.

Learning activities and teaching methods:

	Hours
Watching video material	15 hours
Reading literature	60 hours
Exercises	40 hours
Graded course assignments	15 hours
Exam	3 hours
Total	**133 hours (5 ECTS)**

Prerequisites and co-requisites:

Upper secondary school mathematics. Students should have Microsoft Excel software at their disposal during the course. All course material is available on the course site.

Recommended or required reading:

Ikäheimo, S. – Malmi, T. – Wallden, R. (2019) Yrityksen laskentatoimi. Talentum, Helsinki.

Assessment methods and criteria:

Students are graded on a scale from 1 to 5. The grade comprises

- graded course assignments: 30 %
- exam: 70 %

The course exam is open on three occasions. The dates for taking the exam are given on the course platform.

Grading:

Numeric, scale 1–5

Person responsible:

Teemu Malmi ja Seppo Ikäheimo
E-mail: teemu.malmi@aalto.fi, seppo.ikaheimo@aalto.fi
Organizing university: Aalto University

Contact person for students: Tomi Vuolteenaho (tomi.vuolteenaho@aalto.fi)

Other information:

No restrictions for the number of students admitted. **Proper registration for a course is obligatory and required to receive course credits. Late registrations will not be accepted.**
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi

724832P: Economics and The Business Environment, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

Course slides, weekly assignments and exams are available in Finnish and English. The videos and the course book are in English.

Timing:

Pre-assignment in week 8. Online course March–April 2021 (weeks 9–14). Exam in week 16. Exam resits in weeks 19 and 21.

Learning outcomes:

Upon successful completion of the course, students will be able to:
· define basic economic concepts, and
· understand economic thinking and apply economic theory in the analysis of a business environment and market economies.

Contents:

The course provides students with basic skills in analysing the business environment and an overview of its evolution from an economic perspective. Proactive identification of opportunities in and threats to the business environment is increasingly important for successful businesses in the global economy.
During the course, the students will familiarize themselves with:
· the decision-making processes in companies and among consumers and how the markets function (microeconomics),
· economic growth, business cycles, labour markets, inflation, monetary policy and economic policy (macroeconomics),
· the role of the public sector and the focal public policy instruments in market economies (public economics), and
· international trade, financial markets, European integration and multinational companies (global economy).

Mode of delivery:

Online course

Learning activities and teaching methods:

The course includes a compulsory preliminary assignment that has to be completed successfully by a pre-defined date. The instructions for the pre-assignment are given to the students who have registered for the course within the registration period.

Students will take the course independently as an online course. It is divided into weekly modules with different themes (6 modules in total). Students will complete weekly assignments that open at the beginning of each week.
To be eligible to take the final exam, students must complete and pass the assignment in each weekly module.
133 hours (5 ECTS)

Prerequisites and co-requisites:

No prerequisites.

Recommended or required reading:

The CORE Team, The Economy. Available at: http://www.core-econ.org.
Additional literature will be assigned by the instructors at the beginning of the course.

Grading:

Students are graded on a scale from 1 to 5.
The course exam is open on three occasions. The dates for taking the exam are announced on the course platform.

Person responsible:

Sami Remes (sami.remes@tuni.fi) ja Juha-Matti Tauriainen (juha-matti.j-m.tauriainen@jyu.fi)
Organizing university: University of Tampere (academic year 2020-21)

Other information:

No restrictions for the number of students admitted. **Proper registration for the course at the home university is obligatory and required for credit. Late registrations will not be accepted.**
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi

724833P: Introduction to Entrepreneurship, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

All the course material is in English. Should there be any foreign students in a group, the language of group work and assignments is English.

Timing:

Early October–December 2020 (weeks 41–50). Pre-assignment in week 41.

Learning outcomes:

During the course, students will learn to understand the significance of an entrepreneurial team and will form an understanding of entrepreneurship as a creative activity that occurs in the form of business. After completing the course, students will be able to:

- define business-related principles, possibilities and challenges,
- plan business initiation based on customer needs, value creation, testing and agility, and

· interpret business-related substance areas where competence is needed.

Contents:

· Deciding to become an entrepreneur
o Introduction to entrepreneurship
· Creating viable business ideas
o Creating business opportunities
o Preliminary research
o Industry analysis
o Business plan
· From idea to an entrepreneurial firm
o Building a team
o Analysing start-up strengths and weaknesses from the funding perspective
o Ethical and legal issues in starting a company
o Creating a business plan and constructing a story
o Attracting funding
· Managing an entrepreneurial firm and generating growth
o Marketing
o Understanding VC operations
o IPRs
o Challenges of growth and managing growth
o Growth strategies
o Forms of operation

Mode of delivery:

The course includes a compulsory preliminary assignment that has to be completed successfully by a pre-defined date. The instructions for the pre-assignment are given to the students who have registered for the course within the registration period.
Course assignments include:
· reading the course book, and
· learning and reflection assignments,
Students complete the assignments on the online learning platform individually and as groupwork.

Learning activities and teaching methods:

	Hours
Reading the course materials	48 hours
Learning and reflection assignments individually and in groups	85 hours
Total	**133 hours (5 ECTS)**

Prerequisites and co-requisites:

No prerequisites

Recommended or required reading:

Barringer, B. – Ireland. D. (2012) Entrepreneurship: Successfully Launching New Ventures. 4th Edition. Prentice Hall. Later editions can also be used.

Assessment methods and criteria:

The course consists of five modules. Each module is linked to two chapters in the course book, and there are related assignments to be completed by the end of each module. They are evaluated on the scale pass /fail. To pass the course, students must receive a passing grade for all the assignments.
A final essay composed and submitted at the end of the course, and covering the entire course content, determines the final grade.

Grading:

Students are graded on a scale from 1 to 5.

Person responsible:

Teachers 2020-21: Markku Ikävalko, LUT (markku.ikavalko@lut.fi), Satu Korhonen (LUT), Terhi Virkki-Hatakka (LUT) and Abdollah Mohammadparast Tabas (University of Oulu)

Organizing university: University of Oulu (academic year 2020-21)

Other information:

At least 75 students per university in the order of when they registered for the course. The total number of participants should not exceed 700. If there are fewer than 75 students from any university, the number of students in the other universities may be increased.
Proper registration for the course at the home university is obligatory and required for credit. Late registrations will not be accepted.
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi.

724834P: Basics of Marketing and Sales, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

The literature is mainly in English. The student may submit the assignments either in Finnish or in English

Timing:

March - early May 2021 (weeks 9-18), Pre exercises in week 9.

Learning outcomes:

Upon completion of the course, students will be able to:
· describe the role of marketing in an organization and identify the significance of customer-orientation in both the development of the organization and personal actions,
· apply the key concepts of marketing (e.g., customer-perceived value, value creation process, brand, marketing mix and segmentation) in decision-making and the evaluation of made decisions,
· describe the diverse emphasis of B-to-B and consumer marketing and the key characteristics of both logics,
· identify and utilize key marketing communication channels in the fickle business environment, and
· understand sales processes in their entirety, the different parts of them in both consumer and in B-to-B sales.

Contents:

- key marketing concepts, definitions and phenomena now and before such as value, value creation and marketing mix
- understanding these concepts in diverse contexts: the differences between consumer and B-to-B logics
- customer-centric thinking and value creation
- customer-oriented strategy in a changing business environment
- the key concepts and phenomena in consumer marketing
- B-to-B marketing and organizational buying behaviour
- marketing communication channels and content
- sales process in consumer and B-to-B contexts, as well as personal sales and interaction skills, at different phases of the sales process

Mode of delivery:

On-line teaching

Learning activities and teaching methods:

The course includes a compulsory preliminary assignment that has to be completed successfully by a pre-defined date. The instructions for the pre-assignment are given to the students who have registered for the course within the registration period.
Students will complete weekly assignments during the course.

	Hours
Independent reading of the course materials	70 hours
Weekly assignments	60 hours
Feedback	3.5 hours
Total	**133.5 hours (5 ECTS)**

Prerequisites and co-requisites:

No prerequisites.

Recommended or required reading:

The instructors will specify the literature at the beginning of the course.

Assessment methods and criteria:

The course includes a compulsory preliminary assignment that has to be completed successfully by a pre-defined date. The instructions for the pre-assignment are given to students who have registered for the course within the registration period.
Students will complete weekly exercises.

Grading:

Students complete the course by submitting weekly assignments. Grading on scale 1–5/fail.

Person responsible:

Minna-Maarit Jaskari (minna-maarit.jaskari@uva.fi) ja Tuula Lehtimäki (tuula.lehtimaki@oulu.fi)
Organizing university: University of Vaasa (academic year 2020-21)

Other information:

No restrictions for the number of students admitted. **Proper registration for the course at the home university is obligatory and required for credit. Late registrations will not be accepted.**
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi.

724837P: Understanding and managing a business as a dynamic whole - business simulation game, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

The language of instruction is English, but a student may return individual assignments in Finnish if s/he so wishes. The simulation teams may speak Finnish, if there are no non-Finnish speaking members in the team.

Timing:

1st course period: late September–mid-November 2020 (weeks 39–46). Pre-assignment in week 39.
2nd course period: late January–February 2021 (weeks 4–11). Pre-assignment in week 4.
3rd course period: mid-March–mid-May 2021 (weeks 11–19). Pre-assignment in week 11.

Learning outcomes:

After completing the course, students will:
· understand how different areas in business studies are connected in the entity of enterprise functions and in making a profit,
· understand the role of ERP and its significance in managing a company,
· be able to apply different business analysis tools in planning and managing a business and to understand the essential role of strategy in the process, and
· be able to apply various methods of collaboration in a virtual team.
A central part of the course is to see the business as a whole, students will understand why it is not practical to optimize single functions separately and why the management needs to have a holistic perspective of the company.

Contents:

· The foundation for this course is a business simulation game that engages the students in real-time decision-making and provides them with various tasks related to various business topics.
· The participation takes place in small virtual groups, in which the team members (3–4 students) all come from different universities.
· The thematic core for the simulation is supply chain management and the entity formed by different functions of a company. The relevant themes include several areas of cross-company logistics: purchase, inventory management, delivery, customer relations and the reporting related to these topics. The course emphasizes effective management of the supply chain and the impact it has on the company’s profit and cash flow.
· During the course, students are also introduced to the dynamics of supply chains in company networks, where the students’ company is part of a network of suppliers, competitors and customers.
· In addition, the course gives an overall picture of the role of a company’s information systems in steering the business as a whole: how the different functions utilize common enterprise resource planning and how the ERP works as an essential tool in decision-making.
· The theoretical material and the exercises distributed in the course are related to supply chain management and other LITO learning themes.

Mode of delivery:

Online teaching

Learning activities and teaching methods:

The course includes a compulsory preliminary assignment that has to be completed successfully by a pre-defined date. The instructions for the pre-assignment are given to the students who have registered for the course within the registration period.
The course assignments are mainly related to the planning of the simulation company operations and the analysis of materialized operations. These include:
· developing a business plan,
· analysing the profitability in light of various parameters and reporting these to the different stakeholders,
· various strategic analyses of the company operations and competitive situation (SWOT, Pester, benchmarking),
· calculations related to the company’s basic supply chain and ERP parameters,
· income statement and profitability, gross margin and cash flow analysis (the essential parameters covered in the course Introduction to Accounting and Financial Management), and
· market analysis.
Furthermore, there will be a written assignment on team dynamics and a team functionality analysis and reflections.

	Hours
Reading the theoretical supplementary material	50 hours
Planning and analysis tasks	66 hours
Business simulation game	3 x 6 hours = 18 hours
Total	**134 hours (5 ECTS)**

Prerequisites and co-requisites:

The course serves as a capstone, bridging together the other modules in the LITO entity. The course provides an overall picture of business dynamics and explains how the different fields in business studies are related to it.
It is recommended that before taking this course, the student has taken at least the following LITO courses: Introduction to Accounting and Financial Management and Basics of Management and Organization.

Recommended or required reading:

Simulation game instructions, description of the simulation environment, learning videos, course hand-out and a selection of other articles (to be announced).

Grading:

The evaluation scale of pass/fail is used. Performance will be evaluated based on the assignments given during the course.

Person responsible:

Eeli Saarinen (eeli.saarinen@utu.fi)
Organizing university: University of Turku (academic year 2020-21)

Other information:

When registering for the course, bear in mind that the simulation game requires your commitment to the entire duration of the course, as the implementation of the simulation game requires that there are at least 50 attendees from the LITO universities.
A max. 20 of students per university are admitted in the order of registration for each business simulation game period. If there are fewer students from any university, the number of students from the other universities may be increased; the total number of students should not exceed 180.
Proper registration for the course at the home university is obligatory and required for credit. Late registrations will not be accepted.
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi.

724831P: Introduction to Business Law, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 credits

Language of instruction:

Finnish

Timing:

Mid October - mid December 2020 (weeks 43-50)

Learning outcomes:

After the course, the student will:
· know the main features of the Finnish legal system, its connections to other legal systems and the most important legal concepts and structures, particularly from the business perspective,
· know the different sources of law and the fundamentals of how to solve legal problems,

- understand the role of law as a system that steers society and its importance at the heart of business activities,
- understand how and why a company should prepare for the legal risks of a business, how to manage the risks and how to take the legal aspect into account in the company's decision-making, and
- know the basic key areas of business law, corporate law in particular, contract law, immaterial law, labour law, competition law and tax law (tax law accounts for 30 % of the course).

Contents:

- Structure of the Finnish legal system and its relationship to other legal systems
- Basic legal concepts and structures
- Relevance of law at the heart of societal decision-making and business activities
- Risks and possibilities that law provides for business
- Legal risk management in business
- Sources of law and their mutual relationships
- Fundamentals of solving legal problems
- Basics of corporate law
- Basics of contract law
- Basics of immaterial law
- Basics of labour law
- Basics of tax law (tax law accounts for 30 % of the course)
- Basics of competition law

Mode of delivery:

Online course

Learning activities and teaching methods:

The purpose of the course assignments is to review the main issues learned in the course and to deepen the students' understanding by transferring theoretical knowledge into practice. The assignments deal with, for example, the basic concepts and structures of the legal system, recognizing legal problems and the basics of different fields of business law. They also include case assignments.
133 hours (5 ECTS). The course consists of three modules, the schedules of which are as follows:

- Introduction to legal thought 25 hours
- Business law 68 hours
- Tax law 40 hours

Prerequisites and co-requisites:

No prerequisites.

Recommended or required reading:

The literature will be assigned by the instructors at the beginning of the course.

Assessment methods and criteria:

Each of the module exams can be taken three times. The dates for taking the exams are given on the course platform.

Grading:

Students are graded on a scale from 1 to 5 based on the module exams (3 exams).

Person responsible:

Martti Nieminen, Jenni Similä & Lassi Salminen
Martti Nieminen (contact person)
E-mail martti.nieminen@tuni.fi
Organizing university: Tampere University

Other information:

No restrictions for the number of students admitted. **Proper registration for the course at the home university is obligatory and required for credit. Late registrations will not be accepted.**
LITO courses are organised in co-operation with multiple universities. To receive credits for the courses, students must be granted the right to attend the courses for which they have registered from the host university. To grant the right to attend a course(s), the home university will transfer personal student information to the host university responsible for organizing the course. The data to be transferred includes surname, first name, possible middle name(s), gender, nationality, e-mail address, personal identification number and home university. If a student does not have a Finnish personal identification number, his/her date of birth will be transferred. Data classified as secret will not be transferred. Receiving credit for the course(s) is not possible without transferring personal student information.
The latest information about the course is updated and published on the course platform at www.lito.fi.

805351A: Linear Regression, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Leikkaavuudet:

806359A	Regression modelling	10.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year during B.Sc. studies

Learning outcomes:

After successful completion of the course the student can describe basic concepts and assumptions in linear models for continuous outcome variables as well as main principles of regression modelling, and can also apply these methods in analysis of experimental and non-experimental observation data.

Contents:

Linear regression models for a continuous outcome variable; formulation of the model, selection of variables and interpretation of parameters; fitting the models, estimation of parameters and prediction using method of least squares; model criticism and diagnostics; use of R environment and SAS software in modelling.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (28 h), practicals and computer classes (14 h) and independent work.

Target group:

Students having statistics as the major or a minor subject.

Prerequisites and co-requisites:

Basic Methods of Data Analysis; Core courses in the B.Sc curriculum of mathematical sciences.

Recommended optional programme components:

Prerequisite to the course Generalized Linear Models

Recommended or required reading:

Agresti, A. (2015). Foundations of Linear and Generalized Linear Models. Wiley, Hoboken; chapters 1-3 and 12.
James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; luvut 1-3 ja 6-7. -- vapaasti imuroitavissa osoitteesta http://www-bcf.usc.edu/~gareth/ISL/

Assessment methods and criteria:

Active participation in practicals and final exam.

Grading:

Fail, 1-5

Person responsible:

Esa Läärä

Working life cooperation:

No

805353A: Statistical Software, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

805340A	Statistical Software	4.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

3. year studies. Fall semester. Timing varies.

Learning outcomes:

After successful completion of the course the student can use independently major statistical software needed in data analysis.

Contents:

The course covers R, SAS and IBM SPSS, and their most important tools for data management, statistical computation, graphics and programming will be introduced and proficiency for their fluent use is acquired.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

42 h lectures, exercises and tutoring. 88 h learning tasks and self-study.

Target group:

Major and minor students

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics

Recommended or required reading:

Lecture notes

Assessment methods and criteria:

Home works and/or exam

Grading:

Numerical grading 1-5 (or fail)

Person responsible:

Hanna Heikkinen

Working life cooperation:

No

805306A: Introduction to Multivariate methods, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

Finnish

Timing:

Autumn term, 2nd period. Recommended to be taken already in the 2nd year for those aiming at specialization in data science.

Learning outcomes:

Upon successful completion of the course the student can describe the basic concepts and main principles of the logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis, and is able to apply these methods in analysing a small scale data set as well as to apply the necessary computational tools.

Contents:

Logistic regression, principal components analysis, discriminant analysis, classification analysis and clustering analysis; Use of R environment in modelling; Course is an application oriented.

Mode of delivery:

Contact teaching

Learning activities and teaching methods:

Lectures 28 h, practicals 14 h, and independent work. The practicals include both homework and computer class exercises.

Target group:

Students of mathematical sciences and other interested. The course belongs to core studies for those with an orientation to data science. It is a prerequisite for those doing M.Sc. in computational mathematics and data science having data science as the specialization profile. The course is useful also for students of the Faculty of Science and the Oulu Business School as well as those of computer science or computational engineering, who have statistics as a minor subject.

Prerequisites and co-requisites:

806113P Introduction to Statistics or 806119P A Second Course in Statistics and 805305A Introduction to Regression and Analysis of Variance or corresponding abilities acquired otherwise.

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 material distributed during lectures and practicals. Recommended reading:James, G., Witten, D., Hastie, T., Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R}. Springer, New York; chapters 4 and 10. -- freely downloadable from http://www-bcf.usc.edu/~gareth/ISL/.

Assessment methods and criteria:

Practical exercises and final exam. Passing the course requires adequate participation in practical sessions and sufficient homework activity.

Grading:

Numeric assessment scale from 1 to 5, Fail

Person responsible:

Jari Päkkilä

Working life cooperation:

No

805349A: Likelihood and Bayesian Inference, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Leikkaavuudet:

805310A Statistical Inference I 10.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year of B.Sc. studies, spring term

Learning outcomes:

After successful completion of the course the student can describe the basic principles of likelihood inference, derive likelihood functions of models with few parameters, compute likelihood quantities basen on them, and interpret results such obtained.

Contents:

Statistical model and observation data; likelihood function, log-likelihood, score, information; maximum likelihood estimation, relative likelihood, likelihood interval and likelihood region, profile likelihood; normal approximation of log-likelihood; use of R environment in inferential problems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (28 h), practicals and computer classes (14 h), and independent work

Target group:

Students having statistics as the major or a minor subject

Prerequisites and co-requisites:

Introduction to Regression and Analysis of Variance, Probability Theory

Recommended optional programme components:

Is needed in nearly all intermediate and advanced courses in statistics

Recommended or required reading:

Migon, H.S., Gamerman, D., Louzada, F. Statistical Inference: An Integrated Approach, Second Edition. Chapman and Hall/CRC, 2014; Pawitan, Y: In All Likelihood: Statistical Modelling and Inference Using Likelihood, Oxford, 2001; Sprott, D. A.: Statistical Inference in Science, Springer, 2000; Kalbfleisch, J.G.: Probability and Statistical Inference, volume 2: Statistical Inference, Second Edition, Springer, 1985.

Assessment methods and criteria:

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

Grading:

Fail, 1-5

Person responsible:

Esa Läärä

Working life cooperation:

No

805350A: Estimation and Test Theory, 5 op

Voimassaolo: 01.06.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Field of Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Läärä Esa

Opintokohteen kielet: Finnish

Leikkaavuudet:

805310A	Statistical Inference I	10.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

Finnish

Timing:

2nd or 3rd year during B.Sc. studies

Learning outcomes:

After successful completion of the course the student can describe the basic principles of frequentist and bayesian statistical inference, compute point and interval estimates, test statistics and P-values based on likelihood function of models with few parameters, and interpret results thus obtained.

Contents:

Statistical model and observational data; construction and properties of point estimators and confidence intervals; likelihood ratio, score and Wald test statistics and their asymptotic sampling distribution; jackknife and bootstrap methods; elements of bayesian inference; use of R environment in inferential problems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures (28 h), practicals and computer classes (14 h), and independent work

Target group:

Students having statistics as the major or a minor subject

Prerequisites and co-requisites:

Introduction to Regression and Analysis of Variance, Probability Theory, Likelihood and Bayesian Inference, Introduction to Probability Theory II

Recommended optional programme components:

Needed in nearly all intermediate and advanced courses of statistics

Recommended or required reading:

Migon, H.S., Gamerman, D., Louzada, F. Statistical Inference: An Integrated Approach, Second Edition. Chapman & Hall/CRC, 2014; Pawitan, Y: In All Likelihood: Statistical Modelling and Inference Using Likelihood, Oxford, 2001; Sprott, D. A.: Statistical Inference in Science, Springer, 2000; Kalbfleisch, J.G.: Probability and Statistical Inference, volume 2: Statistical Inference, Second Edition, Springer, 1985.

Assessment methods and criteria:

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

Grading:

Fail, 1-5

Person responsible:

Esa Läärä

Working life cooperation:

No

Supplementary Module: OAMK, 15 ECTS cr

030009M: Studies in Other Universities/Institutes, 0 - 60 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Faculty of Information Technology and Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

521285S: Affective Computing, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits
Language of instruction:
In English
Timing:
Fall, periods 1
Learning outcomes:
After completing the course, student
1. is able to explain the emotion theory and modeling
2. is able to implement algorithms for emotion recognition from visual and audio signals, and the fusion of multi-modalities
3. has the ideas of wide applications of affective computing
Contents:
The history and evolution of affective computing; psychological study about emotion theory and modeling; emotion recognition from different modalities: facial expression, speech, fusion of multi-modalities; crowdsourcing study; synthesis of emotional behaviors; emotion applications.
Mode of delivery:
Online teaching in Moodle/Zoom.
Moodle: https://moodle.oulu.fi/course/view.php?id=325&section=0
Learning activities and teaching methods:
The course consists of lectures and exercises. The final grade is based on the points from exam while there are several mandatory exercises.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
A prior programming knowledge with Python, possibly the bachelor level mathematical studies and/or some lower level intermediate studies (e.g. computer engineering or artificial intelligence courses). The recommended optional studies include the advanced level studies e.g. the pattern recognition and neural networks and/or computer vision courses.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
The assessment of the course is based on the exam (100%) with mandatory exercises.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5, zero stands for fail.
Person responsible:
Guoying Zhao, Henglin Shi, Yante Li

Working life cooperation:
No
Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lauri Lovén

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
Upon completion of the course, the student :

1. is able to explain the big data phenomenon, its challenges and opportunities.
2. is able to explain the requirements and common principles for data intensive systems design and implementation, and evaluate the benefits, risks and restrictions of available solutions.
3. can explain the principles of big data management and processing technologies and utilize them on a basic level.

Contents:
General introduction into big data, namely: big data fundatmenals, data storage, batch and stream data processing, data analysis, privacy and security, big data use cases.
Mode of delivery:
Online teaching, exercises and seminars. Independent and group work.
Learning activities and teaching methods:
Lectures, exercises, seminars, independent and group work
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu
Prerequisites and co-requisites:
The Bachelor level studies of Computer science and engineering study programmes or respective knowledge.
Recommended optional programme components:
Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.
Recommended or required reading:
Lecture slides and exercise material will be provided. Each lecture will include the refernce list for recommended reading. Instructions to necessary installations will be given.
Assessment methods and criteria:
This course assesses students continuously by the completion of small project work, seminar presentations and short reports on a selected topic (group work). Answering two quizzes during the course is optional and provides additional points for final grade. To pass the course, it is enough to get 50 % of available points. No exam.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Lauri Lovén
Working life cooperation:
The course includes also invited lectures from industry.
Other information:
Course is in Moodle.

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen, Zalan Rajna

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits.
Language of instruction:
English.
Timing:
The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the master's degree level.
Learning outcomes:
After completing the course, student:

1. knows about special characteristics of the biosignals and typical signal processing methods
2. can solve small-scale problems related to biosignal analysis
3. implement small-scale MATLAB software for signal processing algorithms.

Contents:
Biomedical signals. Digital filtering. Analysis in time-domain and frequency domain. Nonstationarity. Event detection. Signal characterization.
Mode of delivery:
Face-to-face teaching and guided laboratory work. The laboratory work can alternatively be performed on an online system (MathWorks Grader). Student can do the lab works remotely or in the lab using the same online system.
Learning activities and teaching methods:
Lectures 12h, Laboratory work 24h, Self-study for laboratory working and examination 99 h.
Target group:
Students interested in digital signal processing applications in biomedical engineering, at their master's level studies.
Prerequisites and co-requisites:
The mathematic studies of the candidate degree program of computer science and engineering, or equivalent. Programming skills, especially basics of the MATLAB. Basic knowledge of digital signal processing.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
The course is based on selected chapters of the book "Biomedical Signal Analysis", R.M Rangayyan, 2nd edition (2015). + Lecture slides + Task assignment specific material.
Assessment methods and criteria:
Face-to-face lectures. Students solve the programming problems in the laboratory work independently, supervised by assistants. The MathWorks Grader online system is used for programming tasks and it also verifies the completed tasks. Written examination.
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.

521140S: Computer Graphics, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521493S	Computer Graphics	7.0 op

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

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clippin
2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling
3. is able to explain the relationship between the 2D and 3D versions of such algorithms
4. possesses the necessary basic skills to use these basic algorithms available in PyOpenGL

Contents:
The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (PyOpenGL) for implementation.
Mode of delivery:
Remote teaching
Learning activities and teaching methods:
Lectures 22 h / Programming lessons 12 hours / Self-study and programming assignments 101 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
Programming skills using Python; basic data structures; simple linear algebra.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English)
5) Online PyOpenGL tutorials (e.g. http://pyopengl.sourceforge.net/context/tutorials/index.html)
Assessment methods and criteria:
The assessment of the course is based on the exam (70%) and programming assignments (30%).
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, Tuomas Varanka, Muzammil Behzad.
Working life cooperation:
No
Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521153S: Deep Learning, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Li Liu

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/135 hours of work
Language of instruction:
English
Timing:
autumn, period 2
Learning outcomes:
Upon completion of this course, the students will be able to:

1. learn the theories, models, algorithms, implementation and recent progress of deep learning, and obtain empirical experience on training deep neural networks.
2. will learn about linear classifiers, multilayer neural networks, back propagation and stochastic gradient descent, convolutional neural networks, recurrent neural networks, generative adversarial networks, deep network compression, deep transfer learning techniques and deep reinforcement learning (tentative).
3. know about applications of deep learning to typical computer vision problems such as image classification, object detection and segmentation.
4. learn to implement, train and debug their own neural networks with PyTorch.

Contents:
Students should be comfortable taking derivatives and understanding matrix vector operations and notations.
Basic Probability and Statistics, Linear Algebra, basics of probabilities, Gaussian distributions, mean, standard deviation, etc.
have knowledge of Machine Learning course and digital image processing course

Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
20h lectures, 12h exercise sessions, independent studying 95 hours.
Target group:
B.Sc. and M.Sc. students of Computer Science and Engineering. The course fits also for Statistics and Math M.Sc. students interested in learning deep learning techniques.
Prerequisites and co-requisites:
The Bachelor level knowledge of Computer science and engineering study programmes. Good programming skills in a chosen language.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Lecture hand-out, complementary reading list, and exercise material will be provided.
Assessment methods and criteria:
Attending lectures and exercise sessions, and returning the weekly exercises and final project.
Read more about assessment criteria at the University of Oulu webpage.

Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Li Liu
Working life cooperation:
The course may include the invited guest lectures from industry and other top universities.

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn, during period 1.
Learning outcomes:
After completing the course the student is able to solve optimization convex optimization problems with the basic optimization algorithms. The student is also able to form the necessary and sufficient conditions for the optimality.
Contents:
Linear optimization, Simplex-algorithm, nonlinear optimization, KKT-conditions, duality, conjugate gradient method, penalty and barrier function methods.
Mode of delivery:
Face-to-face teaching
Learning activities and teaching methods:
Lectures 28 h / Group work 14 h / Self-study 93 h.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.
Target group:
Students in Wireless Communication Engineering
Prerequisites and co-requisites:
The recommended prerequisite is the completion of the courses Calculus I and II, Matrix algebra
Recommended optional programme components:
-
Recommended or required reading:
P. Ciarlet; Introduction to numerical linear algebra and optimization, M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming
Assessment methods and criteria:
The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail
Person responsible:
Keijo Ruotsalainen
Working life cooperation:
-
Other information:
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

521289S: Machine Learning, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:
5 ECTS credits.
Language of instruction:

English.
Timing:
The course unit is held in the spring semester, during period III. It is recommended to complete the course at the end of studies.
Learning outcomes:
After completing the course, student

1. can design simple optimal classifiers from the basic theory and assess their performance.
2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.
3. can apply regression techniques to practical machine learning problems.

Contents:
Introduction. Bayesian decision theory. Parametric and non-parametric classification. Feature extraction. Classifier design and optimization. Example classifiers. Statistical regression methods.
Mode of delivery:
Online teaching, guided laboratory work and independent assignment. The laboratory works are done on an online system (Mathworks Grader). Student can do the lab works remotely or in the lab using the same online system.
The course is implemented as remote education via the Moodle work space https://moodle.oulu.fi/course/view.php?id=5729
This work space opens to students before the course begins. The student must register to the course in WebOodi in order to participate the course.
Learning activities and teaching methods:
Lectures 16 h, Laboratory work 16 h, and Self-study the rest (Independent task assignment).
Target group:
Students who are interested in machine learning and pattern recognition theory and methods.
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:
Will be informed when the course starts.
Assessment methods and criteria:
Laboratory work is supervised by assistants who also verify that the task assignments are completed properly. The Matworks Grader online system also verifies the completed tasks. The independent task assignment is graded which establishes the grade for the course.
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 the independent task assignment.
Person responsible:
Tapio Seppänen
Working life cooperation:
No

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS cr
Language of instruction:
English
Timing:
Spring, period 3.
Learning outcomes:

Upon completion of the course the student
1. understands the fundamentals of image acquisition, representation and modeling
2. can utilize elementary methods of machine vision for image recognition problems
3. can use 2D transformations in model fitting and image registration
4. can explain the basics of 3D imaging and reconstruction

Contents:
1. Introduction, 2. Imaging and image representations, 3. Light and color, 4. Binary image analysis, 5. Texture, 6. Local features, 7. Recognition, 8. Motion, 9. 2D models and transformations, 10. Perceiving 3D from 2D images, 11. 3D transformations and reconstruction.
Mode of delivery:
Online lectures and exercises, homework assignments.
Learning activities and teaching methods:
Lectures (24 h), exercises (16 h) and programming assignments (32 h), self-studying (61 h)
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
521467A Digital Image Processing or an equivalent course, basic Python programming skills.
Recommended optional programme components:
521289S Machine Learning. This course provides complementary knowledge on machine learning methods needed in machine vision.
Recommended or required reading:
Lecture slides and exercise material. The following books are recommended for further information: 1) Shapiro, L.G. & Stockman, G.C.: Computer Vision, Prentice Hall, 2001. 2) Szeliski, R.: Computer Vision: Algorithms and Applications, Springer, 2011. 3) Forsyth, D.A. & Ponce, J.: Computer Vision: A Modern Approach, Prentice Hall, 2002.
Assessment methods and criteria:
The course is passed with final exam and accepted homework assignments.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5. Zero stands for a fail.
Person responsible:
Janne Heikkilä
Working life cooperation:
No.
Other information:
Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=4317

521161S: Multi-Modal Data Fusion, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jaakko Suutala

Opintokohteen kielet: English

ECTS Credits:
5 ECTS cr / 135 hours of work
Language of instruction:
English
Timing:
Autumn / period 2.
Learning outcomes:
Upon completion of the course, the student will be able to
1. understand the problem of combining data of different natures and coming from different sources
2. explain basic principles of combining multi-sensor data
3. know the common types of data fusion techniques
4. understand and utilize Bayesian probabilistic reasoning framework in multi-modal data fusion
5. understand basic principles of machine learning applied to multi-modal data fusion

6. implement basic solutions towards the accomplishment of a given task requiring the integration and combination of data

Contents:
This course will provide a comprehensive introduction to the concepts and ideas of multi-sensor data fusion. We will be concentrated on defining general statistical framework for multi-modal data processing. Using this framework, we will show concepts of common representation and alignments, sequential Bayesian inference, and machine learning approaches to data fusion as well as specific models and algorithms in each category. Furthermore, the course will illustrate many real-life examples taken from a diverse range of applications to show how they can be benefitted from data fusion approaches.
The course will discuss the following topics:

1. Introduction
2. Sensors and architectures
3. Common representation
4. Alignments
5. Bayesian inference and probabilistic reasoning
6. Sequential Bayesian inference
7. Bayesian Decision Theory and ensemble learning
8. Advanced topics

Mode of delivery:
The course will be based on a combination of lectures (face-to-face teaching), exercises, and a final project.
Learning activities and teaching methods:
16 h lectures, 16 h exercises (including programming tasks), 35 h final programming project, home study.
Target group:
The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.
Prerequisites and co-requisites:
The course will be self-contained as much as possible (i.e., no previous knowledge of multi-sensor data fusion is assumed). Basic knowledge on mathematics and statistics as well as related topics like signal processing, and machine learning will be a plus.
The required prerequisite is the completion of the following courses: 031078P Matrix Algebra, 031021P Probability and Mathematical Statistics, 521156S Towards Data Mining, and 521289S Machine Learning.

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 will be based on the following textbook: H.B. Mitchell. Data Fusion: Concepts and Ideas. Springer (2012) and selected recent journal articles.
Assessment methods and criteria:
To pass the course, the student should return the exercises, complete a final programming project. Half of the grade will be based on exercises and half on the final project.
Grading:
The course will utilize a numerical grading scale 1-5. Zero stands for a fail.

Person responsible:
Jaakko Suutala and Markus Harju
Working life cooperation:
-
Other information:
Course uses Moodle platform.

521158S: Natural Language Processing and Text Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 120 hours of works
Language of instruction:
English
Timing:
Period 1. It is recommended to complete the course at the end of period 1
Learning outcomes:
Upon completing the course, the student is expected to i) comprehend, design and implement basic (online) text retrieval and query systems; ii) account for linguistic aspects and perform word sense disambiguation; iii) perform basic (statistical) inferences using corpus; iv) manipulate (statistical) language modelling toolkits, online lexical databases and various natural language processing tools.
Contents:
Foundation of text retrieval systems, Lexical ontologies, word sense disambiguation, Text categorization, Corpus-based inferences and Natural Language Processing tools
Mode of delivery:
Face- to-face teaching and laboratory sessions
Learning activities and teaching methods:
Lectures (24 h), tutorial/laboratory sessions (16h), seminar (6h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.
Target group:
students with (moderate to advanced) programming skills in Python
Prerequisites and co-requisites:
Programming skills (preferably) in Python

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time
Recommended or required reading:
Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze. Cambridge University Press, 2008. (Free from http://nlp.stanford.edu/IR-book/) Foundations of statistical natural language processing, by Manning, Christopher D., Schütze, Hinrich. Cambridge, Mass.: MIT Press, 2000
Assessment methods and criteria:
One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Mourad Oussalah
Working life cooperation:
-

521156S: Towards Data Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Tamminen

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Autumn, period I.
Learning outcomes:
After completing this course, student can recognize data types and perform required pre-processing steps before further analysis:

1. Student can design and implement a data collection process
2. Student can combine data from different sources

3. Student can normalize and transform data, and handle missing or incorrect values
4. Student can ensure generalizability of the results

Contents:
Course provides good ability to start Master's Thesis or graduate studies. Topics at the course include data mining process in general level, data gathering and different data types, quality and reliability of the data, data preparation including the processing of missing values, outliers, and privacy issues, combination of signals from several sources, utilization of data bases in data mining process, and normalization and transformation of data and interdependence of the observations and their distributions. Additionally, topics concerning the generality of the results are covered, as well as, the principles of data division, for example, train-test-validate, cross-validation and leave-one-out methods.
Mode of delivery:
Lectures, independent work, group work
Learning activities and teaching methods:
16 h lectures, 16 h exercises, independent studying.
Target group:
The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.
Prerequisites and co-requisites:
031021P Probability and Mathematical Statistics or similar
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. The material is mostly in English.
Assessment methods and criteria:
Weekly pre-lecture assignment + exercise submissions, and final exam. Half of the grade will be based on the submissions and half on the final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Tamminen Satu
Working life cooperation:
-
Other information:
Moodle: https://moodle.oulu.fi/course/view.php?id=1679
Towards Data Mining 521156S:3

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lauri Lovén

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Period IV. It is recommended that the course is taken on the fourth year Spring.
Learning outcomes:
Upon completion of the course, the student :

1. is able to explain the big data phenomenon, its challenges and opportunities.
2. is able to explain the requirements and common principles for data intensive systems design and implementation, and evaluate the benefits, risks and restrictions of available solutions.
3. can explain the principles of big data management and processing technologies and utilize them on a basic level.

Contents:

General introduction into big data, namely: big data fundatmenals, data storage, batch and stream data processing, data analysis, privacy and security, big data use cases.
Mode of delivery:
Online teaching, exercises and seminars. Independent and group work.
Learning activities and teaching methods:
Lectures, exercises, seminars, independent and group work
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu
Prerequisites and co-requisites:
The Bachelor level studies of Computer science and engineering study programmes or respective knowledge.
Recommended optional programme components:
Finishing 521290S Distributed Systems, 521497S Pattern recognition and neural networks, and 521286A Computer Systems is beneficial.
Recommended or required reading:
Lecture slides and exercise material will be provided. Each lecture will include the refernce list for recommended reading. Instructions to necessary installations will be given.
Assessment methods and criteria:
This course assesses students continuously by the completion of small project work, seminar presentations and short reports on a selected topic (group work). Answering two quizzes during the course is optional and provides additional points for final grade. To pass the course, it is enough to get 50 % of available points. No exam.

Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Lauri Lovén
Working life cooperation:
The course includes also invited lectures from industry.
Other information:
Course is in Moodle.

521042S: Creative Design, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Georgi Georgiev

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits/ 135 hours of work
Language of instruction:
English
Timing:
Period 1
Learning outcomes:
Upon completion of this course, students are able to:
- Understand and apply in practice basic creative problem-solving and design thinking approaches.
- Systematically ideate and implement creative solutions to a problem, both independently and within a team.
- Apply creative design thinking and low-resolution prototyping, with emphasis on empathy, iterative strategies, and interactions.
Contents:
The course teaches students of (1) Creative problem-solving; (2) Design thinking and low-resolution prototyping; (3) Teamwork problem-solving; (4) Systematic ideation approaches.
Mode of delivery:
Face-to-face teaching, teamwork/individual work, and independent studying.
Learning activities and teaching methods:
Lectures 21h / Individual work 124h. There are TA hours each week where guidance is available.
Target group:

Primary target group is first year master's level students of computer science and engineering with the applied computing orientation.
Prerequisites and co-requisites:
There are no prerequisites or co-requisites.
Recommended optional programme components:
-
Recommended or required reading:
All necessary material will be provided by the instructor.
Assessment methods and criteria:
20% attendance of 7 lecture-exercises; 40% exercise completion and performance; 40% individual project outcome.
Grading:
The course utilizes a numerical grading scale 1-5. In the numerical scale zero stands for fail.
Person responsible:
Georgi Georgiev
Working life cooperation:
-
Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01	Distributed Systems, Exam	0.0 op
521266S-02	Distributed Systems, Exercise Work	0.0 op
521266S	Distributed Systems	6.0 op

ECTS Credits:
5 ECTS cr
Language of instruction:
In English.
Timing:
Spring, period 3.
Learning outcomes:
After completing the course, the student
1. is able to explain the key principles of distributed systems
2. apply the principles in evaluating major design paradigms used in implementing distributed systems
3. solve distributed systems related problems
4. design and implement a small distributed system
Contents:
Introduction, architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, case studies.
Mode of delivery:
Online teaching
Learning activities and teaching methods:
Lectures 22 h, exercises 16 h, project work 50 h, self-study 47 h.
Target group:
M.Sc. students (computer science and engineering) and other Students of the University of Oulu
Prerequisites and co-requisites:
None.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:

Required literature: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems – Principles and Paradigms, Third Edition, 2017.

Assessment methods and criteria:

The course uses continuous assessment so that there are 2 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

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

Grading:

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

Person responsible:

Teemu Leppänen

Working life cooperation:

None.

Other information:

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

521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Steven LaValle

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the spring semester, during period III. It is recommended to complete the course at the 4rd spring semester.

Learning outcomes:

Upon completion of the course the students will be able to:

- Deeply understand the fundamentals common to widely used sensing and filtering systems.
- Design new sensors and filters.
- Apply the material to critical problems in robotics, internet of things, and virtual and augmented reality.
- Understand the links between theory and practice in sensing and filtering systems.

Contents:

Defining sensors; physical vs virtual sensors. Chronometers, cameras, infrared, laser, temperature, IMU. Sensor mappings, resolution, noise, calibration. Preimages, sources of uncertainty, comparing sensors, stochastic modeling. Multiple sensor readings and networks of sensors. Triangulation principles. Motion models: Discrete time, continuous time, event-based. Linear, complementary, Kalman, Bayesian, and combinatorial filters. Localization and mapping; global positioning systems; tracking humans.

Mode of delivery:

Online teaching.

Learning activities and teaching methods:

The course will consist of lectures (28h), individual homework assignments (48h), self-study (56h), final exam (3h).

Target group:

M.Sc. students in CSE, EE, and related areas.

Prerequisites and co-requisites:

Matrix Algebra (mandatory BSc 1st year); Differential Equations (mandatory BSc 1st year); Introduction to Computer Systems (mandatory BSc 2nd year); Mathematical Structures for Computer Science (mandatory BSc 2nd year).

Recommended optional programme components:

The course does not require other courses to be completed simultaneously. This course is the first part of a two-part series, in which the second part would finish tracking and cover autonomy. The course fundamentals complement parts of 521287A Introduction to Computer Systems, which provides experimental practice with sensors. The course is related to 521161S Multi-Modal Data Fusion as applied artificial intelligence, but instead has emphasis on geometric concepts and use cases derived from robotics, IoT, and VR/AR. The course has minor overlap with 521124S Sensors and Measuring Techniques, which focuses on experimentation, data collection, and sensor selection.

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (1-5).

Person responsible:

Steven LaValle

Working life cooperation:

The course does not contain working life cooperation.

521043S: Internet of Things, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ella Peltonen

Opintokohteen kielet: English

Proficiency level:

Status:

ECTS Credits:

5 ECTS / 135 hours of work

Language of instruction:

English

Timing:

Autumn semester during period 2.

Learning outcomes:

Upon completion of the course, the student will be able to:

1. explain application areas of IoT and requirements from such application areas for IoT systems.
2. will be able to explain the state-of-the-art IoT solutions, and understand the basic technologies behind them.
3. learn the principles of the novel IoT technologies and know important directions IoT research towards.

Contents:

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

Mode of delivery:
The course will be given fully remotely. Please join the Moodle page (https://moodle.oulu.fi/course/view.php?id=5330, password is iot2020) and attend the introduction Zoom lectures in Tue 27.10. 10:15-12 (for general organisation) and Wed 28.10. 14:15-16 (for course project).

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

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

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

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:
Lecture hand-out, complementary reading list, and exercise material will be provided.

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

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

Person responsible:
Ella Peltonen

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

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

521158S: Natural Language Processing and Text Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 120 hours of works
Language of instruction:
English
Timing:
Period 1. It is recommended to complete the course at the end of period 1
Learning outcomes:
Upon completing the course, the student is expected to i) comprehend, design and implement basic (online) text retrieval and query systems; ii) account for linguistic aspects and perform word sense disambiguation; iii) perform basic (statistical) inferences using corpus; iv) manipulate (statistical) language modelling toolkits, online lexical databases and various natural language processing tools.
Contents:
Foundation of text retrieval systems, Lexical ontologies, word sense disambiguation, Text categorization, Corpus-based inferences and Natural Language Processing tools
Mode of delivery:
Face- to-face teaching and laboratory sessions
Learning activities and teaching methods:
Lectures (24 h), tutorial/laboratory sessions (16h), seminar (6h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.
Target group:
students with (moderate to advanced) programming skills in Python
Prerequisites and co-requisites:
Programming skills (preferably) in Python

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time
Recommended or required reading:
Introduction to Information Retrieval, by C. Manning, P. Raghavan, and H. Schütze. Cambridge University Press, 2008. (Free from http://nlp.stanford.edu/IR-book/) Foundations of statistical natural language processing, by Manning, Christopher D., Schütze, Hinrich. Cambridge, Mass.: MIT Press, 2000
Assessment methods and criteria:
One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
1-5
Person responsible:
Mourad Oussalah
Working life cooperation:
-

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:
The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.
ECTS Credits:
5 ECTS cr
Language of instruction:
In English.
Timing:
Spring, periods 3-4.
Learning outcomes:
Upon completion of this course, students:

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

Contents:
RESTful Web APIs, Hypermedia and HATEOAS, RESTful Clients
Mode of delivery:
Online learning.
Learning activities and teaching methods:
Lectures 4 h, guided laboratory exercise 15 h, the rest as self-study and group work. Each group implements software and writes a report. Students present their work at least twice in online meetings with the course staff.
Target group:
M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.
Prerequisites and co-requisites:
Elementary programming (521141P) or equivalent Python programming
skills. Applied computing project I is recommended.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.
Assessment methods and criteria:
Course will be assessed based on project work assignment (functional working software prototype, content of the report…) and the exercises results. More detailed information on assessment will be provided with the course material.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Ivan Sanchez Milara
Working life cooperation:
None.
Other information:
We will use Moodle to provide links to the working tools and information about distance learning: https://moodle.oulu.fi/course/view.php?id=6032

Course material can be found at Lovelace: https://lovelace.oulu.fi/.

521044A: Social Computing, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

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

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

Contents:
Basics of social computing, computer-mediated human communication, designing social software, analysing social computing projects, crowdsourcing
Mode of delivery:
The course consists of lectures, exercises and individual / group-based assignments.
Learning activities and teaching methods:
The course consists of lectures (12h), exercises (16h), assignments and self-study (102h).
Target group:
M.Sc. and B.Sc. students. The course recommended for anyone who wishes to strengthen their expertise on social aspects of computational systems as well as designing for humans.
Prerequisites and co-requisites:
No recommended or required preparations.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time. The course involves design exercises that demand some experience with computer programs (not programming per se).
Recommended or required reading:
Required reading will be delivered during the course.
Assessment methods and criteria:
The course completion relies on a number of completed solo-works (such as reflections and evaluation of specific online systems that are graded). The majority of the numerical assessment is project-based. Students have to complete several individual exercises throughout the semester: ideating an application, designing various versions of its prototype, evaluating those prototypes, documenting the final application designs. Passing criteria: all stages of the project-based work must be completed, each receiving more than 50% of the available points.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Associate Professor Simo Hosio
Assistant Ville Paananen
Working life cooperation:
The course contains optional guest lectures.
Other information:
Uses Moodle as the learning environment: https://moodle.oulu.fi/course/view.php?id=4449

521156S: Towards Data Mining, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Satu Tamminen

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits
Language of instruction:
English
Timing:
Autumn, period I.
Learning outcomes:
After completing this course, student can recognize data types and perform required pre-processing steps before further analysis:

1. Student can design and implement a data collection process
2. Student can combine data from different sources
3. Student can normalize and transform data, and handle missing or incorrect values
4. Student can ensure generalizability of the results

Contents:
Course provides good ability to start Master's Thesis or graduate studies. Topics at the course include data mining process in general level, data gathering and different data types, quality and reliability of the data, data preparation including the processing of missing values, outliers, and privacy issues, combination of signals from several sources, utilization of data bases in data mining process, and normalization and transformation of data and interdependence of the observations and their distributions. Additionally, topics concerning the generality of the results are covered, as well as, the principles of data division, for example, train-test-validate, cross-validation and leave-one-out methods.
Mode of delivery:
Lectures, independent work, group work
Learning activities and teaching methods:
16 h lectures, 16 h exercises, independent studying.
Target group:
The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.
Prerequisites and co-requisites:
031021P Probability and Mathematical Statistics or similar
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. The material is mostly in English.
Assessment methods and criteria:
Weekly pre-lecture assignment + exercise submissions, and final exam. Half of the grade will be based on the submissions and half on the final exam.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Tamminen Satu
Working life cooperation:
-
Other information:
Moodle: https://moodle.oulu.fi/course/view.php?id=1679
Towards Data Mining 521156S:3

521291S: VR Systems and Humans, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Paula Alavesa

Opintokohteen kielet: English

ECTS Credits:
5 ECTS / 135 hours of work.
Language of instruction:
Primary instruction language is English.
Timing:
The course is held in the autumn semester, during period II. It is recommended to complete the course at the 4rd autumn semester.
Learning outcomes:
Upon completion of the course, the student will:

- Gain knowledge in human physiology and human perception in relationship to VR.
- Understand common perceptual flaws of modern VR systems related to resolution, latency, frame rates, tracking, lens aberrations, drift, and jitter.
- Be able to critically assess a given VR system or experience, and recommend improvements.
- Formulate a hypothesis about a VR experience, create such a VR experience in Unity3D, and design a human subject experiment testing the hypothesis.

Contents:
Overview of human physiology, neuroscience, and human perception with relationship to VR. Depth and scale perception. Perception of screen resolution, perception of motion. Perceptually optimal parameters for frame rate, latency, and drift in VR systems. Perceptual training. Comfort and VR sickness. Psychophysical experiments. Design of human subjects experiments.
Mode of delivery:
The lectures will be held online in Zoom https://oulu.zoom.us/j/64488083079
The courseMoodle site is at https://moodle.oulu.fi/enrol/index.php?id=3356

For exercise we will have three groups of 12 people that can attend at TS135. If the students do not have their own face masks, those will be provided. The students are expected to finish the exercise that require using VR headsets in two weeks. The students are also allowed to use their own VR headsets at home, and there are few headsets that can be borrowed for two weeks at a time. The exercise groups are held 4.11.-13.11., 18.11.-27.11. and 2.12.-11.12. During the first week of the course the students are expected to signup for one of these exercise groups, or independent work. There will be no exercise session during the first week of the course.
Learning activities and teaching methods:
The course will utilize the VR-ready computer room for both teaching and exercises. The course will consist of lectures (28h), individual lab exercises (28h), team project (28h), self-study (48h), and the final exam (3h). Parts of the exercise lab work will be organized as guided teaching.
Target group:
B.Sc. and M.Sc. students in all areas, especially applied computing and human sciences.
Prerequisites and co-requisites:
It is required that the students complete 521293A, Introduction to XR Systems, prior to enrolling for the course. It is recommended, but not required, that the students also take 521040A, 3D environments and Applications, prior to enrolling for the current course.
Recommended optional programme components:
The course is an independent entity, and does not require other additional studies carried out at the same time.
Recommended or required reading:
Online-material that is delivered throughout the course.
Assessment methods and criteria:
The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.
Grading:
Numerical (0-5). In the numerical scale zero stands for a fail.
Person responsible:
Paula Alavesa
Working life cooperation:
When possible, a guest lecture will be held by a visitor from a VR company.

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mehdi Safarpour

Opintokohteen kielet: English

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English.
Timing:
Autumn, period 1
Learning outcomes:
After completing the course, student

1. Can distinguish the main types of signal processors
2. Can design basic customized transport triggered architecture processors
3. Is capable of assembling a signal processor out of basic entities
4. Can match the processor performance and the application requirements
5. Applies the TTA codesign environment and Altera's FPGA tools to synthesize a system

Contents:
Examples of modern signal processing applications, main types of signal processors, parallel signal processing, transport triggered architectures, algorithm-architecture matching, TCE design environment and Altera FPGA tools.
Mode of delivery:
Lectures, exercises, independent work, group work.
Learning activities and teaching methods:
Lectures 12h (participation mandatory); Instructed labs 12h. Independent work 111h
Target group:
Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.
Prerequisites and co-requisites:
521267A Computer Engineering or 521286A Computer Systems (8 ECTS cr) or 521287A Introduction to Computer Systems (5 ECTS cr) and 521337A digital filters, programming skills

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Handouts.
Assessment methods and criteria:
Participation in mandatory classes and approved lab exercises and project works.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Mehdi Safarpour
Working life cooperation:
No.

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning, Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 135 hours of work

Language of instruction:

English

Timing:

Autumn Semester, period 1.

Learning outcomes:

Upon completion of this course, students know and understand the basics and advanced concepts of the following key areas of the course and cybersecurity, know key terminology and can write about the topics clearly and with justifications:

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

Additionally, students that have attained grades 2 or 3 have demonstrated technical capacity to perform practical work relevant to the course key areas. Students that have attained grades 4 or 5 have additionally demonstrated capacity for independent, ambitious work on the key areas working on advanced and challenging security research questions.

Contents:

The course covers the essential aspects of computer security and computer security research in theory and through practical examples.

Mode of delivery:

Contact teaching and independent work

Learning activities and teaching methods:

14 hours of lectures ja 28 hours of laboratory exercises, rest independent work alone or in groups.

Target group:

The course is intended for computer engineering masters students and additionally to any student interested in computer security that has the sufficient technical background to complete the course exercises.

Prerequisites and co-requisites:

As prior knowledge students should have a basic understanding of how computers, operating systems and the Internet work and basic skills in programming. Examples of suitable courses to cover these fundamentals are Operating Systems 521453A, Introduction to Programming 521141P and Computer Engineering 521267A.

Recommended optional programme components:

The course is an independent entity.

Recommended or required reading:

-

Assessment methods and criteria:

Grading of the course is made based on the course practical assignments.

Grading:

Numerical grade 0-5, where 0 stands for a fail.

Person responsible:

Juha Röning, Teemu Tokola

Working life cooperation:

-

Other information:

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

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:
5
Language of instruction:
Lecturing in Finnish, material available in English
Timing:
Spring, periods 3-4.
Learning outcomes:
1. After passing the course, the student is familiar with the design process of an embedded system, from specifying the application leading to the requirement specification for the device, and then to having produced a functional prototype of the defined system.
2. The student is more familiar with the roles of the client and the system developer during the requirement specification, and the role of the iterations as a part of the whole design process. From the specifications, the student is familiar with the process of choosing the suitable hardware components, circuit design and implementation. In the end, the student is also able to know the factors arising from the SW/HW partitioning process of the actual implementation, and the concept of SW/HW dualism. The student can then better utilize the basic development tools used for embedded system design and recognize their possible advantages and disadvantages.
3. The student is more familiar with the testing and problem solving methodology related to the prototype implementation of an embedded system, to have the prototype working correctly according to the specifications.
Contents:
The embedded system design process, from initial specification to implementation of a first functional prototype and demonstrating its functionality in practice. The application can be suggested by the student group, or chosen from the topics suggested by the course organizers. During the work, the students familiarize themselves with modern design tools and methodologies related to embedded system design (according to the microcontroller the student group has chosen to utilize in their work). Most commonly used platforms on the course include STM, Atmel and Microchip based platforms.

Mode of delivery:
Online teaching. Lectures, tutoring and self-study.
Learning activities and teaching methods:
The course is run as a project work in groups of three with progress follow-up reporting meetings. Lectures 10 h, laboratory exercise in period 3-4 120 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
811122P Introduction to Programming
521412A Digital Techniques I
Also recommended; 521275A Embedded Software Project, 521432A Electronics Design I.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
-
Assessment methods and criteria:
Project work.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Juha Röning
Working life cooperation:
None.

521043S: Internet of Things, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ella Peltonen

Opintokohteen kielet: English

Proficiency level:

Status:

ECTS Credits:
5 ECTS / 135 hours of work

Language of instruction:
English

Timing:
Autumn semester during period 2.

Learning outcomes:
Upon completion of the course, the student will be able to:
1. explain application areas of IoT and requirements from such application areas for IoT systems.
2. will be able to explain the state-of-the-art IoT solutions, and understand the basic technologies behind them.
3. learn the principles of the novel IoT technologies and know important directions IoT research towards.

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

Mode of delivery:
The course will be given fully remotely. Please join the Moodle page (https://moodle.oulu.fi/course/view.php?id=5330, password is iot2020) and attend the introduction Zoom lectures in Tue 27.10. 10:15-12 (for general organisation) and Wed 28.10. 14:15-16 (for course project).

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

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

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

Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.

Recommended or required reading:
Lecture hand-out, complementary reading list, and exercise material will be provided.

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

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

Person responsible:
Ella Peltonen

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

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

521288S: Multiprocessor Programming, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Praneeth Susarla

Opintokohteen kielet: Finnish

Leikkaavuudet:

521280S	DSP Laboratory Work	5.0 op

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
Spring semester, periods 3-4
Learning outcomes:
Upon completition of the course, the student:

1. has basic understanding of multiprocessor architectures and heterogeneous computing,
2. has basic understanding on how to design and implement algorithms for heterogeneous platforms,
3. understands the possible challenges and shortcomings related to the current heterogeneous systems,

4. is able to use the OpenCL framework for designing, implementing and optimizing signal processing algorithms for heterogeneous platforms

Contents:
Algorithm design, general purpose computing on graphics processing units, heterogeneous computing, OpenCL programming and optimization

Mode of delivery:
Opening lecture and independent exercise project, which is divided into smaller sub-entities. The exercise project is performed using both desktop and mobile platforms. After each sub-entity, a short seminar is held where the students discuss their results and possible ways to optimize the performance of their implementation.
Learning activities and teaching methods:
Opening lecture (2h), seminars (8h) and independent exercise project (125h).
Target group:
Computer Science and Engineering students + other Students of the University of Oulu. This is an advanced-level course intended for masters-level students and post-graduate students, especially to those who are specializing into signal processing.
Prerequisites and co-requisites:
Matrix Algebra 031078P, Elementary programming 521141P, Computer Systems 521286A, Digital Filters 521337A
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
-
Assessment methods and criteria:
Students complete the course exercises after the attending to the opening lecture in groups of two students. Assessment is based on the quality of the completed exercises and exercise reports. More detailed information on assessment will be announced at the beginning of the course.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Numerical grading scale 1-5; zero stands for a fail.
Person responsible:
Praneeth Susarla
Working life cooperation:
No.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits / 135 hours of work
Language of instruction:
English
Timing:
The course is held in the autumn semester, during period II. For master students of Computer Science and Engineering specializing in Computer Engineering, it is recommended to complete the course at the first autumn semester.
Learning outcomes:
Learning outcomes of the course are:

1. The student understands common real number formats used in digital signal processing.
2. The student can implement a digital filter using fixed-point computations. He can optimize word lengths so that the required performance goals are fulfilled.
3. The student knows the CORDIC algorithm and can utilize it in the implementation of function and transform (e.g. DCT) computations.
4. The student knows the principles, which allow computationally efficient implementation of decimation and interpolation operations. Related to this, he can implement narrow-band digital filters.

5. The student can explain how a modulated filter bank works and knows its polyphase decomposition based implementation.
6. The student can implement convolution for long data sequences and filters. He also knows, how the same principles are used in the implementation of correlation.
7. The student can explain the general operational principles of adaptive filters and knows some of their applications. He knows operation of some common adaptive algorithms. He can study behaviour of adaptive filters with simulation.

Some exercise tasks of the course are done in the Matlab environment utilizing also its Simulink tool. The student learns how it can be used in the modelling of signal processing systems.

Contents:
Fixed-point and floating-point arithmetics, fixed-point filter implementation, CORDIC, DCT, FFT, polyphase decomposition, multirate signal processing, modulated filter banks, sectioning, adaptive filters and algorithms, Matlab and Simulink tools in DSP modelling.
Mode of delivery:
The tuition will be implemented as face-to-face teaching and web-based teaching. Moodle is used as the learning environment.
Due to Covid-19 pandemic, teaching in Autumn 2020 will be implemented remotely. Details of arrangement can be found from the course web page, which will be available from October 16 in Moodle.
Learning activities and teaching methods:
Lectures 28 h / Group work 42 h / Self-study 65 h. The group work consists of six weekly design tasks.
Target group:
The course is primarily targeted to the students of Computer Science and Engineering specializing to Computer Engineering.
Prerequisites and co-requisites:
A recommended prerequisite is the completion of "521337A Digital Filters".
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 provides lecture notes for reading. In addition, the following books provide useful information:
E.C. Ifeachor, B.W. Jervis. Digital Signal Processing - A Practical Approach. Second Edition. Prentice-Hall, 2002.
W.T. Padgett, D.V. Anderson. Fixed-Point Signal Processing. Morgan&Claypool Publishers, 2009.
Assessment methods and criteria:
The course uses continuous assessment, which is based on evaluation of the weekly group works and exams arranged during lectures.
Grading:
The course utilizes a numerical grading scale 0-5. In the numerical scale zero stands for a fail.
Person responsible:
Pekka Sangi
Working life cooperation:
The course does not contain working life cooperation. There may be guest lectures.
Other information:

The web page of the course arranged at Autumn 2020 will be https://moodle.oulu.fi/course/view.php?id=3212

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Christian Wieser

Opintokohteen kielet: English

ECTS Credits:
7
Language of instruction:
Finnish/English, material available in English.
Timing:
Autumn, periods 1-2.

Learning outcomes:
After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.
Contents:
Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.
Mode of delivery:
Face-to-face and independent studies.
Learning activities and teaching methods:
Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.
Target group:
Computer Science and Engineering students and other Students of the University of Oulu.
Prerequisites and co-requisites:
521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.
Recommended optional programme components:
The course is an independent entity and does not require additional studies carried out at the same time.
Recommended or required reading:
Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.
Assessment methods and criteria:
Project work and documentation.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
The course unit utilizes a numerical grading scale 1-5. In the numerical scale zero stands for a fail.
Person responsible:
Christian Wieser
Working life cooperation:
-
Other information:
-

A452295: Advanced Module / Artificial Intelligence, 25 - 60 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional Studies:l Artificial Intelligence, Choose f.g. from the following courses total 30 ECTS cr

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning, Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 135 hours of work

Language of instruction:

English

Timing:

Autumn Semester, period 1.

Learning outcomes:

Upon completion of this course, students know and understand the basics and advanced concepts of the following key areas of the course and cybersecurity, know key terminology and can write about the topics clearly and with justifications:

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

Additionally, students that have attained grades 2 or 3 have demonstrated technical capacity to perform practical work relevant to the course key areas. Students that have attained grades 4 or 5 have additionally demonstrated capacity for independent, ambitious work on the key areas working on advanced and challenging security research questions.

Contents:

The course covers the essential aspects of computer security and computer security research in theory and through practical examples.

Mode of delivery:

Contact teaching and independent work

Learning activities and teaching methods:

14 hours of lectures ja 28 hours of laboratory exercises, rest independent work alone or in groups.

Target group:

The course is intended for computer engineering masters students and additionally to any student interested in computer security that has the sufficient technical background to complete the course exercises.

Prerequisites and co-requisites:

As prior knowledge students should have a basic understanding of how computers, operating systems and the Internet work and basic skills in programming. Examples of suitable courses to cover these fundamentals are Operating Systems 521453A, Introduction to Programming 521141P and Computer Engineering 521267A.

Recommended optional programme components:

The course is an independent entity.

Recommended or required reading:

-

Assessment methods and criteria:

Grading of the course is made based on the course practical assignments.

Grading:

Numerical grade 0-5, where 0 stands for a fail.

Person responsible:

Juha Röning, Teemu Tokola

Working life cooperation:

-

Other information:

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

031051S: Numerical Matrix Analysis, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Marko Huhtanen

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

Finnish or English.
The course can be completed in English by intermediate exams or by a final exam.

Timing:

Fall semester, period 1

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

-

Prerequisites and co-requisites:

Completion of courses Calculus I and II, a course on Differential Equations and a Course on Linear Algebra and Numerical analysis

Recommended optional programme components:

-

Recommended or required reading:

Material posted on the web-page of the course.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Marko Huhtanen

Working life cooperation:

-

Other information:

-

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Ojala, Timo Kullervo
Opintokohteen kielet: Finnish

ECTS Credits:

8 ECTS credits / 213 hours of work

Language of instruction:

English.

Timing:

Autum and spring, periods 1-4.

Learning outcomes:

Upon completing the course, the student is able to:
1. conduct independent research as a responsible member of a research group;
2. conduct a literature survey;
3. apply theoretical knowledge in solving a practical problem;
4. design, implement and evaluate a prototype;
5. collect and analyze research data;
6. report research results in form of a scientific publication and an oral presentation.

Contents:

The student conducts independently a small-scale research work under the supervision of a senior researcher. Topics for research works can be requested from research group leaders and senior researchers.

Mode of delivery:

Self-study, meetings with the supervisor of the work.

Learning activities and teaching methods:

Independent project work 213 h.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Literature is selected for each research work separately.

Assessment methods and criteria:

Assessment is based on the scientific publication and the oral presentation reporting the research 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:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

521348S: Statistical Signal Processing 1, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes, Janne Lehtomäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521484A	Statistical Signal Processing	5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st semester of the master studies.

Learning outcomes:

Upon completion the student

1. knows the key tools of linear algebra and quadratic optimization and can apply them in solving signal processing problems.
2. understands how to handle complex valued random variables and processes.
3. understands the key concepts in estimation theory such as the classical and Bayesian philosophies.
4. masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators.
5. can derive an estimator for a given criterion and basic data models.
6. can use the methodology of estimation theory to analyze the performance of estimators and compare to performance benchmarks such as the Cramer-Rao lower bound.
7. understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), the Neyman-Pearson and Bayesian detectors.

Contents:

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

Mode of delivery:

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

Learning activities and teaching methods:

Face-to-face-teaching (lectures and exercises) 50h, Matlab simulation exercises in groups 30 h, independent work & passed assignment 50 h.

Target group:

Electrical, communications and computer science and engineering students.

Prerequisites and co-requisites:

The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal Analysis, 031021P Probability and Mathematical Statistics, 031078P Matrix Algebra, 521330A. The recommended prerequisite is the completion of Telecommunication Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Parts from books:
1. Steven M Kay, "Fundamentals of statistical signal processing: estimation theory."vol 1 Prentice Hall 1993.
2. Steven M. Kay, "Fundamentals of statistical signal processing: Detection theory, vol. 2." Prentice Hall 1999.
3. Peter Selinger, “Matrix Theory and Linear Algebra”, Creative Commons.
4. Paolo Prandoni & Martin Vetterli, Martin, “Signal Processing for Communications”, CRC Press 2008.
5. Other literature, lecture notes and material.

Assessment methods and criteria:

Completing the simulation project tasks, and a mid-term exam during the course. The mid-term exams can be retaken by a final exam later. In the final grade of the course, the weight for the examination is 0.7 and that of project report 0.3.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero (0) stands for a fail.

Person responsible:

Janne Lehtomäki and Markku Juntti

Working life cooperation:

No

Other information:

Lecture materials etc. can be found on Moodle https://moodle.oulu.fi/course/view.php?id=4203.

521291S: VR Systems and Humans, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Paula Alavesa

Opintokohteen kielet: English

ECTS Credits:

5 ECTS / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the autumn semester, during period II. It is recommended to complete the course at the 4rd autumn semester.

Learning outcomes:

Upon completion of the course, the student will:

- Gain knowledge in human physiology and human perception in relationship to VR.
- Understand common perceptual flaws of modern VR systems related to resolution, latency, frame rates, tracking, lens aberrations, drift, and jitter.
- Be able to critically assess a given VR system or experience, and recommend improvements.
- Formulate a hypothesis about a VR experience, create such a VR experience in Unity3D, and design a human subject experiment testing the hypothesis.

Contents:

Overview of human physiology, neuroscience, and human perception with relationship to VR. Depth and scale perception. Perception of screen resolution, perception of motion. Perceptually optimal parameters for frame rate, latency, and drift in VR systems. Perceptual training. Comfort and VR sickness. Psychophysical experiments. Design of human subjects experiments.

Mode of delivery:

The lectures will be held online in Zoom https://oulu.zoom.us/j/64488083079
The courseMoodle site is at https://moodle.oulu.fi/enrol/index.php?id=3356

For exercise we will have three groups of 12 people that can attend at TS135. If the students do not have their own face masks, those will be provided. The students are expected to finish the exercise that require using VR headsets in two weeks. The students are also allowed to use their own VR headsets at home, and there are few headsets that can be borrowed for two weeks at a time. The exercise groups are held 4.11.-13.11., 18.11.-27.11. and 2.12.-11.12. During the first week of the course the students are expected to signup for one of these exercise groups, or independent work. There will be no exercise session during the first week of the course.

Learning activities and teaching methods:

The course will utilize the VR-ready computer room for both teaching and exercises. The course will consist of lectures (28h), individual lab exercises (28h), team project (28h), self-study (48h), and the final exam (3h). Parts of the exercise lab work will be organized as guided teaching.

Target group:

B.Sc. and M.Sc. students in all areas, especially applied computing and human sciences.

Prerequisites and co-requisites:

It is required that the students complete 521293A, Introduction to XR Systems, prior to enrolling for the course. It is recommended, but not required, that the students also take 521040A, 3D environments and Applications, prior to enrolling for the current course.

Recommended optional programme components:

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

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (0-5). In the numerical scale zero stands for a fail.

Person responsible:

Paula Alavesa

Working life cooperation:

When possible, a guest lecture will be held by a visitor from a VR company.

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish/English

Timing:

Autumn semester, Period II

Learning outcomes:

Upon completing this course, students will possess:

1. Knowledge of Human Computer Interaction (HCI) fundamentals
2. Knowledge and practical experience of user-centric computer interface and usability evaluation techniques, such as questionnaires and interviewing
3. Knowledge and experience of prototyping techniques (both paper-based as well as digital)
4. Knowledge of how HCI can be incorporated in the software development process

Contents:

Fundamental knowledge of humans, and how that relates to computer systems and interfaces. Learning design in 2-3 different ways, and conducting evaluations of the designs. Evaluation constitutes data collection and analysis, including qualitative and quantitative data.

Mode of delivery:

Online teaching (lectures), group work (labs).

Learning activities and teaching methods:

Lectures (12 h), exercises (16 h), and practical work (105 h). The course is passed with approved classroom/reading package reflections, and an approved group-based practical work (several assignments). The implementation is doable fully in English.

Target group:

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

Prerequisites and co-requisites:

While no specific courses are not required, elementary teamwork skills are required and the capability to provide documentation.

Recommended optional programme components:

All necessary material will be provided by the instructor.

Recommended or required reading:

No required reading.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Associate Professor Simo Hosio

Working life cooperation:

If relevant, guest lectures may be organized (optional).

Other information:

Using Moodle as the teaching platform: https://moodle.oulu.fi/course/view.php?id=5409

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01 Distributed Systems, Exam 0.0 op

521266S-02 Distributed Systems, Exercise Work 0.0 op

521266S Distributed Systems 6.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, period 3.

Learning outcomes:

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

Contents:

Introduction, architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, case studies.

Mode of delivery:

Online teaching

Learning activities and teaching methods:

Lectures 22 h, exercises 16 h, project work 50 h, self-study 47 h.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

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

Recommended or required reading:

Required literature: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems – Principles and Paradigms, Third Edition, 2017.

Assessment methods and criteria:

The course uses continuous assessment so that there are 2 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

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

Grading:

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

Person responsible:

Teemu Leppänen

Working life cooperation:

None.

Other information:

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

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Olli Silven
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Online teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Online lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silven

Working life cooperation:

None.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Open University students enroll for studies through an open website.

521293A: Introduction to XR Systems, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Paula Alavesa

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the spring semester, during period III. It is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

Upon completion of the course the students will be able to:

- Recall all of the components of modern XR systems
- Understand the interaction between the hardware, software, and human senses during an XR experience.
- Understand how the choices in hardware and software components influence human perception and the quality of XR experiences.
- Identify challenges facing next generation XR systems.
- Develop a basic VR experience using Unity3D.

Contents:

Overview of XR hardware: projectors, screens, light field displays, retinal scanners, waveguides. Overview of XR systems software: rendering systems and methods (gaming engines, panoramas, telepresence) tracking systems and methods (inside-out and inside-in tracking, camera-based methods, lighthouse, natural and artificial markers, IMU integration, sensor fusion. High level overview of human physiology, neuroscience, and human perception in relation to XR hardware and software.

Mode of delivery:

Online

Learning activities and teaching methods:

The course will consist of lectures (28h), individual lab exercises (28h), solo project (28h), self-study (48h), online final exam (3h). Students can borrow equipment from the lab to minimize the need for lab attendance. It is also possible, in small groups (<10), to do the exercise in the lab, however we aim to minimize any need for face to face teaching with other arrangements.

Target group:

B.Sc. students in all areas, especially applied computing and human sciences.

Prerequisites and co-requisites:

No prerequisites.

Recommended optional programme components:

The course is an independent entity, and does not require other additional studies carried out at the same time. It can also be considered as the first in the set of courses on VR and XR. It should be taken before VR Systems and Humans course (521291S) and 3D environments and Applications (521040A).

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments, in-lecture quizzes, final project, and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (0-5). In the numerical scale zero stands for a fail.

Person responsible:

Anna LaValle.

Working life cooperation:

When possible, a guest lecture will be held by a visitor from a VR company.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will able to:
* explain the general principles of scientific research and the practices of scientific methodology,
* generate research problems in information processing sciences,
* identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem,
* evaluate the methodological quality of a research publication, as well as
* 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:

Blended teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended or required reading:

Lecture slides and specified literature.

Assessment methods and criteria:

Accepted learning diary, active participation

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:

The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

Upon completion of this course, students:

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

Contents:

RESTful Web APIs, Hypermedia and HATEOAS, RESTful Clients

Mode of delivery:

Online learning.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory exercise 15 h, the rest as self-study and group work. Each group implements software and writes a report. Students present their work at least twice in online meetings with the course staff.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming (521141P) or equivalent Python programming skills. Applied computing project I is recommended.

Recommended optional programme components:

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

Recommended or required reading:

Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:

Course will be assessed based on project work assignment (functional working software prototype, content of the report…) and the exercises results. More detailed information on assessment will be provided with the course material.

Grading:

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

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

We will use Moodle to provide links to the working tools and information about distance learning: https://moodle.oulu.fi/course/view.php?id=6032

Course material can be found at Lovelace: https://lovelace.oulu.fi/.

521292S: Fundamentals of Sensing, Tracking and Autonomy, 5 op

Voimassaolo: 01.08.2020 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Steven LaValle

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work.

Language of instruction:

Primary instruction language is English.

Timing:

The course is held in the spring semester, during period III. It is recommended to complete the course at the 4rd spring semester.

Learning outcomes:

Upon completion of the course the students will be able to:

- Deeply understand the fundamentals common to widely used sensing and filtering systems.
- Design new sensors and filters.

- Apply the material to critical problems in robotics, internet of things, and virtual and augmented reality.
- Understand the links between theory and practice in sensing and filtering systems.

Contents:

Defining sensors; physical vs virtual sensors. Chronometers, cameras, infrared, laser, temperature, IMU. Sensor mappings, resolution, noise, calibration. Preimages, sources of uncertainty, comparing sensors, stochastic modeling. Multiple sensor readings and networks of sensors. Triangulation principles. Motion models: Discrete time, continuous time, event-based. Linear, complementary, Kalman, Bayesian, and combinatorial filters. Localization and mapping; global positioning systems; tracking humans.

Mode of delivery:

Online teaching.

Learning activities and teaching methods:

The course will consist of lectures (28h), individual homework assignments (48h), self-study (56h), final exam (3h).

Target group:

M.Sc. students in CSE, EE, and related areas.

Prerequisites and co-requisites:

Matrix Algebra (mandatory BSc 1st year); Differential Equations (mandatory BSc 1st year); Introduction to Computer Systems (mandatory BSc 2nd year); Mathematical Structures for Computer Science (mandatory BSc 2nd year).

Recommended optional programme components:

The course does not require other courses to be completed simultaneously. This course is the first part of a two-part series, in which the second part would finish tracking and cover autonomy. The course fundamentals complement parts of 521287A Introduction to Computer Systems, which provides experimental practice with sensors. The course is related to 521161S Multi-Modal Data Fusion as applied artificial intelligence, but instead has emphasis on geometric concepts and use cases derived from robotics, IoT, and VR/AR. The course has minor overlap with 521124S Sensors and Measuring Techniques, which focuses on experimentation, data collection, and sensor selection.

Recommended or required reading:

Online-material that is delivered throughout the course.

Assessment methods and criteria:

The students are assessed according to their performance in assignments and the final exam. The assessment criteria are based on the learning goals of the course.

Grading:

Numerical (1-5).

Person responsible:

Steven LaValle

Working life cooperation:

The course does not contain working life cooperation.

521282S: Biosignal Processing II, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Kortelainen

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS cr

Language of instruction:

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

Timing:

Period 4

Learning outcomes:

After completing the course, student
1. knows the special characteristics of neural signals and the typical signal processing methods related to them
2. can solve advanced problems related to the neural signal analysis

Contents:

Introduction to neural signals, artifact removal, anesthesia and natural sleep, topographic analysis and source localization, epilepsy, evoked potentials.

Mode of delivery:

Online teaching / Moodle

Learning activities and teaching methods:

Lectures (8 h) and laboratory work (20 h), written exam.

Target group:

Engineering students, medical and wellness technology students, and other students interested in biomedical engineering. Students of the University of Oulu.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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Recommended or required reading:

The course is based on selected parts from books "EEG Signal Processing", S. Sanei and J. A. Chambers, "Bioelectrical Signal Processing in Cardiac and Neurological Applications", L. Sörnmo and P. Laguna, and "Neural Engineering", B. He (ed.) as well as lecture slides and task assignment specific material.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Kortelainen

Working life cooperation:

-

Other information:

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

521157A: Introduction to Social Network Analysis, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 120 hours of works

Language of instruction:

English

Timing:

Period 4. It is recommended to complete the course at the end of period 4

Learning outcomes:

Upon completing the course, the student is expected to i) understand social aspects of the web; ii) learn to collect, clean and represent social media data; iii) quantify important properties of social media; iv) find and analyze (online) communities; v) understand the diffusion process in social network; vi) familiarize with simple modelling toolkits for social media analysis

Contents:

The course describes basics of social network analysis, allowing the students to understand structure and evolution of the network, while enabling them to use appropriate tools and techniques to draw inferences and discover hidden patterns from the network. The course is designed to accommodate computer science, mathematical and social science student background, which helps in emergence of multi-disciplinary research in the university

Mode of delivery:

Face- to-face teaching and laboratory sessions

Learning activities and teaching methods:

Lectures (24 h), tutorial/laboratory sessions (12h), seminar (6 h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.

Target group:

Students with moderate logical reasoning skills

Prerequisites and co-requisites:

None

Recommended optional programme components:

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

Recommended or required reading:

R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014

Assessment methods and criteria:

One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mourad Oussalah

Working life cooperation:

-

Other information:

We hope to attract students from humanties, economics and political in order to encourage multidisciplinary studies and enforce interesting student projects where each group contains at least one student from computer science and one from another faculty.

521045S: Mobile Computing, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Aku Visuri

Opintokohteen kielet: English

Leikkaavuudet:

521046A	Mobile Computing	5.0 op
521147S	Mobile and Social Computing	5.0 op

Timing:

Person responsible:

Aku Visuri

Other information:

Course is in Moodle
https://moodle.oulu.fi/course/view.php?id=6195
New code and the course is 521046A Mobile Computing.
See course description 521046A Mobile Computing, 5 ECTS cr.

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pekka Sangi, Jaakko Suutala

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

The course in held in the spring semester, during period III. For bachelor students of Computer Science and Engineering specializing to artificial intelligence, it is recommended to complete the course at the 3rd spring semester.

Learning outcomes:

After completing the course, students

1. know the basic search strategies that can be applied in problem solving and optimization.
2. understand how search-based decisions are made in game-like competitive applications.
3. know the basic principles of probabilistic reasoning in artificial intelligence systems.
4. know how rational decision making under uncertainty can be formulated using utility theory.
5. understand the fundamentals of machine learning and how some of the established methods can be applied to problems in AI.
6. are familiar with advanced AI applications of perception and robotics and how probabilistic inference and machine learning can be used in these settings.

In the course projects, students get some experience in programming and using search methods.

Contents:

intelligent agent types, uninformed search methods, informed (heuristic) search, local search, constraint satisfaction problems, adversarial search, uncertainty handling, probabilistic reasoning, utility, machine learning, decision networks, Markov decision process, reinforcement learning, applications

Mode of delivery:

The tuition is implemented as web-based teaching. Moodle environment is used in the course.

Due to Covid-19 pandemic, teaching in Spring 2021 will be implemented remotely. Course work space can be found from University of Oulu Moodle platform.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211, where details of implementation will be provided. The page will be available from December 21, 2020.
Online lectures will be given with Zoom and link for them will be provided in Moodle.

Learning activities and teaching methods:

Lectures 28 h / Group work (programming projects) 42 h / Self-study 65 h

Target group:

The primary target group is the students of the Computer Science and Engineering specializing in Artificial Intelligence.

Prerequisites and co-requisites:

Completion of the course "521160P Introduction to Artificial Intelligence" (lectured in Finnish) is recommended, but is not a prerequisite. It is also recommended that a student has completed studies related to probability and statistics (e.g. course "031021P Probability and Mathematical Statistics") and Python programming (e.g. course "521141P 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:

The course is based on the book Stuart Russell, Peter Norvig (2010, global edition 2016): Artificial Intelligence: A Modern Approach (3rd Edition), Chapters 1-6, 13-18, 20-21, partly 24-25.
The course utilizes materials of an introductory course on artificial intelligence taught at UC Berkeley (http://ai.berkeley.edu).

Assessment methods and criteria:

The assessment of the course is based on the final exam. Both the final exam and the course projects must be passed. Well-done course projects can increase the grade by one unit.

Grading:

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

Person responsible:

Pekka Sangi, Jaakko Suutala

Working life cooperation:

The course does not contain working life cooperation.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Moodle page in Spring 2021 will be https://moodle.oulu.fi/course/view.php?id=3211

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

Spring, period 4.

Learning outcomes:

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

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Contents:

1. Introduction
2. Fundamentals of digital image
3. Intensity transformations and spatial filtering
4. Image processing in frequency domain
5. Restoration
6. Color image processing
7. Wavelets and multi-scale processing
8. Compression
9. Morphological image processing
10. Segmentation

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and homework assignments 30 h. The rest is independent work.

Target group:

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

Prerequisites and co-requisites:

521141P Elementary Programming or equivalent Python programming skills.

Recommended optional programme components:

None.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Third Edition, Prentice-Hall, 2008, Chapters 1-10.
Lecture notes and exercise

Assessment methods and criteria:

The course is completed by passing the exam and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

Other information:

Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=6840

A452300: Advanced Module / Applied Computing, 23 - 28 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional Studies: Applied Computing, Choose f.g. from the following courses total 35 ECTS cr. You can find more studies in the study guide https://weboodi.oulu.fi/oodi/opasopiskopas.jsp

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Christian Wieser

Opintokohteen kielet: English

ECTS Credits:

7

Language of instruction:

Finnish/English, material available in English.

Timing:

Autumn, periods 1-2.

Learning outcomes:

After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

Phases of software engineering process: requirement gathering, analysis, design, implementation, testing, (maintenance). Project-work, starting a project, project management, working with external parties, project documentation. Project related implementation techniques and tools, software documentation.

Mode of delivery:

Face-to-face and independent studies.

Learning activities and teaching methods:

Working methods: The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited. Lectures 10 h, design project in period 4-6 180 h.

Target group:

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

Prerequisites and co-requisites:

521457A Software Engineering, 521453A Operating Systems, 521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and varying project related background reading.

Recommended optional programme components:

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

Recommended or required reading:

Pressman, R.S.: Software Engineering A Practitioner's Approach, 4th edition, Mc Graw-Hill, 1997; Phillips, D.: The Software Project Manager's Handbook, IEEE Computer Society, 2000; Project documentation; project related manuals and handbooks.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Christian Wieser

Working life cooperation:

-

Other information:

-

811372A: Software Development, Maintenance and Operations, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Mäntylä

Opintokohteen kielet: English

Leikkaavuudet:

ay811372A	Software Development, Maintenance and Operations (OPEN UNI)	5.0 op
815312A	Software Production and Maintenance	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

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

Learning outcomes:

After completing the course, the student will able to:
* explain and utilize theories of software evolution,
* utilize the processes, techniques and tools for software deployment, and operations,
* utilize the processes, techniques and tools for software maintenance, as well as
* utilize the processes, techniques and tools to better understand and maintain large code bases.

Contents:

* Software Maintenance and Evolution
* Software Product Lines
* Software Maintenance and Evolution Models
* DevOps
* Reengineering
* Legacy Systems

Mode of delivery:

Blended teaching

Learning activities and teaching methods:

Lectures (Video): 20 h, exercises / assignments 78 h, weekly study 42 h

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and programming.

Recommended or required reading:

Videos, books, exercises

Assessment methods and criteria:

Exercises, assignements

Grading:

Numerical scale 1-5 or fail

Person responsible:

Mika Mäntylä

521155S: Computer Security, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning, Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr / 135 hours of work

Language of instruction:

English

Timing:

Autumn Semester, period 1.

Learning outcomes:

Upon completion of this course, students know and understand the basics and advanced concepts of the following key areas of the course and cybersecurity, know key terminology and can write about the topics clearly and with justifications:

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

Additionally, students that have attained grades 2 or 3 have demonstrated technical capacity to perform practical work relevant to the course key areas. Students that have attained grades 4 or 5 have additionally demonstrated capacity for independent, ambitious work on the key areas working on advanced and challenging security research questions.

Contents:

The course covers the essential aspects of computer security and computer security research in theory and through practical examples.

Mode of delivery:

Contact teaching and independent work

Learning activities and teaching methods:

14 hours of lectures ja 28 hours of laboratory exercises, rest independent work alone or in groups.

Target group:

The course is intended for computer engineering masters students and additionally to any student interested in computer security that has the sufficient technical background to complete the course exercises.

Prerequisites and co-requisites:

As prior knowledge students should have a basic understanding of how computers, operating systems and the Internet work and basic skills in programming. Examples of suitable courses to cover these fundamentals are Operating Systems 521453A, Introduction to Programming 521141P and Computer Engineering 521267A.

Recommended optional programme components:

The course is an independent entity.

Recommended or required reading:

-

Assessment methods and criteria:

Grading of the course is made based on the course practical assignments.

Grading:

Numerical grade 0-5, where 0 stands for a fail.

Person responsible:

Juha Röning, Teemu Tokola

Working life cooperation:

-

Other information:

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

521286A: Computer Systems, 8 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521142A	Embedded Systems Programming	5.0 op

ECTS Credits:

8 ECTS cr

Language of instruction:

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

Timing:

Autumn, periods 1-2.

Learning outcomes:

Upon completion of the course:
Student understands the basic computer architecture and organization.
Student understands CPU operation and basic datapath operation.
Student knows different 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 is able to implement small assembly language programs.
Student recognizes how embedded systems programming is different from programming general-purpose computers.

Contents:

Overview of computer architecture and organization, CPU and datapath, memory hierarchies, data types, interrupts, registers and I/O, basics of the C programming language and basics of assembly language. Embedded systems programming.

Mode of delivery:

Web-based teaching + face-to-face teaching.

Learning activities and teaching methods:

Lectures (32h), course exercises (10-30h), laboratory exercise (3h) and two course projects, one is completed in a group and the other alone.

Target group:

2nd year students of computer science and engineering and 3rd year students of Electronics and Communications 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 and exercise material are available in the course website.
Literature:
Bryant & O'Hallaron, Computer Systems: A Programmer's Perspective, 3rd Edition, Chapters 1-9.
Patterson & Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Chapters 1-2, 4-5.
Patterson & Hennessy, Computer Organization and Design, 5th Edition: The Hardware/Software Interface, 2014.
Bryant & O'Hallaron, Computer Systems: A Programmer's Perspective, 2016.

Assessment methods and criteria:

The assessment criteria is based on the learning outcomes of the course. Students complete the course exercises, participate to the laboratory exercise and complete the course projects. Assessment is based on the exercises and the course projects. More detailed information on assessment is published in the lecture material.

Grading:

Numerical grading scale 1-5, zero stands for fail.

Person responsible:

Teemu Leppänen

Working life cooperation:

Visiting lectures with experts from local industry are possible.

Other information:

The course learning platform is Lovelace (lovelace.oulu.fi).

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Tokola

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

Lecturing in Finnish, material available in English

Timing:

Spring, periods 3-4.

Learning outcomes:

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

Contents:

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

Mode of delivery:

Online teaching. Lectures, tutoring and self-study.

Learning activities and teaching methods:

The course is run as a project work in groups of three with progress follow-up reporting meetings. Lectures 10 h, laboratory exercise in period 3-4 120 h.

Target group:

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

Prerequisites and co-requisites:

811122P Introduction to Programming
521412A Digital Techniques I
Also recommended; 521275A Embedded Software Project, 521432A Electronics Design I.

Recommended optional programme components:

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

Recommended or required reading:

-

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Juha Röning

Working life cooperation:

None.

521495S: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2005 - 31.07.2012

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Pietikäinen, Matti

Opintokohteen kielet: English

ECTS Credits:

5

Language of instruction:

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

Timing:

Periods 4-5

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:

25 hours of lectures and a programming exercise (approximately 25 hours) during periods 4-5.
Prerequisites and co-requisites:

Target group:

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Prerequisites and co-requisites:

Programming skills.

Recommended optional programme components:

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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.

Grading:

1-5 / fail.

Person responsible:

Professor Matti Pietikäinen.

Working life cooperation:

-

Other information:

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811607S: Persuasive Systems Design, 5 op

Voimassaolo: 01.08.2019 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Information Processing Science DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Oinas-Kukkonen, Harri Ilmari
Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 1st spring semester of the Master's studies.

Learning outcomes:

After passing the course a student will be able to:
* analyze methods and techniques employed by persuasive systems,
* apply such methods in an ethical manner as design guidelines for developing persuasive ICT solutions, as well as
* apply gamification as persuasive design principles for serious games and other similar solutions.

Contents:

Attitudinal theories from social psychology have been quite extensively applied to the study of user intentions and behaviour. These theories have been developed mostly for predicting user acceptance of information technology rather than for providing systematic analysis and design methods for developing software solutions that aim at attitude or behaviour change. At the same time a growing number of information technology systems and services are being developed for these purposes.
This course will focus on persuasive technology. It will address the process of designing and evaluating persuasive systems, the types of content and software functionality in such systems, the underlying assumptions behind these, methods for analysing the persuasion context, and principles for persuasive system design. The course also looks into the methods and techniques of gamifying persuasive content. The course is primarily geared towards analysis and design tasks using the Persuasive Systems Design model as the main approach. Gamification forms another segment of the course, introducing topics in the role of games and game-like experiences in supporting persuasion.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 20h, readings before lectures 21h, personal reflective exercises 21h, supervisory meetings 14h, project assignment 48h, other course related activity 10h.

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended optional programme components:

This course offers good groundwork for ICT and Behaviour Change course, but is not compulsory.

Recommended or required reading:

Research articles to be announced more specifcally during the course implementation

Assessment methods and criteria:

Participation in lectures, personal reflection reports, course assignments.

Grading:

Numerical scale 1-5 or fail

Person responsible:

Harri Oinas-Kukkonen

812671S: User Experience (UX) and Usability Evaluation, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Dorina Rajanen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work.

Language of instruction:

English

Timing:

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

Learning outcomes:

After completing the course, the student will be able to:
* design and follow through a UX/usability evaluation process,
* design test scenarios and tasks,
* select participants,
* plan and follow through the evaluation in laboratory or in the field, as well as
* analyse and report the findings from the evaluations.

Contents:

Basic terms and types of UX and usability testing, usability and UX tests process, usability and UX test tasks and scenarios, test subjects, following through a usability and UX tests, analysing usability and UX test material, reporting the findings from usability and UX tests.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24h, assignment tutoring 13h, assignment 90h, seminar 7h.

Target group:

MSc students

Prerequisites and co-requisites:

The recommended prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Servitisation, Co-Creation and Business Development.

Recommended optional programme components:

Recommended or required reading:

Dumas, J. S. & Redish, J. C. (1993): A Practical Guide to Usability Testing. Ablex Publishing Corporation. Rubin, J. (1994): Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests. Chichester: John Wiley & Sons, Inc.

Assessment methods and criteria:

Assessment of the course is based on the learning outcomes of the course based on the written usability test plan, supervised usability tests, written usability test report and oral seminar presentation

Grading:

Pass or fail

Person responsible:

Mikko Rajanen

Working life cooperation:

Students learn how to collaborate with real customers

Other information:

521275A: Embedded Software Project, 8 op

Voimassaolo: 01.08.2007 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Teemu Tokola
Opintokohteen kielet: English

ECTS Credits:

8

Language of instruction:

Material in English, lectures and guidance of individual groups available in English.

Timing:

Spring, periods 3-4.

Learning outcomes:

1. Can work independently on a non-trivial problem

2. Knows how to write a thesis and has gained lot of experience on refining text

3. Can make a scientific background study on a topic

4. Has increased experience on implementing an embedded software

5. Has improved group work and project skills

Contents:

This course familairizes the student with modern embedded system development with modern methods and tools. Topics: Development tools, practical application program for an embedded system. The students additionally work on the application topic through scientific papers and use their application program to produce a scientific work of their own.

Mode of delivery:

Remote teaching, guidance meetings and independent project work in groups.

Learning activities and teaching methods:

Pair project with monitoring meetings and a compulsory exercise. Lectures 30 h, design exercise in period 3-4 180 h.

Target group:

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

Prerequisites and co-requisites:

521457A Software Engineering, 521286A Computer Systems or 521142A Embedded Systems Programming. In addition, 521453A Operating Systems be beneficial.

Recommended optional programme components:

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

Recommended or required reading:

Course website, hardware data sheets and manuals, scientific publications.

Assessment methods and criteria:

Project report and a demonstrated implementation.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Teemu Tokola

Working life cooperation:

The topics of the course are relevant research topics with applications in the industry, and visiting lecturers are occasionally arranged to shed light on how the course topics are applied in the industry.

Other information:

The 521275A course offers the possibility to complete your Bachelor thesis in a structured course environment. The course is suitable also for students who do not use the course for their Bachelor Thesis. Course work space can be found from University of Oulu Moodle platform: https://moodle.oulu.fi/course/view.php?id=5927.

521140S: Computer Graphics, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521493S	Computer Graphics	7.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

In English

Timing:

Spring, period 4.

Learning outcomes:

Upon comletion of the course, the student

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clippin
2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling
3. is able to explain the relationship between the 2D and 3D versions of such algorithms
4. possesses the necessary basic skills to use these basic algorithms available in PyOpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (PyOpenGL) for implementation.

Mode of delivery:

Remote teaching

Learning activities and teaching methods:

Lectures 22 h / Programming lessons 12 hours / Self-study and programming assignments 101 h.

Target group:

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

Prerequisites and co-requisites:

Programming skills using Python; basic data structures; simple linear algebra.

Recommended optional programme components:

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

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English)
5) Online PyOpenGL tutorials (e.g. http://pyopengl.sourceforge.net/context/tutorials/index.html)

Assessment methods and criteria:

The assessment of the course is based on the exam (70%) and programming assignments (30%).
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, Tuomas Varanka, Muzammil Behzad.

Working life cooperation:

No

Other information:

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

812651S: ICT and Behaviour Change, 5 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Piiastiina Tikka

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

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

Learning outcomes:

After completing the course, the student will be able to:
* grasp the core theories of behaviour change and how they are/can be applied in goal-oriented behaviour change,
* identify and discuss ethical concerns inherent in behaviour change and persuasive systems, and
* identify and discuss the possible negative effects of ICT use not only as regards persuasive systems, but also with social media and other use.

Contents:

The focus of the course is role of ICT in supporting people with their endeavours to change their habits or lifestyles. The course introduces the main theories and models regarding behaviour change in order to provide students with a solid base for understanding how behaviour change can also work through ICT. The course also introduces some of the more problematic topics in ICT and behaviour, such as the dark side of ICT use and ethics of persuasion.
The course aims at providing existing knowledge and theoretical starting points to the development and use of persuasive systems. With such base, the student will be able to review the field from a broad perspective with the view to applying appropriate theories and approaches when analysing or developing persuasive systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The suggested prerequisite is that the learning outcomes of the following courses and their predecessors are accomplished: Persuasive Systems Design.

Recommended optional programme components:

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

Recommended or required reading:

Research articles to be announced more specifcally during the course implementation

Assessment methods and criteria:

Course assignment

Grading:

Numerical scale 1-5 or fail

Person responsible:

Piiastiina Tikka

Working life cooperation:

-

521157A: Introduction to Social Network Analysis, 5 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mourad Oussalah

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 120 hours of works

Language of instruction:

English

Timing:

Period 4. It is recommended to complete the course at the end of period 4

Learning outcomes:

Upon completing the course, the student is expected to i) understand social aspects of the web; ii) learn to collect, clean and represent social media data; iii) quantify important properties of social media; iv) find and analyze (online) communities; v) understand the diffusion process in social network; vi) familiarize with simple modelling toolkits for social media analysis

Contents:

The course describes basics of social network analysis, allowing the students to understand structure and evolution of the network, while enabling them to use appropriate tools and techniques to draw inferences and discover hidden patterns from the network. The course is designed to accommodate computer science, mathematical and social science student background, which helps in emergence of multi-disciplinary research in the university

Mode of delivery:

Face- to-face teaching and laboratory sessions

Learning activities and teaching methods:

Lectures (24 h), tutorial/laboratory sessions (12h), seminar (6 h) and practical work. The course is passed with an approved practical work and class test. The implementation is fully in English.

Target group:

Students with moderate logical reasoning skills

Prerequisites and co-requisites:

None

Recommended optional programme components:

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

Recommended or required reading:

R. Zafarani, M. A. Abbasi, and H. Liu, Social Media Mining: An Introduction, Cambridge University Press, 2014

Assessment methods and criteria:

One class test (30%) in the middle of the term + Project work (70%)
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Mourad Oussalah

Working life cooperation:

-

Other information:

We hope to attract students from humanties, economics and political in order to encourage multidisciplinary studies and enforce interesting student projects where each group contains at least one student from computer science and one from another faculty.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

ECTS Credits:

8 ECTS credits / 213 hours of work

Language of instruction:

English.

Timing:

Autum and spring, periods 1-4.

Learning outcomes:

Upon completing the course, the student is able to:
1. conduct independent research as a responsible member of a research group;
2. conduct a literature survey;
3. apply theoretical knowledge in solving a practical problem;
4. design, implement and evaluate a prototype;
5. collect and analyze research data;
6. report research results in form of a scientific publication and an oral presentation.

Contents:

The student conducts independently a small-scale research work under the supervision of a senior researcher. Topics for research works can be requested from research group leaders and senior researchers.

Mode of delivery:

Self-study, meetings with the supervisor of the work.

Learning activities and teaching methods:

Independent project work 213 h.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Literature is selected for each research work separately.

Assessment methods and criteria:

Assessment is based on the scientific publication and the oral presentation reporting the research 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:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

521152S: Applied Computing Project II, 10 op

Voimassaolo: 01.08.2013 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

ECTS Credits:

10 ECTS cr

Language of instruction:

English.

Timing:

Autumn and Spring, periods 1-4.

Learning outcomes:

1. has advanced understanding on how to collaboratively design a medium-scale software project,

2. has advanced understanding on how to implement and evaluate a medium-scale software project,

3. is able to extensively document a medium-scale software project,

4. has advanced skills in presenting and pitching a project work, i.e. give a good, concise presentation of the work,

Contents:

Project work that is typically executed in groups of 3-5 students. Note: the project work cannot be done alone.

Mode of delivery:

3-4 lectures to introduce and conclude the course and project works, collaborative project work for a "client" (teaching assistants and/or industry representatives).

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

While no specific courses are not required, programming and design skills are desired.

Recommended optional programme components:

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

Recommended or required reading:

For additional reading (not mandatory): Dix, Finlay, Abowd & Beale: Human-Computer Interaction (http://www.hcibook.com); Rogers, Sharp & Preece: Interaction Design: Beyond Human-Computer Interaction (http://www.id-book.com).

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Timo Ojala

Working life cooperation:

No

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

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English.

Timing:

Summer semester (June).

Learning outcomes:

Summer school comprises of multiple parallel workshops that each have specific learning outcomes.

Contents:

Each workshop has specific contents.

Mode of delivery:

Face-to-face teaching in workshops.

Learning activities and teaching methods:

Lectures, a project completed as group work, self-study.

Target group:

MSc. and doctoral students.

Prerequisites and co-requisites:

Each workshop may have specific prerequisites.

Recommended optional programme components:

None.

Recommended or required reading:

Each workshop has a specific required reading package.

Assessment methods and criteria:

Final exam (50%), project (50%).

Grading:

The summer school uses a numerical grading scale 1-5.

Person responsible:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

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

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5-8

Language of instruction:

English

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:

Professor of CSE

Working life cooperation:

-

Other information:

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

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will able to:
* explain the general principles of scientific research and the practices of scientific methodology,
* generate research problems in information processing sciences,
* identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem,
* evaluate the methodological quality of a research publication, as well as
* 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:

Blended teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended or required reading:

Lecture slides and specified literature.

Assessment methods and criteria:

Accepted learning diary, active participation

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

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

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Dorina Rajanen

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during period 3. It is recommended to complete the course at the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will be able to:
* describe state-of-the-art research results related to digital cultures and design;
* understand the strengths and limitations of various methods and frameworks used;

* show competence in critiquing research articles published in some of the leading academic journals and conference proceedings;
* show competence in critical thinking, and analysis and synthesis of academic sources;
* show competence in verbally presenting arguments in an academic fashion;
* write a literature review on a relevant research topic;
* acquire knowledge and critically read relevant research articles on digital culture and design related research topics; as well as
* describe ethical aspects involved with work related to digital cultures and design.

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 20 h, assignments 107 h, seminars 6 h.

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended optional programme components:

Recommended or required reading:

Selected scientific articles.

Assessment methods and criteria:

Assignments

Grading:

Numerical scale 1-5 or fail

Person responsible:

Mikko Rajanen

A452297: Advanced Module / Computer Engineering, Hardware, 48 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies, 22 ECTS cr

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

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

Timing:

Autumn, period 2

Learning outcomes:

1. knows the common architectures of synchronous digital logic circuits, and the building blocks they consist of, and can design digital circuits that realize complex data and signal processing functions.
2. knows most common combinational and sequential logic based buildning blocks, and can use them to design and realize complex digital circuits.
3. knows digital logic design methods, such as use of hardware description languages, functional verification using simulation, realization of logic with a logic synthesis program, and functional and timing verification of gate-level models.

Contents:

1. Logical and physical properties of digital logic components. 2. Representation of digital designs. 3. Combination logic design. 4. Sequential logic design. 5. Digital artithmetics. 6. Semiconductor memories. 7. Register transfer level architecture design. 8. Register transfer level modeling and synthesis. 9. Timing design. 10. Digital interface design. 11. Design verification

Mode of delivery:

Classroom

Learning activities and teaching methods:

Lectures 24h/ exercises 30h (group work)/independent work 84h.

Target group:

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

Prerequisites and co-requisites:

Digital techniques 1

Recommended optional programme components:

No

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Lahti

Working life cooperation:

No

Other information:

-

521303A: Circuit Theory 2, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521306A	Circuit Theory 2	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, period 2

Learning outcomes:

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

Contents:

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

Mode of delivery:

Classroom

Learning activities and teaching methods:

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

Target group:

Finnish BSc students

Prerequisites and co-requisites:

Basics of circuit theory, differential equations.

Recommended optional programme components:

Continuation for Circuit theory 1. Needed in most analog electronics courses.

Recommended or required reading:

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

Assessment methods and criteria:

Final exam. Also the 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:

-

521406S: Digital Techniques 3, 7 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

ECTS Credits:

7 ECTS

Language of instruction:

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

Timing:

Spring, peridos 3-4

Learning outcomes:

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

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

Contents:

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

Mode of delivery:

Classroom

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

Digital techniques 1 and Digital techniques 2

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Jukka Lahti

Working life cooperation:

-

Other information:

-

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Mika Ylianttila
Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. Students understand how the modern communications networks have evolved and how the architecture has changed through the recent paradigm shift towards software-centric communications.
2. Students are able to describe the basic system architecture elements of mobile networks, and understands the significance of emerging technologies such as Network Function Virtualization (NFV), Software Defined Networking (SDN), and core network functionalities such as Evolved Packet Core (EPC).
3. Students can describe the main principles of mobility management, network management and orchestration, and network security, and can apply and solve related engineering problems.
4. Students know the basic properties of routing algorithms, and can use graph theory to solve network routing problems.
5. Students are able to simulate different types of networks in simulation environments and solve basic network programming problems. Upon completing the required coursework, students understand the basic functionalities in TCP/IP protocol stack.

Contents:

Communications architecture in mobile, wireless local area and personal area networks. Introduction to cloud and edge computing, network function virtualization and software defined networking. Basic principles of mobility management, network security, network management and orchestration. The goal is to present the basics of the modern communications architectures, and their technical implementation.

Mode of delivery:

Due to Covid-19 pandemic, teaching in Autumn 2020 will be implemented remotely. Details of arrangement can be found from the course web page, which will be available in Moodle.
https://moodle.oulu.fi/course/view.php?id=1454

Learning activities and teaching methods:

Lectures 30 h and the compulsory design work (15 h). Design work can be done alternatively either as NS-2 simulation or TCP/IP programming exercise. Design work instructions are provided in digital learning environment (Moodle).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture, M Liyanage, A Gurtov, M Ylianttila – 2015; A comprehensive Guide to 5G Security, M Liyanage, I Ahmad, A Abro, A Gurtov, M Ylianttila – 2018; In addition, selected supportive online reading materials from recent standards and publications are provided in digital learning environment (Optima / Moodle).

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Mika Ylianttila

Working life cooperation:

No

Other information:

-

Optional Courses, Choose f.g. from the following courses total 26 ECTS cr.

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A	Introduction to Broadband Transmission Techniques	4.0 op
521433A	Laboratory Exercises on Analogue Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, periods 1-2

Learning outcomes:

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

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

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

Contents:

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

Mode of delivery:

Face-to-face teaching, partially independent work

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

No

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

The course unit utilizes verbal grading scale pass or fail

Person responsible:

Kari Määttä

Working life cooperation:

No

Other information:

-

521405A: Electronic System Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

English/Finnish.

Timing:

Period 1

Learning outcomes:

1. is able to choose the optimum method of the choices presented in the course in the field of power supply, thermal design, grounding, and routing of the high speed signals.
2. is able to calculate problems, caused by electrical disturbances, crosstalk and non-idealities of electrical components.
3. can calculate reliability of an electrical device or system.
4. The main goal of the course is to introduce methods and techniques needed in designing larger electronic entities such as equipment and systems.

Contents:

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

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Kari Määttä

Working life cooperation:

No.

Other information:

-

521401S: Electronics Design II, 6 op

Voimassaolo: 01.08.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Nissinen

Opintokohteen kielet: English

Leikkaavuudet:

521443S	Analogue Electronics 2	5.0 op

ECTS Credits:

6 ECTS

Language of instruction:

In Finnish (In English if needed).

Timing:

Autumn, period 1

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

Principles of electronics design, Electronics design I

Recommended optional programme components:

-

Recommended or required reading:

Lecture handout,T. C. Carusone, D. A. Johns & K.W. Martin: Analog integrated circuit design , Wiley cop. 2012. 2nd ed., chapters 1, 3, 6, 9, 10, 15, 16 and 17, parts of 4 ja 11; P.E. Allen & D.R. Holberg: CMOS Analog Circuit Design, Oxford University Press 2002, chapters 1,3,4,5, 6, 8 and 10.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Ilkka Nissinen

Working life cooperation:

-

Other information:

-

521395S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Kokkonen, Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 1

Learning outcomes:

Student
1. can analyze the performance of multilevel digital modulation methods in AWGN channel
2. can explain the effect of fading channel on the performance of the modulation method and can analyze the performance
3. recognizes and understand suitable diversity methods for fading channel and related combining methods
4. can understand and explain coding methods for wireless channels
5. recognizes different wideband systems
6. understands the cellular system principle

Contents:

Radio channel models, digital modulation and detection methods, carrier and symbol synchronization, performance of digital modulation in AWGN and fading channel, diversity techniques, coding for wireless channel, multicarrier modulation, spread spectrum, cellular systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and exercise (total 40 hours) and the compulsory design work with a simulation program.

Target group:

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

Prerequisites and co-requisites:

521330A Telecommunication Engineering

Recommended optional programme components:

-

Recommended or required reading:

Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005.

Assessment methods and criteria:

The course is passed with minor exams (only during lecture period) or with final exam; and the accepted design work report. In the final grade of the course, the weight for the examination(s) is 0.6 and that for the design work report 0.4.

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

Grading:

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

Person responsible:

Jari Iinatti / Timo Kokkonen

Working life cooperation:

Visiting lecturers from industry.

Other information:

-

521088S: Optoelectronics, 5 op

Voimassaolo: 01.01.2014 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, period 1

Learning outcomes:

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

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

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

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

Principles of semiconductor devices.

Recommended optional programme components:

This course is independent, no other components are recommended simultaneously.

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:

Kari Määttä

Working life cooperation:

Does not apply.

Other information:

-

521348S: Statistical Signal Processing 1, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes, Janne Lehtomäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521484A	Statistical Signal Processing	5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st semester of the master studies.

Learning outcomes:

Upon completion the student

1. knows the key tools of linear algebra and quadratic optimization and can apply them in solving signal processing problems.
2. understands how to handle complex valued random variables and processes.
3. understands the key concepts in estimation theory such as the classical and Bayesian philosophies.
4. masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators.
5. can derive an estimator for a given criterion and basic data models.
6. can use the methodology of estimation theory to analyze the performance of estimators and compare to performance benchmarks such as the Cramer-Rao lower bound.
7. understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), the Neyman-Pearson and Bayesian detectors.

Contents:

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

Mode of delivery:

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

Learning activities and teaching methods:

Face-to-face-teaching (lectures and exercises) 50h, Matlab simulation exercises in groups 30 h, independent work & passed assignment 50 h.

Target group:

Electrical, communications and computer science and engineering students.

Prerequisites and co-requisites:

The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal Analysis, 031021P Probability and Mathematical Statistics, 031078P Matrix Algebra, 521330A. The recommended prerequisite is the completion of Telecommunication Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Parts from books:
1. Steven M Kay, "Fundamentals of statistical signal processing: estimation theory."vol 1 Prentice Hall 1993.
2. Steven M. Kay, "Fundamentals of statistical signal processing: Detection theory, vol. 2." Prentice Hall 1999.
3. Peter Selinger, “Matrix Theory and Linear Algebra”, Creative Commons.
4. Paolo Prandoni & Martin Vetterli, Martin, “Signal Processing for Communications”, CRC Press 2008.
5. Other literature, lecture notes and material.

Assessment methods and criteria:

Completing the simulation project tasks, and a mid-term exam during the course. The mid-term exams can be retaken by a final exam later. In the final grade of the course, the weight for the examination is 0.7 and that of project report 0.3.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero (0) stands for a fail.

Person responsible:

Janne Lehtomäki and Markku Juntti

Working life cooperation:

No

Other information:

Lecture materials etc. can be found on Moodle https://moodle.oulu.fi/course/view.php?id=4203.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ojala, Timo Kullervo

Opintokohteen kielet: Finnish

ECTS Credits:

8 ECTS credits / 213 hours of work

Language of instruction:

English.

Timing:

Autum and spring, periods 1-4.

Learning outcomes:

Upon completing the course, the student is able to:
1. conduct independent research as a responsible member of a research group;
2. conduct a literature survey;
3. apply theoretical knowledge in solving a practical problem;
4. design, implement and evaluate a prototype;
5. collect and analyze research data;
6. report research results in form of a scientific publication and an oral presentation.

Contents:

The student conducts independently a small-scale research work under the supervision of a senior researcher. Topics for research works can be requested from research group leaders and senior researchers.

Mode of delivery:

Self-study, meetings with the supervisor of the work.

Learning activities and teaching methods:

Independent project work 213 h.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Literature is selected for each research work separately.

Assessment methods and criteria:

Assessment is based on the scientific publication and the oral presentation reporting the research 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:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

521070A: Introduction to Microfabrication Techniques, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Niina Halonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521218A	Introduction to Microelectronics and Micromechanics	4.0 op
521218A-02	Introduction to Microelectronics and Micromechanics, demonstration	0.0 op
521218A-03	Introduction to Microelectronics and Micromechanics, exercise	0.0 op
521218A-01	Introduction to microelectronics and micromechanics, exam	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

2nd period

Learning outcomes:

1. Can present the process of source materials used to manufacture micro- and nanoelectronics /mechanics and analyse the required material properties depending of the application

2. Can explain the fabrication methods and discuss the characteristic features of each fabrication method, inculding their utilisation and restrictions.

3. Is capable of designing a fabrication process for a simple microelectronics application and is able to indetify the process steps also in complex application.

Contents:

The content of the course covers fabrication methods of micro-, nano- and optoelectronics as well as MEMS systems. 1. Fabrication methods for silicon based electronics and MEMS systems 2. Additive manufacturing methods 3. Nanomaterials and fabrication.

Mode of delivery:

Face-to face teaching

Learning activities and teaching methods:

Lectures (20 hours) and exercises (10 +10).

Target group:

Electrical engineering bachelor degree students.

Prerequisites and co-requisites:

Course content of 521104P Introduction to Materials Physics and 521071A Principles of Semiconductor Devices.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, Franssila Sami: Introduction to Microfabrication

Assessment methods and criteria:

Final written exam and passes laboratory exercises.

Grading:

Numerical grading 1-5.

Person responsible:

Merja Teirikangas

Working life cooperation:

No

521328A: Simulations and Tools for Telecommunications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Johanna Vartiainen

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Fall, period 2

Learning outcomes:

1. A student recognizes problems and limitations related to simulations.

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

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

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

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

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

7. A student knows basics of one or two fundamental simulation programs

Contents:

Simulation methods, modelling communication systems with simulations, confidence limits of simulation, noise generation and modelling of fading channel. A simple baseband simulation example. Basics of MATLAB and OPNET simulation software (these could vary depending on needs/availability).

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 24 h (including program introductions), and the compulsory assignment with a simulation program (40 h).

Target group:

3rd year bachelor's degree students and M.Sc. students

Prerequisites and co-requisites:

Telecommunication Engineering

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes. Selected parts (informed in the notes) of Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems, Modeling Methodology and Techniques, 2nd edition. Plenum Press, 2000. Additional reading: William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Johanna Vartiainen

Working life cooperation:

No

Other information:

In 2020, the whole course including compulsory exercise and exam is organized in Moodle https://moodle.oulu.fi/enrol/index.php?id=3757 (opens no later than one week before the start of the course)

521304A: Filters, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521331A	Filters	4.0 op

ECTS Credits:

5

Language of instruction:

Finnish. Exams can be arranged in English on demand.

Timing:

Spring, period 3

Learning outcomes:

After the course the student can:
1. draw a pole-zero map for a given transfer function;
2. perform impedance and frequency scaling for component values;
3. choose an appropriate prototype filter and filter degree;
4. synthesize passive RLC filters;
5. synthesize active opamp based filters;
6. can compare various filter technologies;
7. understands the basics of scaling the dynamic range of active filters

Contents:

Filter types and prototypes, component scaling. Synthesis of active and passive filters. Sensitivity analysis and scaling of the dynamic range.

Mode of delivery:

Lectures, excercise and design excercise

Learning activities and teaching methods:

30 h lectures, 16 h exercises. A design excercise.

Target group:

Finnish electrical engineering students

Prerequisites and co-requisites:

Basics of circuit theory, Bode plots and analog design.

Recommended optional programme components:

Course Digital filters expands the topic into digital domain.

Recommended or required reading:

van Valkenburg: Analog Filter Design, 1982, chapters1-14, 18 ja 20 ; or year 2001 edition chapters 1-13.

Assessment methods and criteria:

Circuit is examined by a final exam. Also the obligatory design exercise must be passed.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

1-5

Person responsible:

Prof. Timo Rahkonen

Working life cooperation:

-

Other information:

-

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will able to:
* explain the general principles of scientific research and the practices of scientific methodology,
* generate research problems in information processing sciences,
* identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem,
* evaluate the methodological quality of a research publication, as well as
* 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:

Blended teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended or required reading:

Lecture slides and specified literature.

Assessment methods and criteria:

Accepted learning diary, active participation

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

A452298: Advanced Module / Computer Engineering, Software, 48 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Module

Laji: Study module

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies, 20 ECTS cr

521348S: Statistical Signal Processing 1, 5 op

Voimassaolo: 01.08.2016 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes, Janne Lehtomäki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521484A	Statistical Signal Processing	5.0 op

ECTS Credits:

5 ECTS

Language of instruction:

English

Timing:

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st semester of the master studies.

Learning outcomes:

Upon completion the student

1. knows the key tools of linear algebra and quadratic optimization and can apply them in solving signal processing problems.
2. understands how to handle complex valued random variables and processes.
3. understands the key concepts in estimation theory such as the classical and Bayesian philosophies.
4. masters the most important estimation principles such as minimum variance, maximum likelihood, least squares and minimum mean square error estimators.
5. can derive an estimator for a given criterion and basic data models.
6. can use the methodology of estimation theory to analyze the performance of estimators and compare to performance benchmarks such as the Cramer-Rao lower bound.
7. understands the basics of detection and classification theory: hypothesis testing, receiver operating characteristics (ROC), the Neyman-Pearson and Bayesian detectors.

Contents:

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

Mode of delivery:

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

Learning activities and teaching methods:

Face-to-face-teaching (lectures and exercises) 50h, Matlab simulation exercises in groups 30 h, independent work & passed assignment 50 h.

Target group:

Electrical, communications and computer science and engineering students.

Prerequisites and co-requisites:

The required prerequisite is the completion of the following courses prior to enrolling for the course: 031080A Signal Analysis, 031021P Probability and Mathematical Statistics, 031078P Matrix Algebra, 521330A. The recommended prerequisite is the completion of Telecommunication Engineering.

Recommended optional programme components:

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

Recommended or required reading:

Parts from books:
1. Steven M Kay, "Fundamentals of statistical signal processing: estimation theory."vol 1 Prentice Hall 1993.
2. Steven M. Kay, "Fundamentals of statistical signal processing: Detection theory, vol. 2." Prentice Hall 1999.
3. Peter Selinger, “Matrix Theory and Linear Algebra”, Creative Commons.
4. Paolo Prandoni & Martin Vetterli, Martin, “Signal Processing for Communications”, CRC Press 2008.
5. Other literature, lecture notes and material.

Assessment methods and criteria:

Completing the simulation project tasks, and a mid-term exam during the course. The mid-term exams can be retaken by a final exam later. In the final grade of the course, the weight for the examination is 0.7 and that of project report 0.3.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

The course utilizes a numerical grading scale 1-5. In the numerical scale zero (0) stands for a fail.

Person responsible:

Janne Lehtomäki and Markku Juntti

Working life cooperation:

No

Other information:

Lecture materials etc. can be found on Moodle https://moodle.oulu.fi/course/view.php?id=4203.

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Mika Ylianttila

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Fall, period 2

Learning outcomes:

1. Students understand how the modern communications networks have evolved and how the architecture has changed through the recent paradigm shift towards software-centric communications.
2. Students are able to describe the basic system architecture elements of mobile networks, and understands the significance of emerging technologies such as Network Function Virtualization (NFV), Software Defined Networking (SDN), and core network functionalities such as Evolved Packet Core (EPC).
3. Students can describe the main principles of mobility management, network management and orchestration, and network security, and can apply and solve related engineering problems.
4. Students know the basic properties of routing algorithms, and can use graph theory to solve network routing problems.
5. Students are able to simulate different types of networks in simulation environments and solve basic network programming problems. Upon completing the required coursework, students understand the basic functionalities in TCP/IP protocol stack.

Contents:

Communications architecture in mobile, wireless local area and personal area networks. Introduction to cloud and edge computing, network function virtualization and software defined networking. Basic principles of mobility management, network security, network management and orchestration. The goal is to present the basics of the modern communications architectures, and their technical implementation.

Mode of delivery:

Due to Covid-19 pandemic, teaching in Autumn 2020 will be implemented remotely. Details of arrangement can be found from the course web page, which will be available in Moodle.
https://moodle.oulu.fi/course/view.php?id=1454

Learning activities and teaching methods:

Lectures 30 h and the compulsory design work (15 h). Design work can be done alternatively either as NS-2 simulation or TCP/IP programming exercise. Design work instructions are provided in digital learning environment (Moodle).

Target group:

1st year M.Sc. and WCE students

Prerequisites and co-requisites:

-

Recommended optional programme components:

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

Recommended or required reading:

Software Defined Mobile Networks (SDMN): Beyond LTE Network Architecture, M Liyanage, A Gurtov, M Ylianttila – 2015; A comprehensive Guide to 5G Security, M Liyanage, I Ahmad, A Abro, A Gurtov, M Ylianttila – 2018; In addition, selected supportive online reading materials from recent standards and publications are provided in digital learning environment (Optima / Moodle).

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Mika Ylianttila

Working life cooperation:

No

Other information:

-

521290S: Distributed Systems, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Teemu Leppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521266S-01	Distributed Systems, Exam	0.0 op
521266S-02	Distributed Systems, Exercise Work	0.0 op
521266S	Distributed Systems	6.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, period 3.

Learning outcomes:

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

Contents:

Introduction, architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security, case studies.

Mode of delivery:

Online teaching

Learning activities and teaching methods:

Lectures 22 h, exercises 16 h, project work 50 h, self-study 47 h.

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

None.

Recommended optional programme components:

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

Recommended or required reading:

Required literature: Maarten van Steen and Andrew S. Tanenbaum, Distributed Systems – Principles and Paradigms, Third Edition, 2017.

Assessment methods and criteria:

The course uses continuous assessment so that there are 2 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory project work.

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

Grading:

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

Person responsible:

Teemu Leppänen

Working life cooperation:

None.

Other information:

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

521395S: Wireless Communications I, 5 op

Voimassaolo: 01.08.2019 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Timo Kokkonen, Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S-01	Wireless Communications I, Exam	0.0 op
521395S-02	Wireless Communications I, Exercise	0.0 op
521323S	Wireless Communications 2	5.0 op

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

ECTS Credits:

5

Language of instruction:

English

Timing:

Fall, period 1

Learning outcomes:

Student
1. can analyze the performance of multilevel digital modulation methods in AWGN channel
2. can explain the effect of fading channel on the performance of the modulation method and can analyze the performance
3. recognizes and understand suitable diversity methods for fading channel and related combining methods
4. can understand and explain coding methods for wireless channels
5. recognizes different wideband systems
6. understands the cellular system principle

Contents:

Radio channel models, digital modulation and detection methods, carrier and symbol synchronization, performance of digital modulation in AWGN and fading channel, diversity techniques, coding for wireless channel, multicarrier modulation, spread spectrum, cellular systems.

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures and exercise (total 40 hours) and the compulsory design work with a simulation program.

Target group:

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

Prerequisites and co-requisites:

521330A Telecommunication Engineering

Recommended optional programme components:

-

Recommended or required reading:

Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005.

Assessment methods and criteria:

The course is passed with minor exams (only during lecture period) or with final exam; and the accepted design work report. In the final grade of the course, the weight for the examination(s) is 0.6 and that for the design work report 0.4.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Jari Iinatti / Timo Kokkonen

Working life cooperation:

Visiting lecturers from industry.

Other information:

-

Optional Courses, Choose f.g. from the following courses total 28 ECTS cr

521156S: Towards Data Mining, 5 op

Voimassaolo: 01.08.2017 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Satu Tamminen
Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

Autumn, period I.

Learning outcomes:

After completing this course, student can recognize data types and perform required pre-processing steps before further analysis:

1. Student can design and implement a data collection process
2. Student can combine data from different sources
3. Student can normalize and transform data, and handle missing or incorrect values
4. Student can ensure generalizability of the results

Contents:

Course provides good ability to start Master's Thesis or graduate studies. Topics at the course include data mining process in general level, data gathering and different data types, quality and reliability of the data, data preparation including the processing of missing values, outliers, and privacy issues, combination of signals from several sources, utilization of data bases in data mining process, and normalization and transformation of data and interdependence of the observations and their distributions. Additionally, topics concerning the generality of the results are covered, as well as, the principles of data division, for example, train-test-validate, cross-validation and leave-one-out methods.

Mode of delivery:

Lectures, independent work, group work

Learning activities and teaching methods:

16 h lectures, 16 h exercises, independent studying.

Target group:

The course is suitable for Master level students in Computer science and engineering study programmes, for minor subject studies or for doctoral students.

Prerequisites and co-requisites:

031021P Probability and Mathematical Statistics or similar

Recommended optional programme components:

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

Recommended or required reading:

Lecture hand-out and exercise material will be provided. The course book will be announced in the beginning of the course. The material is mostly in English.

Assessment methods and criteria:

Weekly pre-lecture assignment + exercise submissions, and final exam. Half of the grade will be based on the submissions and half on the final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Tamminen Satu

Working life cooperation:

-

Other information:

Moodle: https://moodle.oulu.fi/course/view.php?id=1679
Towards Data Mining 521156S:3

521307A: Laboratory Exercises on Analogue Electronics, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Määttä

Opintokohteen kielet: Finnish

Leikkaavuudet:

521316A	Introduction to Broadband Transmission Techniques	4.0 op
521433A	Laboratory Exercises on Analogue Electronics	3.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

Autumn, periods 1-2

Learning outcomes:

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

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

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

Contents:

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

Mode of delivery:

Face-to-face teaching, partially independent work

Learning activities and teaching methods:

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

Target group:

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

Prerequisites and co-requisites:

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

Recommended optional programme components:

No

Recommended or required reading:

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

Assessment methods and criteria:

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

Grading:

The course unit utilizes verbal grading scale pass or fail

Person responsible:

Kari Määttä

Working life cooperation:

No

Other information:

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521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Computer Science and Engineering DP
Arvostelu: 1 - 5, pass, fail
Opettajat: Ojala, Timo Kullervo
Opintokohteen kielet: Finnish

ECTS Credits:

8 ECTS credits / 213 hours of work

Language of instruction:

English.

Timing:

Autum and spring, periods 1-4.

Learning outcomes:

Upon completing the course, the student is able to:
1. conduct independent research as a responsible member of a research group;
2. conduct a literature survey;
3. apply theoretical knowledge in solving a practical problem;
4. design, implement and evaluate a prototype;
5. collect and analyze research data;
6. report research results in form of a scientific publication and an oral presentation.

Contents:

The student conducts independently a small-scale research work under the supervision of a senior researcher. Topics for research works can be requested from research group leaders and senior researchers.

Mode of delivery:

Self-study, meetings with the supervisor of the work.

Learning activities and teaching methods:

Independent project work 213 h.

Target group:

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

Prerequisites and co-requisites:

None.

Recommended optional programme components:

None.

Recommended or required reading:

Literature is selected for each research work separately.

Assessment methods and criteria:

Assessment is based on the scientific publication and the oral presentation reporting the research 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:

Professor Timo Ojala.

Working life cooperation:

None

Other information:

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

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Applied Mathematics and Computational Mathematics

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits / 135 hours of work

Language of instruction:

English

Timing:

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

Learning outcomes:

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

Contents:

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

Mode of delivery:

Face-to-face teaching

Learning activities and teaching methods:

Lectures 28 h / Group work 14 h / Self-study 93 h.
The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

Target group:

Students in Wireless Communication Engineering

Prerequisites and co-requisites:

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

Recommended optional programme components:

-

Recommended or required reading:

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

Assessment methods and criteria:

The course can be completed by a final exam.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Keijo Ruotsalainen

Working life cooperation:

-

Other information:

The course, Introduction to Optimization, will be lectured remotely through the ZOOM video conferencing tool. The more detailed instructions and access to ZOOM lectures can be found in the Moodle work space of the course. The link is here: https://moodle.oulu.fi/course/view.php?id=5350.

521145A: Human-Computer Interaction, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Simo Hosio

Opintokohteen kielet: English

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish/English

Timing:

Autumn semester, Period II

Learning outcomes:

Upon completing this course, students will possess:

1. Knowledge of Human Computer Interaction (HCI) fundamentals
2. Knowledge and practical experience of user-centric computer interface and usability evaluation techniques, such as questionnaires and interviewing
3. Knowledge and experience of prototyping techniques (both paper-based as well as digital)
4. Knowledge of how HCI can be incorporated in the software development process

Contents:

Fundamental knowledge of humans, and how that relates to computer systems and interfaces. Learning design in 2-3 different ways, and conducting evaluations of the designs. Evaluation constitutes data collection and analysis, including qualitative and quantitative data.

Mode of delivery:

Online teaching (lectures), group work (labs).

Learning activities and teaching methods:

Lectures (12 h), exercises (16 h), and practical work (105 h). The course is passed with approved classroom/reading package reflections, and an approved group-based practical work (several assignments). The implementation is doable fully in English.

Target group:

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

Prerequisites and co-requisites:

While no specific courses are not required, elementary teamwork skills are required and the capability to provide documentation.

Recommended optional programme components:

All necessary material will be provided by the instructor.

Recommended or required reading:

No required reading.

Assessment methods and criteria:

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

Grading:

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

Person responsible:

Associate Professor Simo Hosio

Working life cooperation:

If relevant, guest lectures may be organized (optional).

Other information:

Using Moodle as the teaching platform: https://moodle.oulu.fi/course/view.php?id=5409

521273S: Biosignal Processing I, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen, Zalan Rajna

Opintokohteen kielet: Finnish

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

The course unit is held in the autumn semester, during period 2. It is recommended to complete the course at the master’s degree level.

Learning outcomes:

After completing the course, student:

1. knows about special characteristics of the biosignals and typical signal processing methods
2. can solve small-scale problems related to biosignal analysis
3. implement small-scale MATLAB software for signal processing algorithms.

Contents:

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

Mode of delivery:

Face-to-face teaching and guided laboratory work. The laboratory work can alternatively be performed on an online system (MathWorks Grader). Student can do the lab works remotely or in the lab using the same online system.

Learning activities and teaching methods:

Lectures 12h, Laboratory work 24h, Self-study for laboratory working and examination 99 h.

Target group:

Students interested in digital signal processing applications in biomedical engineering, at their master's level studies.

Prerequisites and co-requisites:

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

Recommended optional programme components:

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

Recommended or required reading:

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

Assessment methods and criteria:

Face-to-face lectures. Students solve the programming problems in the laboratory work independently, supervised by assistants. The MathWorks Grader online system is used for programming tasks and it also verifies the completed tasks. Written examination.
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.

521070A: Introduction to Microfabrication Techniques, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Electrical Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Niina Halonen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521218A	Introduction to Microelectronics and Micromechanics	4.0 op
521218A-02	Introduction to Microelectronics and Micromechanics, demonstration	0.0 op
521218A-03	Introduction to Microelectronics and Micromechanics, exercise	0.0 op
521218A-01	Introduction to microelectronics and micromechanics, exam	0.0 op

ECTS Credits:

5

Language of instruction:

Finnish

Timing:

2nd period

Learning outcomes:

1. Can present the process of source materials used to manufacture micro- and nanoelectronics /mechanics and analyse the required material properties depending of the application

2. Can explain the fabrication methods and discuss the characteristic features of each fabrication method, inculding their utilisation and restrictions.

3. Is capable of designing a fabrication process for a simple microelectronics application and is able to indetify the process steps also in complex application.

Contents:

The content of the course covers fabrication methods of micro-, nano- and optoelectronics as well as MEMS systems. 1. Fabrication methods for silicon based electronics and MEMS systems 2. Additive manufacturing methods 3. Nanomaterials and fabrication.

Mode of delivery:

Face-to face teaching

Learning activities and teaching methods:

Lectures (20 hours) and exercises (10 +10).

Target group:

Electrical engineering bachelor degree students.

Prerequisites and co-requisites:

Course content of 521104P Introduction to Materials Physics and 521071A Principles of Semiconductor Devices.

Recommended optional programme components:

-

Recommended or required reading:

Lecture notes, Franssila Sami: Introduction to Microfabrication

Assessment methods and criteria:

Final written exam and passes laboratory exercises.

Grading:

Numerical grading 1-5.

Person responsible:

Merja Teirikangas

Working life cooperation:

No

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Olli Silven

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS cr

Language of instruction:

Finnish, English study material available

Timing:

Spring, period 3.

Learning outcomes:

1. Student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods.

2. Student is able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on the responses of the f

3. Student is able to explain the impacts of finite word length in filter design.

4. Student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Sampling theorem, aliasing and imaging, 2. Discrete Fourier transform, 3. Z-transform and frequency response, 4. Correlation and convolution, 5. Digital filter design, 6. FIR filter design and realizations, 7. IIR filter design and realizations, 8. Finite word length effects and analysis, 9. Multi-rate signal processing.

Mode of delivery:

Online teaching (Lectures), independent work, group work

Learning activities and teaching methods:

Online lectures and exercises 50 h. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The rest as independent work.

Target group:

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

Prerequisites and co-requisites:

031077P Complex Analysis, 031080A Signal Analysis

Recommended optional programme components:

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

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English. Course book: Ifeachor, E., Jervis, B.: Digital Signal Processing, A Practical Approach, Second Edition, Prentice Hall, 2002.

Assessment methods and criteria:

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Olli Silven

Working life cooperation:

None.

Other information:

Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.
Open University students enroll for studies through an open website.

813621S: Research Methods, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Information Processing Science DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Netta Iivari

Opintokohteen kielet: English

Leikkaavuudet:

521146S	Research Methods in Computer Science	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

English

Timing:

The course is held in the spring semester, during periods 3 and 4. It is recommended to complete the course in the 1st spring semester of the Master's studies.

Learning outcomes:

After completing the course, the student will able to:
* explain the general principles of scientific research and the practices of scientific methodology,
* generate research problems in information processing sciences,
* identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem,
* evaluate the methodological quality of a research publication, as well as
* 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:

Blended teaching

Learning activities and teaching methods:

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

Target group:

MSc students

Prerequisites and co-requisites:

The required prerequisite is that the student has completed BSc degree as well as has basic knowledge on Software Engineering and Information Systems

Recommended or required reading:

Lecture slides and specified literature.

Assessment methods and criteria:

Accepted learning diary, active participation

Grading:

Pass or fail.

Person responsible:

Arto Lanamäki

521260S: Programmable Web Project, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Ivan Sanchez Milara

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Status:

The course is mandatory for International Master's Programme in Computer Science and Engineering and Master's Programme in Computer Science and Engineering. It is optional for other degree and master programmes.

ECTS Credits:

5 ECTS cr

Language of instruction:

In English.

Timing:

Spring, periods 3-4.

Learning outcomes:

Upon completion of this course, students:

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

Contents:

RESTful Web APIs, Hypermedia and HATEOAS, RESTful Clients

Mode of delivery:

Online learning.

Learning activities and teaching methods:

Lectures 4 h, guided laboratory exercise 15 h, the rest as self-study and group work. Each group implements software and writes a report. Students present their work at least twice in online meetings with the course staff.

Target group:

M.Sc. level students of Computer Science and Engineering; other students of the university of Oulu are accepted if there is enough space in the classes.

Prerequisites and co-requisites:

Elementary programming (521141P) or equivalent Python programming
skills. Applied computing project I is recommended.

Recommended optional programme components:

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

Recommended or required reading:

Mainly course slides and links to different Web resources announced during the first lecture. Course books: * Leonard Richardson, Mike Amundsen & Sam Ruby. RESTful Web APIs. O'Reilly Media 2013. ISBN: 978-1-4493-5806-8. * Leonard Richardson & Sam Ruby,RESTful Web Services. O'Reilly Media 2007. ISBN: 978-0-596-52926-0.

Assessment methods and criteria:

Course will be assessed based on project work assignment (functional working software prototype, content of the report…) and the exercises results. More detailed information on assessment will be provided with the course material.

Grading:

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

Person responsible:

Ivan Sanchez Milara

Working life cooperation:

None.

Other information:

We will use Moodle to provide links to the working tools and information about distance learning:
https://moodle.oulu.fi/course/view.php?id=6032

Course material can be found at Lovelace: https://lovelace.oulu.fi/.

521466S: Machine Vision, 5 op

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

ECTS Credits:

5 ECTS cr

Language of instruction:

English

Timing:

Spring, period 3.

Learning outcomes:

Upon completion of the course the student
1. understands the fundamentals of image acquisition, representation and modeling
2. can utilize elementary methods of machine vision for image recognition problems
3. can use 2D transformations in model fitting and image registration
4. can explain the basics of 3D imaging and reconstruction

Contents:

1. Introduction, 2. Imaging and image representations, 3. Light and color, 4. Binary image analysis, 5. Texture, 6. Local features, 7. Recognition, 8. Motion, 9. 2D models and transformations, 10. Perceiving 3D from 2D images, 11. 3D transformations and reconstruction.

Mode of delivery:

Online lectures and exercises, homework assignments.

Learning activities and teaching methods:

Lectures (24 h), exercises (16 h) and programming assignments (32 h), self-studying (61 h)

Target group:

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

Prerequisites and co-requisites:

521467A Digital Image Processing or an equivalent course, basic Python programming skills.

Recommended optional programme components:

521289S Machine Learning. This course provides complementary knowledge on machine learning methods needed in machine vision.

Recommended or required reading:

Lecture slides and exercise material. The following books are recommended for further information: 1) Shapiro, L.G. & Stockman, G.C.: Computer Vision, Prentice Hall, 2001. 2) Szeliski, R.: Computer Vision: Algorithms and Applications, Springer, 2011. 3) Forsyth, D.A. & Ponce, J.: Computer Vision: A Modern Approach, Prentice Hall, 2002.

Assessment methods and criteria:

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

Grading:

Numerical grading scale 1-5. Zero stands for a fail.

Person responsible:

Janne Heikkilä

Working life cooperation:

No.

Other information:

Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=4317

521289S: Machine Learning, 5 op

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

521497S-01	Pattern Recognition and Neural Networks, Exam	0.0 op
521497S-02	Pattern Recognition and Neural Networks; Exercise Work	0.0 op
521497S	Pattern Recognition and Neural Networks	5.0 op

ECTS Credits:

5 ECTS credits.

Language of instruction:

English.

Timing:

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

Learning outcomes:

After completing the course, student

1. can design simple optimal classifiers from the basic theory and assess their performance.
2. can explain the Bayesian decision theory and apply it to derive minimum error classifiers and minimum cost classifiers.
3. can apply regression techniques to practical machine learning problems.

Contents:

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

Mode of delivery:

Online teaching, guided laboratory work and independent assignment. The laboratory works are done on an online system (Mathworks Grader). Student can do the lab works remotely or in the lab using the same online system.
The course is implemented as remote education via the Moodle work space https://moodle.oulu.fi/course/view.php?id=5729
This work space opens to students before the course begins. The student must register to the course in WebOodi in order to participate the course.

Learning activities and teaching methods:

Lectures 16 h, Laboratory work 16 h, and Self-study the rest (Independent task assignment).

Target group:

Students who are interested in machine learning and pattern recognition theory and methods.

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:

Will be informed when the course starts.

Assessment methods and criteria:

Laboratory work is supervised by assistants who also verify that the task assignments are completed properly. The Matworks Grader online system also verifies the completed tasks. The independent task assignment is graded which establishes the grade for the course.
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 the independent task assignment.

Person responsible:

Tapio Seppänen

Working life cooperation:

No

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521467A	Digital Image Processing (OPEN UNI)	5.0 op

ECTS Credits:

5 ECTS credits / 133 hours of work

Language of instruction:

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

Timing:

Spring, period 4.

Learning outcomes:

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

-

Contents:

1. Introduction
2. Fundamentals of digital image
3. Intensity transformations and spatial filtering
4. Image processing in frequency domain
5. Restoration
6. Color image processing
7. Wavelets and multi-scale processing
8. Compression
9. Morphological image processing
10. Segmentation

Mode of delivery:

Face-to-face teaching.

Learning activities and teaching methods:

Lectures 24 h, exercises 14 h and homework assignments 30 h. The rest is independent work.

Target group:

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

Prerequisites and co-requisites:

521141P Elementary Programming or equivalent Python programming skills.

Recommended optional programme components:

None.

Recommended or required reading:

Gonzalez, R.C., Woods, R.E.: Digital Image Processing, Third Edition, Prentice-Hall, 2008, Chapters 1-10.
Lecture notes and exercise

Assessment methods and criteria:

The course is completed by passing the exam and homework assignments.
Read more about assessment criteria at the University of Oulu webpage.

Grading:

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

Person responsible:

Janne Heikkilä

Working life cooperation:

None.

Other information:

Course is in Moodle: https://moodle.oulu.fi/course/view.php?id=6840

521283S: Big Data Processing and Applications, 5 op

Voimassaolo: 01.08.2015 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Lauri Lovén

Opintokohteen kielet: English

ECTS Credits:

5 ECTS credits

Language of instruction:

English

Timing:

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

Learning outcomes:

Upon completion of the course, the student :

1. is able to explain the big data phenomenon, its challenges and opportunities.
2. is able to explain the requirements and common principles for data intensive systems design and implementation, and evaluate the benefits, risks and restrictions of available solutions.
3. can explain the principles of big data management and processing technologies and utilize them on a basic level.

Contents:

General introduction into big data, namely: big data fundatmenals, data storage, batch and stream data processing, data analysis, privacy and security, big data use cases.

Mode of delivery:

Online teaching, exercises and seminars. Independent and group work.

Learning activities and teaching methods:

Lectures, exercises, seminars, independent and group work

Target group:

M.Sc. students (computer science and engineering) and other Students of the University of Oulu

Prerequisites and co-requisites:

The Bachelor level studies of Computer science and engineering study programmes or respective knowledge.

Recommended optional programme components:

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

Recommended or required reading:

Lecture slides and exercise material will be provided. Each lecture will include the refernce list for recommended reading. Instructions to necessary installations will be given.

Assessment methods and criteria:

This course assesses students continuously by the completion of small project work, seminar presentations and short reports on a selected topic (group work). Answering two quizzes during the course is optional and provides additional points for final grade. To pass the course, it is enough to get 50 % of available points. No exam.

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

Grading:

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

Person responsible:

Lauri Lovén

Working life cooperation:

The course includes also invited lectures from industry.

Other information:

Course is in Moodle.

521140S: Computer Graphics, 5 op

Voimassaolo: 01.08.2018 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521493S	Computer Graphics	7.0 op

ECTS Credits:

5 ECTS credits

Language of instruction:

In English

Timing:

Spring, period 4.

Learning outcomes:

Upon comletion of the course, the student

1. is able to specify and design 2D graphics algorithms including: line and circle drawing, polygon filling and clippin
2. is able to specify and design 3D computer graphics algorithms including transformations, viewing, hidden surface removal, shading, texture mapping and hierarchical modeling
3. is able to explain the relationship between the 2D and 3D versions of such algorithms
4. possesses the necessary basic skills to use these basic algorithms available in PyOpenGL

Contents:

The history and evolution of computer graphics; 2D graphics including: line and circle drawing, polygon filling, clipping, and 3D computer graphics algorithms including viewing transformations, shading, texture mapping and hierarchical modeling; graphics API (PyOpenGL) for implementation.

Mode of delivery:

Remote teaching

Learning activities and teaching methods:

Lectures 22 h / Programming lessons 12 hours / Self-study and programming assignments 101 h.

Target group:

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

Prerequisites and co-requisites:

Programming skills using Python; basic data structures; simple linear algebra.

Recommended optional programme components:

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

Recommended or required reading:

1) Textbook: Edward Angel, Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, 7th Edition, Addison-Wesley 2015
2) Textbook: Edward Angel: Interactive Computer Graphics, 5th Edition, Addison-Wesley 2008
3) Reference: Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
4) Lecture notes (in English)
5) Online PyOpenGL tutorials (e.g. http://pyopengl.sourceforge.net/context/tutorials/index.html)

Assessment methods and criteria:

The assessment of the course is based on the exam (70%) and programming assignments (30%).
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, Tuomas Varanka, Muzammil Behzad.

Working life cooperation:

No

Other information:

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

521027S: Advanced practical training, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

Opintokohteen kielet: Finnish

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish or English
Timing:
This course can be taken in periods I-IV. The recommended time to take this course is during summer of the fourth year.
Learning outcomes:
Student can apply knowledge and skills learned during university studies to complete work assignments in his/her own field.
Student can evaluate and develop himself/herself as a learner and worker.
Student can plan and evaluate his/her time management and working methods.
Student is capable of working in systematic and goal-oriented manner in group as well as independently.
Student can name important factors that direct the actions of work community and the employer.
Student can name duties where he/she can work after graduating from university.
Contents:
Planning and preparation, carrying out work assignments in the students field of studies, documentation of own accomplishments, writing report and reflection.
Mode of delivery:
Independent work.
Learning activities and teaching methods:
Student independently finds a place to work to complete the course. To pass the course minimum of two months of full time work is required. Work can also be carried out in multiple periods. The course works includes a) Making a practice plan for the working period 4 h, b) Documentation of progress during working 20 h, c) Learning while working 108 h, d) Final raport and reflection 8 h.
Target group:
Master level students.
Prerequisites and co-requisites:
-
Recommended optional programme components:
The course does not require additional studies carried out at the same time. While carrying out the course working assigments are compared to already completed studies.
Recommended or required reading:
No required material
Assessment methods and criteria:
Course is carried out by working minimum of two months in a work accepted by study program responsible person. Before starting the actual work the student needs to make a plan for the working period and return it to the responsible person. A weekly report is required from every working week. These reports have to turned in before the working period ends. After the working period is over the student writes a final report and returns it to the responsible person. Signed testimonial from the employer is also required with the final report.
Grading:
The course is graded as ”pass/fail”
Person responsible:
Riku Hietaniemi
Working life cooperation:
The course is carried out as practical training.
Other information:
This course is alternative to 521013A Advanced Practical Training, 3 ECTS.
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521009S: Computer Science and Engineering, The Maturity Test for Master`s Degree, 0 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
0; The maturity test is integrated in the MSc Thesis credits (30 ECTS).
Language of instruction:
Finnish/Swedish/other
Timing:
Periods 1-4
Learning outcomes:
After the maturity test, the student has demonstrated that his/her language skills meet the requirements of the work life.
Contents:
The aim of the maturity test is to confirm the student's familiarity of the thesis area as well as his/her command of the domestic language of his/her school education.
Mode of delivery:
The maturity test is written in a controlled event, on a topic provided by the thesis supervisor.
Learning activities and teaching methods:
Written essay, approximately 3 pages hand written text or 380 words / 3040 characters.
Target group:
-
Prerequisites and co-requisites:
The maturity test can be written when the thesis is complete or being finished.
Recommended optional programme components:
-
Recommended or required reading:
MSc Thesis.
Assessment methods and criteria:
The maturity test is evaluated and approved by the thesis supervisor.
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Thesis supervisor.
Working life cooperation:
-

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

Opiskelumuoto: Advanced Studies

Laji: Diploma thesis

Vastuuyksikkö: Computer Science and Engineering DP

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.

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:
https://www.oulu.fi/en/students/thesis-and-graduation/graduation-masters-degree/masters-thesis#177

Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

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 (https://www.oulu.fi/forstudents/traineeship)
Read more about assessment criteria at the University of Oulu webpage.
Grading:
Pass/fail.
Person responsible:
Riku Hietaniemi
Working life cooperation:
Yes.
Other information:
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521014S: Expert Training, 0 - 5 op

Opiskelumuoto: Advanced Studies

Laji: Practical training

Vastuuyksikkö: Computer Science and Engineering DP

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:

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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.

521012A: Practical Training, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Practical training

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521019A	Practical training	5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:
3
Language of instruction:
Finnish.
Timing:
Periods 1-4.
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:
Riku Hietaniemi
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.
Course work space can be found from University of Oulu Moodle platform moodle.oulu.fi.

521019A: Practical training, 5 op

Voimassaolo: 01.01.2017 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Computer Science and Engineering DP

Arvostelu: 1 - 5, pass, fail

Opettajat: Riku Hietaniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521012A	Practical Training	3.0 op

ECTS Credits:
5 ECTS credits
Language of instruction:
Finnish or English
Timing:
This course can be taken in periods I-IV. The recommended time to take this course is during summer of the second year.
Learning outcomes:
Student can apply knowledge and skills learned during university studies to complete work assignments in his/her own field.
Student can evaluate and develop himself/herself as a learner and worker.
Student can plan and evaluate his/her time management and working methods.
Student is capable of working in systematic and goal-oriented manner in group as well as independently.
Student can name important factors that direct the actions of work community and the employer.
Student can name duties where he/she can work after graduating from university.
Contents:
Planning and preparation, introduction to work assignments related to students field of study, carrying out work assignments, documentation of own accomplishments, writing report and reflection.
Mode of delivery:
Independendt work.
Learning activities and teaching methods:
Student independendtly finds a place to work to complete the course. To pass the course, minimum of two months of full time work is required. Work can also be carried out in multiple periods. The required elements are a) Making a practice plan for the working period 4 h, b) Documentation of progress during working 20 h, c) Learning while working 108 h, d) Final raport and reflection 8 h.
Target group:
Bachelor level students in computer science and engineering
Prerequisites and co-requisites:
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Recommended optional programme components:
The course does not require additional studies carried out at the same time. While carrying out the course working assigments are compared to already completed studies.
Recommended or required reading:
No required material.
Assessment methods and criteria:
Course is carried out by working minimum of two months in a work accepted by study program responsible person. Before starting the actual work the student needs to make a plan for the working period and return it to the responsible person. A weekly report is required from every working week. These reports have to turned in

before the working period ends. After the working period is over the student writes a final report and returns it to the responsible person. Signed testimonial from the employer is also required with the final report.

Grading:

The course is graded as ”pass/fail”.

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

Person responsible:

Riku Hietaniemi

Working life cooperation:

Opintojakso suoritetaan työharjoitteluna.

Other information:

The BSc in Computer science and engineering degree can include optional practical training. This course is alternative to 521012A Practical Training, 3 ECTS.

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