

# Opasraportti

## ITEE - Information Processing Science DP (2018 - 2019)

### Tutkintorakenteet

#### Software Engineering Master´s Programme

Tutkintorakenteen tila: published

Lukuvuosi: 2017-18

Lukuvuoden alkamispäivämäärä: 01.08.2017

#### Common Courses (90 op)

- 815303A: Embedded Software Development Environments, 5 op
- 811600S: Emerging Trends in Software Engineering, 5 op
- 813607S: Maturity test, 0 op
- 813613S: Master's Thesis, 30 op
- 813627S: Master's Thesis Seminar, 2 op
- 815657S: Open Source Software Development, 5 op
- 817609S: Project Seminar, 3 op
- 813621S: Research Methods, 5 op
- 817602S: Software Development in Global Environment, 5 op
- 815662S: Software Engineering Management, Measurement and Improvement, 5 op
- 815663S: Software Engineering Research, 5 op
- 817614S: Software Factory Project, 10 op
- 815312A: Software Production and Maintenance, 5 op
- 815311A: Software Quality and Testing, 5 op

#### Optional courses, suggestions (30 - 40 op)

- 811344A: Basics of Statistical Data Analysis for Information Processing Science, 5 op
- 813626S: Emerging Technologies and Issues, 5 op
- 811601S: Emerging Trends in Software Testing, 5 op
- 812331A: Interaction Design, 5 op
- 811392A: Preparatory Course for MSc Studies, 5 op
- 811391A: Requirements Engineering, 5 op
- 813630S: Software Business Development, 5 op

#### Masters Degree Programme in Software Systems and Service Development in the Global Environment (GS3D) 2018-2019 (120 op)

Tutkintorakenteen tila: published

Lukuvuosi: 2018-19

Lukuvuoden alkamispäivämäärä: 01.08.2018

### **Compulsory Studies (85 op)**

902140Y: Cross-Cultural Competence and Communication Skills, 2 op  
 817604S: ICT and Organizational Change, 5 op  
 813607S: IPS (TOL), Maturity Test for Master's Degree, 0 op  
 812349A: IT Infrastructure, 5 op  
 813623S: Information Security Policy and Management in Organisations, 5 op  
 813613S: Master's Thesis, 30 op  
 813627S: Master's Thesis Seminar, 2 op  
 815657S: Open Source Software Development, 5 op  
 811392A: Preparatory Course for MSc Studies, 5 op  
 813621S: Research Methods, 5 op  
 817602S: Software Development in Global Environment, 5 op  
 815662S: Software Engineering Management, Measurement and Improvement, 5 op  
 817614S: Software Factory Project, 10 op  
 817603S: System Design Methods for Information Systems, 5 op

### **Optional Studies (vähintään 25 op)**

Optional studies must be at least 25 ECTS credit points. Optional courses can be chosen in the optional course pool (see below). Also a minor, or carried out elsewhere in higher education approved elective courses.

813625S: Information Systems Theory, 5 op  
 815663S: Software Engineering Research, 5 op

### **Compulsory Studies Optional Courses (5 op)**

813630S: Software Business Development, 5 op  
 813620S: Software Business Management, 5 op

## **European Masters in Software Engineering (EMSE)**

Tutkintorakenteen tila: published

Lukuvuosi: 2018-19

Lukuvuoden alkamispäivämäärä: 01.08.2018

### **First Year in Oulu (60 op)**

815303A: Embedded Software Development Environments, 5 op  
 811600S: Emerging Trends in Software Engineering, 5 op  
 811601S: Emerging Trends in Software Testing, 5 op  
 812349A: IT Infrastructure, 5 op  
 521147S: Mobile and Social Computing, 5 op  
 815657S: Open Source Software Development, 5 op  
 521260S: Programmable Web Project, 5 op  
 815305A: Real Time Distributed Software Development, 5 op  
 817602S: Software Development in Global Environment, 5 op  
 815662S: Software Engineering Management, Measurement and Improvement, 5 op  
 815312A: Software Production and Maintenance, 5 op

815311A: Software Quality and Testing, 5 op

## **Second Year in Oulu (60 op)**

813607S: IPS (TOL), Maturity Test for Master's Degree, 0 op

812331A: Interaction Design, 5 op

813613S: Master's Thesis, 30 op

813627S: Master's Thesis Seminar, 2 op

817609S: Project Seminar, 3 op

817614S: Software Factory Project, 10 op

## **Optional courses, suggestions (12 op)**

813627S: Master's Thesis Seminar, 2 op

813621S: Research Methods, 5 op

815663S: Software Engineering Research, 5 op

## **Degree Programme in Information Processing Science, Master's Level Studies (120 ECTS) McS 2018-2019**

Tutkintorakenteen tila: published

Lukuvuosi: 2018-19

Lukuvuoden alkamispäivämäärä: 01.08.2018

## **Compulsory Studies for all Master's Level Students (vähintään 50 op)**

813607S: IPS (TOL), Maturity Test for Master's Degree, 0 op

813613S: Master's Thesis, 30 op

813627S: Master's Thesis Seminar, 2 op

817609S: Project Seminar, 3 op

813621S: Research Methods, 5 op

817612S: Research and Development Project, 10 op

## **Specialization Studies (vähintään 40 op)**

For the master's studies, a student should choose either information systems or software engineering as his/her study orientation. The choice will be made at the end of the bachelor studies or at the latest at the beginning of the master's studies, by defining it explicitly as part of the personal study plan.

### **Software Engineering Oriented Module**

815303A: Embedded Software Development Environments, 5 op

811600S: Emerging Trends in Software Engineering, 5 op

815657S: Open Source Software Development, 5 op

817602S: Software Development in Global Environment, 5 op

815662S: Software Engineering Management, Measurement and Improvement, 5 op

815663S: Software Engineering Research, 5 op

815312A: Software Production and Maintenance, 5 op

815311A: Software Quality and Testing, 5 op

### **Information Systems Oriented Module**

813626S: Emerging Technologies and Issues, 5 op

812351A: Enterprise Systems, 5 op

817604S: ICT and Organizational Change, 5 op  
 812349A: IT Infrastructure, 5 op  
 813623S: Information Security Policy and Management in Organisations, 5 op  
 813625S: Information Systems Theory, 5 op  
 812331A: Interaction Design, 5 op  
 817603S: System Design Methods for Information Systems, 5 op

### **Optional Studies (vähintään 30 op)**

Optional studies must be at least 30 ECTS credit points. Optional courses can be chosen either in the advanced (Advanced Module) supply or the second specialisation option compulsory courses, or both. Also a minor, or carried out elsewhere in higher education approved elective courses.

#### **Optional Studies**

812649S: Advanced Research Methods, 5 op  
 812650S: Advanced Topics in Human-Centred Design, 5 op  
 811600S: Emerging Trends in Software Engineering, 5 op  
 811601S: Emerging Trends in Software Testing, 5 op  
 812651S: ICT and Behaviour Change, 5 op  
 811392A: Preparatory Course for MSc Studies, 5 op  
 811330A: Project management, 5 op  
 815305A: Real Time Distributed Software Development, 5 op  
 816630S: Scientific paper writing, 1 - 3 op  
 813630S: Software Business Development, 5 op  
 813620S: Software Business Management, 5 op  
 812670S: The Next Generation of the Web, 5 op  
 812671S: Usability Testing, 5 op  
 814601S: Work Experience in ICT responsibilities, 5 op

#### **Minor or other studies**

## **Degree Programme in Information Processing Science, Bachelor Level Studies 2018-2019, LuK**

Tutkintorakenteen tila: published

Lukuvuosi: 2018-19

Lukuvuoden alkamispäivämäärä: 01.08.2018

### **General Studies (2 op)**

810020Y: Orientation Studies, 2 op

### **Language and Communication Studies (10 op)**

902162Y: English Communication for Information Processing / ECIP, 5 op  
 900105Y: Launch your career through communication, 5 op  
 901049Y: Second Official Language (Swedish), Oral Skills, 1 op  
 901048Y: Second Official Language (Swedish), Written Skills, 1 op

### **Basic Studies (40 op)**

810122P: Computer Architecture, 5 op  
 811120P: Discrete Structures, 5 op

811177P: Humans as Users and Developers of Information Technology, 5 op  
 811168P: Information Security, 5 op  
 810136P: Introduction to Information Processing Sciences, 5 op  
 811167P: Introduction to Information Systems Design, 5 op  
 811122P: Introduction to Programming, 5 op  
 811174P: Introduction to Software Business, 5 op

### **Intermediate Studies (97 op)**

813307A: IPS (TOL), Maturity Test for Bachelor 's Degree, 0 op  
 812339A: Advanced Object-Oriented Programming, 5 op  
 811383A: Bachelor Thesis, 7 op  
 811395A: Basics of Databases, 5 op  
 811379A: Basics of Human Computer Interaction, 5 op  
 811344A: Basics of Statistical Data Analysis for Information Processing Science, 5 op  
 813316A: Business Process Modeling, 5 op  
 811312A: Data Structures and Algorithms, 5 op  
 811394A: Database systems, 5 op  
 812332A: Information Systems Design, 5 op  
 812305A: Information Systems in Organisations, 5 op  
 521150A: Introduction to Internet, 5 op  
 811393A: Introduction to research work, 5 op  
 812342A: Object Oriented Analysis and Design, 5 op  
 812341A: Object-Oriented Programming, 5 op  
 811366A: Project Work, 10 op  
 811391A: Requirements Engineering, 5 op  
 815345A: Software Architectures, 5 op  
 811346A: Software Engineering, 5 op  
 811375A: User Interface Programming, 5 op

### **Minor Studies (25 op)**

814339A: Education and adp support training, 1 - 5 op  
 814312A: Exchange in abroad, 1 - 3 op  
 814311A: Internship in ICT-duties, 3 - 5 op  
 815338A: Principles of Programming Languages, 5 op  
 814341A: Research experience, 2 - 5,5 op  
 814340A: Small-Group Tutoring, 3 op  
 812315A: Software Construction, 10 op

### **Other Studies (1 op)**

030005P: Information Skills, 1 op

## **Opintojaksojen kuvaukset**

### **Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset**

**815303A: Embedded Software Development Environments, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskeluoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Juustila, Antti Juhani

**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.

**Learning outcomes:**

After completing the course, a student is able to work with the essential software development tools of a selected embedded platform. The student is able to implement memory and power efficient applications by exploiting existing libraries and knowledge of the programming interfaces provided by the platform.

**Contents:**

The focus of the course is in the software development environments and tools for mobile and embedded platforms, such as Android and iOS. In addition, the course covers memory and power management, core services of the platform, networking and the utilisation of existing libraries. One platform will be selected for deeper study, and the course introduces its essential software development tools and libraries. The emphasis is on application development for the platform as an exercise.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Lectures and exercises about 40 h, exercises and exercise work 93 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Course "815309A Real-time Distributed Software Development", C/C++ and / or Java programming skills or similar knowledge obtained from other courses.

**Recommended or required reading:**

Course material, the documentation of selected technologies, and other related literature.

**Assessment methods and criteria:**

Exercise work.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Antti Juustila

## **811600S: Emerging Trends in Software Engineering, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student understands the recent trends in software engineering. The student is able to perform computer supported trend mining to discover new trends of any given topic. The student is able to critically think about the trends.

**Contents:**

- Software engineering trends (varies yearly)
- Automated trend mining from online databases
- Writing, arguing and discussing about the trends.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 18 h, essays 30 h, project 30 h, independent study 31 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basics on software engineering.

**Recommended or required reading:**

Articles + lectures.

**Assessment methods and criteria:**

Active lecture participation, exercises, assignments, essays.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mika Mäntylä

### **813607S: Maturity test, 0 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

### **813613S: Master's Thesis, 30 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Diploma thesis

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

### **813627S: Master's Thesis Seminar, 2 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**Required proficiency level:**

**ECTS Credits:**

2 ECTS credits / 53 hours of work (1 ECTS / 27 hours of work for GS3D students).

**Language of instruction:**

English

**Timing:**

The course is held throughout the study year, in all periods. It is recommended to start the course during the 1st study year, before Master's Thesis.

**Learning outcomes:**

By completing this course the student can

- plan a scientific study,
- present own research in various stages, and
- give feedback of peers' research plans and results.

**Contents:**

The course consists of three phases following the structure and progress of a Master's Thesis work: 1) previous research and initial research methods (research plan), 2) data gathering and analysis, as well as 3) discussions and conclusions (thesis). In each phase, a student is required to participate first as a peer reviewer, and then present his / her own research.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Planning and presenting the student's own research and giving feedback of peers' plans and results 53 h (27 h for GS3D students).

**Target group:**

MSc students

**Recommended optional programme components:**

813613S Master's Thesis.

**Recommended or required reading:**

Guidelines to producing a Master's thesis.

**Assessment methods and criteria:**

Active participation in at least nine (six for GS3D students) seminar sessions. One session lasts about three hours and they are arranged during the semesters according to the plan published on the website.

**Grading:**

Pass or fail.

**Person responsible:**

Henrik Hedberg

**815657S: Open Source Software Development, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After passing the course, a student will be able to

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

**Contents:**



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

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Independent personal and group work about 40 h, weekly meetings and seminars about 30 h, seminar article and presentation about 60 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work.

**Recommended or required reading:**

Fogel, K. (2017): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media; Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

**Assessment methods and criteria:**

Active participation, seminar article and other assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Henrik Hedberg

## 817609S: Project Seminar, 3 op

**Voimassaolo:** 01.08.2013 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Tonja Molin-Juustila

**Opintokohteen kielet:** English

**ECTS Credits:**

3 ECTS credits / 80 hours of work.

**Language of instruction:**

English.

**Timing:**

The timing of the course is dependent on the Research and Development Project (817612S) course and will immediately follow the project in the next spring semester, during period 3. It is recommended to complete the course at the 2nd spring semester.

**Learning outcomes:**

After completing the course, the students should demonstrate their abilities to work as academic experts in challenging ICT projects. Students will learn to acquire and apply research articles and other new knowledge like an academic expert in a selected topic of their project ("Research and Development Project" course). Students will also learn to analyse and report their experience-based new knowledge on the topic to peer students. By completing this course, students are able to act as reflective, independent academic experts in ICT projects and have learnt expertise in some topic area of their project. As an expert in the selected topic area, the student is able to: search research articles and literature on the topic (review); report practical experiences gained during the project on the topic; evaluate the results of the project and reflect the practical experiences against previous literature and research on the topic; disseminate the (increased) expertise in the topic in a credible way to peers both by a written report and orally.

**Contents:**

Starting lecture, independent analysis and reporting of the expertise on the selected project topic and an expert seminar (2 full days) with the presentations of each topic.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Attendance at the starting lecture (4 h) and the expert seminar (2 full days) is mandatory. Independently writing the seminar paper and preparing the seminar presentation (abt. 50 h).

**Target group:**

MSc students.

**Prerequisites and co-requisites:**

Mandatory: Research and Development Project (817612S) during autumn semester, periods 1 & 2. This course will immediately follow the project course on the project topics. For the students of the Master's degree programme on Software, Systems, and Service Development (GS3D), Software Factory Project Course (817611S) is mandatory before this course.

**Recommended or required reading:**

Research articles and materials are to be independently collected and studied by the students.

**Assessment methods and criteria:**

Expertise in the topic area will be reported on the seminar paper. Seminar presentation will also be evaluated. Assessment criteria in detail will be given at the starting lecture and in the web-based learning environment for the course.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Tonja Molin-Juustila

**Working life cooperation:**

Seminar topics are related to the Master's students projects all of which are authentic project works in unique R&D project assignments from real customers (university, companies and organizations like schools, library etc.).

**Other information:**

Enrollment by contacting the responsible person of the course and outlining a draft of the seminar paper until end of the period 2 (i.e. before the course starts).

## 813621S: Research Methods, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Arto Lanamäki

**Opintokohteen kielet:** English

**Leikkaavuudet:**

521146S Research Methods in Computer Science 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information processing sciences. The student is able to identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching, lecture videos.

**Learning activities and teaching methods:**

Lectures 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:**

Completion of Bachelor's studies.

**Recommended or required reading:**

Lecture slides and specified literature.

**Assessment methods and criteria:**

Accepted learning diary.

**Grading:**

Pass or fail.

**Person responsible:**

Arto Lanamäki

**817602S: Software Development in Global Environment, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Kuvaja

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student can define the key success factors of Global Software Design (GSD) and the potential problems in coordination of projects where teams are separated by physical and / or temporal distance; can define and evaluate the collaborative technologies, which in the best way support distributed software development; can choose the methods and tools for distributed software development; can apply the practices of GSD in a student project and use the supporting tools throughout the project life cycle.

**Contents:**

Some of the topics covered are strategic issues in distributed development (off-shoring, near-shoring, outsourcing, OSS); cost-benefit-risk analysis; the triad of coordination, control and communication; team building (e.g. virtual teams); software process paradigms in the global environment (planned, agile); methods and tools for distributed software development; issues related to allocation of tasks; communication issues that arise due to distance and time zone differences; infrastructure support; geographical dispersion; lack of information communication; coordination complexity; cultural issues; technical issues related to information and artefact sharing; architectural design; and finally knowledge management issues. The lectures and seminars also review current research aspects of the GSD and related case studies from industry. The exercises demonstrate distributed software development as a virtual team with the support of appropriate methods and tools.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars involving all the students as well as lecture assignments (reading articles and writing analyses) 70 h (20 h lecture attendances, 30 h lecture assignments, 20 h additional reading), and exercises 65 h. For lecture assignments each student will read, summarize and analyse selected academic articles. The exercises include laboratory demonstrations of different supporting tools for distributed software development. The students train in project software development and planning practices in a distributed environment. The student project groups are organised into virtual (distributed) teams of 4 students.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of academic writing technique is needed. Basic understanding of software business is an advantage.

**Recommended or required reading:**

To be announced during the course implementation.

**Assessment methods and criteria:**

By active participation or alternatively exam, based on the course study materials.

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Veikko Seppänen

**Other information:**

Course does not have any lectures or exercises in academic year 2019-2020. It is still possible to do course, please sent email to Professor Veikko Seppänen veikko.seppanen@oulu.fi

## **815662S: Software Engineering Management, Measurement and Improvement, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd autumn semester.

**Learning outcomes:**

After completing the course the student understands the fundamental principles of software processes and their development in professional software engineering. The course extends the understanding of quality based on individual techniques (e.g. reviews) so that after completing the course the student is able to:

- Understand professional software development processes in agile, lean and traditional environments
- Evaluate different methods and techniques
- Select from them appropriate ones for different software engineering environments
- Have capabilities to participate in systematic efforts for improvement in software companies.

**Contents:**

The course covers the most fundamental process centred software quality improvement and management approaches, methods and latest research results, as well as approaches to software measurement. The topics of the course include: traditional waterfall, agile (extreme programming, Scrum, Rational unified process, crystal, feature driven development, adaptive software development, dynamic systems development method) and lean methods, process improvement approaches, software process and product measurement, agile and lean practices, process improvement at the enterprise level and practical examples from software industry.

**Mode of delivery:**

Face-to-face teaching + Seminars.

**Learning activities and teaching methods:**

9 Lectures (30 hours), 7 Seminars (30 hours), Individual weekly assignments (43 hours), Group work (30 hours).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree and basic knowledge of software engineering.

**Recommended or required reading:**

- Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004
- Dingsøyr T., Dybå T., Moe N.B., Agile Software Development: Current Research and Future Directions, Springer, 2010
- C. Jones, Applied Software Measurement: Global Analysis of Productivity and Quality, 3rd ed. McGraw-Hill Osborne Media, 2008

- Craig Larman and Bas Vodde, Scaling Lean & Agile Development: Thinking and Organizational Tools for Large-Scale Scrum, Addison-Wesley, 2009
- CMMI: Guidelines for Process Integration and Product Improvement. Mary Beth Chrissis, Mike Konrad, Sandy Shrum. Addison-Wesley, ISBN 032-115496-7, 2004.

**Assessment methods and criteria:**

Active and regular participation to lectures and seminars AND report evaluation AND seminar presentations.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

**Working life cooperation:**

Visiting lecture from industry.

## 815663S: Software Engineering Research, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Muhammad Ahmad, Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course the student will know the current research areas in software engineering and the most important software engineering research methods. The student understands academic research and publishing in software engineering, and is able to critically analyse scientific articles from the viewpoint of the content and research methods used in the article. The student is able to present academic research and actively participate in an academic discussion of research papers and research results.

**Contents:**

State of the art research methods and topics in software engineering.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars 28 h, exercises / assignments 78 h, weekly study 42 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree.

**Recommended or required reading:**

**Assessment methods and criteria:**

Active participation in lectures and attendance. Final grade is composed of attendance, assignments and term paper. No remote participation or distance learning.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

## 817614S: Software Factory Project, 10 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Kuvaja

**Opintokohteen kielet:** English

**ECTS Credits:**

10 ECTS credits / 267 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.

**Learning outcomes:**

After completing the course, the students should demonstrate their abilities to work on a challenging ICT project. Students will learn to acquire and apply professional expertise in the topic of the project. Students will also demonstrate their skills to conduct an ICT project in a professional way. By completing this course, students are able to act as independent professional members of an ICT project and have advanced professionalism in project work and management. The topics for the course can be anything from the ICT field. As a professional expert conducting a successful project in a managed way, the student is able to: collectively produce, monitor and update the plan of the project (project with fixed time and human resources); search up to date information on the subject matter of the project in order to build professional expertise on the topic and apply this in the project work; build professional working knowledge and skills focused in the subject area of the project (e.g. software development, user experience evaluation); develop analytical and creative skills for successful completion of the project; monitor and communicate the status (time & human resources used) of the project in real time within the project team (weekly/daily meetings); use systematic means (e.g. ICT tools) to enable communication and transparency of the project work; develop skills to communicate with the customer in a professional context; manage a successful project review with the steering group/project team organization; report and explain the status (progress, results and future estimations of the project) to the steering group to support the decision making and problem resolution concerning the project's future; work as responsible project team member; as an expert and/or project manager; work as a project team member with people from different technical and/or cultural backgrounds; produce a realistic outcome in relation to the project time and human resources (ok, good, excellent); reflect the relationship between the process model(s) selected for the project (waterfall, evolutionary, agile etc.) and the management practices followed in the project.

**Contents:**

Starting lectures (4 x 2 h) and two workshops (2 x 8 h), where the steps of carrying out the course will be described together with other important information. Allocation of the project teams will immediately follow the starting lectures. The project work will take two periods (one semester). Unique project material provided by the customer of the project and / or material to be collected and studied by the project team.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Project work 260 h per student. Working hours reported during the project. Attendance at the starting lectures (8 h) and workshops (16 h) is mandatory.

**Target group:**

MSc students.

**Prerequisites and co-requisites:**

Mandatory: B.Sc. degree or other equivalent degree. Students enrolling directly to the Master's programme should take the "Preparatory course for MSc studies (811392A)" course first (see the timetable for the autumn semester, period 1) or otherwise master the basics of project work and management as in Pressman, R.S. Software Engineering: A Practitioner's Approach, the chapters related to project management.

**Recommended or required reading:**

Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004. - R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005 -Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.

**Assessment methods and criteria:**

Skills will be reported by a project portfolio. Details about the assessment criteria will be given at the starting lecture and they will also be available in the web-based learning environment

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Pasi Kuvaja

**Working life cooperation:**

Learning by doing, i.e. managing authentic, resource-limited project work and integrating the practices of an academic expert into the unique project assignment.

**Other information:**

Enrollment for the course is well beforehand, i.e. until the end of December during 1st study year.

## 815312A: Software Production and Maintenance, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**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 in the 1st spring semester.

**Learning outcomes:**

After completing the course, the student:

- Can apply the framework of product line engineering in large scale software production
- Can apply the maintenance process and techniques in software production.

**Contents:**

Product line engineering: 1. Product line variability; 2. Domain engineering; 3. Application engineering; 4. Transition strategies and organisational issues. Principles and practices of software evolution and maintenance.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises/ assignments 18 h, weekly study and learning diary 4 2h, term project 45 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of software engineering and software architectures.

**Recommended or required reading:**

Pohl, K., Böckle, G., van der Linden, F. Software Product Line Engineering. Foundations, Principles, and Techniques, Springer-Verlag, 2005; chapters 1-5, 10, 15, 19-20. Chastek G.J., Donohoe P., McGregor J.D., Formulation of a Production Strategy for a Software Product Line, Technical Note CMU/SEI-2009-TN-025, Carnegie Mellon, 2009. Software Evolution and Maintenance, Priyadarshi Tripathy, Kshirasagar Naik, ISBN: 978-0-470-60341-3, 416 pages, January 2015.

**Assessment methods and criteria:**

Active participation to lectures and attendance. Final grade is composed of attendance, learning diary, assignments and term project.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mika Mäntylä

## 815311A: Software Quality and Testing, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Umar Farooq

**Opintokohteen kielet:** English

**Leikkaavuudet:**

ay815311A Software Quality and Testing (OPEN UNI) 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 in the 1st autumn semester.

**Learning outcomes:**

The student understands different views on software quality and the role of testing as a part of software engineering validation and verification activities, and defect identification / removal techniques. The student knows testing levels, strategies and techniques, can create test cases and conduct unit testing with appropriate testing tools. The student knows the basics of test driven development and test automation.

**Contents:**

Software quality and quality assurance. Software quality management and metrics. Fundamental concepts of software testing. Functional and structural testing. Unit, integration, system, acceptance and regression testing. Hands on test-driven development. Test automation.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises / assignments 24 h, weekly study 42 h, term project 42 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Working knowledge of Java programming language is required. Basic knowledge of software engineering.

**Recommended optional programme components:**

**Recommended or required reading:**

Pezze M., Young M., "Software Testing and Analysis: Process, Principles and Techniques", John Wiley&Sons, 2008

\*\*\* Lasse Koskela, "Test Driven: Practical TDD and Acceptance TDD for Java Developers", Manning Publications,

2007 \*\*\* Galin D., "Software Quality Assurance: From theory to implementation", Addison-Wesley, 2004.

**Assessment methods and criteria:**

Active Participation to lectures and exercises. Final grade is composed of attendance, assignments and term project.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Umar Farooq

**Working life cooperation:**

Usually visiting lecture from industry.

## **811344A: Basics of Statistical Data Analysis for Information Processing Science, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Ari Vesanen

**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 in the 2nd autumn semester.

**Learning outcomes:**

After completion of the course, the student can identify and describe the basic properties and types of statistical data and is able to apply them in tasks related to information processing sciences. The student is able to specify metrics and handle statistical variables. She or he is also able to describe and analyse statistical data with basic methods and report the results. The student knows also basics of R-language and is able to use it for conducting statistical analysis.

**Contents:**

Types of statistical data, measurement and variables, data collection methods, sampling, management of statistical data, descriptive statistics, hypothesis testing, basics of data analysis, graphical presentation of statistical data, reporting of statistical analyses, basics of R.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 32 h, exercises 24 h, independent work 77 h.

**Target group:**

BSc students.

**Recommended or required reading:**

Lecture slides, given literature and exercise tasks.

Literature:

- Blaikie (2003), Analyzing Quantitative Data; Wild & Seber (2000), Chance Encounters; Venables, Smith & the R Core Team (2014), An Introduction to R
- Other literature specified in the course.

**Assessment methods and criteria:**

The course is evaluated based on passed exam and acceptable exercise tasks. The exam can be replaced with weekly assignments during the course.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Ari Vesanen

**813626S: Emerging Technologies and Issues, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Xiuyan Shao

**Opintokohteen kielet:** English

**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 spring semester.

**Learning outcomes:**

After completing the course, the student is able to :

- Analyse the on-going changes in online and consumer behaviour, customer requirements, ICT markets and technological development;
- Evaluate key enabling web-based and other information technologies and become an effective participant in web-enabled business endeavours and initiatives;

- Design ways for leveraging information and communication technologies to improve intra- and inter-organisational processes and enhance a firm's competitive position;
- Plan ways for searching innovations; and
- Develop his / her skills for building careers and taking advantage of entrepreneurial opportunities through emerging technologies, in particular related to the web.

**Contents:**

- A shift in thinking about the web and emerging technologies
- How the social web is transforming businesses, software design, our perception of people as well as skills required of us
- How to accelerate innovation creation through web-based and other emerging technologies: Ecosystem thinking, strategies, core business values
- Transformation of the social web into humanized web.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises 8 h, reflective personal exercises 21 h, independent work and exam (required reading) 80 h.

**Target group:**

MSc students

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

Oinas-Kukkonen H. & Oinas-Kukkonen H.: Humanizing the Web: Change and Social Innovation. Palgrave Macmillan, Basingstoke, UK, 2013 (required reading).

**Assessment methods and criteria:**

Exam.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Harri Oinas-Kukkonen

**811601S: Emerging Trends in Software Testing, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**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.

**Learning outcomes:**

After completing the course, a student gets an overview of advanced software testing (ST) techniques, as well as their benefits and limitations. Each student will conduct a deeper investigation of one of the ST subjects as part of the course assignment.

**Contents:**

Advanced testing techniques: Model-based testing, search-based testing, defect prediction, exploratory testing, combinatorial testing, static testing, static analyzers, virtualization, test automation

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures and exercises 24 h, individual weekly assignments 48 h, term project 61 h

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basics on software testing

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

Articles + lectures.

**Assessment methods and criteria:**

Active lecture participation, exercises, assignments, term project

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Alireza Haghighatkhah, Iflaah Salman

**812331A: Interaction Design, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Minna Pakanen

**Opintokohteen kielet:** English

**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.

**Learning outcomes:**

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

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

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 20 h, exercises and seminar 25 h, individual and group assignments 90 h; or self-study: an opening lecture 2 h, one larger assignment 110 h and individual tasks 21 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

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

**Recommended or required reading:**

Sharp et al. (2015) Interaction Design, chapters 1-2, 4-5, 7-13 (pages 1-64, 100-157, 226-473).

**Assessment methods and criteria:**

Accepted assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Minna Pakanen

**Working life cooperation:**

Invited lectures, assignments.

## 811392A: Preparatory Course for MSc Studies, 5 op

**Voimassaolo:** 01.03.2014 - 31.12.2018

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Arto Lanamäki

**Opintokohteen kielet:** English

**ECTS Credits:**

2 ECTS credits / 53 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 in the 1st autumn semester.

**Learning outcomes:**

After completing the course, the student is able to participate in courses requiring basic knowledge of project work. The student is able to apply the basic concepts of project work, act in different roles in projects and is able to describe the significance of the different project outcomes, such as project plan, mid-reports and final reports. The student is able to define the principles of project coordination and communication with the project interest groups. Additionally, the student is able to consider the principles of referenced and scientific writing.

**Contents:**

The focus of the course is in the people, process and tools of a project in information technology field. Course covers the basic principles of project management, planning, coordination and communication within the project as well as outside the project. Course presents the different outcomes of the project, related to internal and external communication – project plans, mid-report, final reports and other project specific outcomes, as well as internal reports, memos and non-written communication and coordination techniques in a project. The latter include unofficial and official meetings held within the project as well as among the external interest groups of the project (for example, customers and the project steering group). Finally, the course presents the basics of written referenced and scientific communication – how to use references, how to acknowledge work of others, how to format an article and what is plagiarization and how to avoid plagiarization.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Lectures and exercises 20h, independent learning methods 34h.

**Target group:**

Msc students. The course is mandatory for GS3D students, and recommended for students with a Finnish University of Applied Sciences (AMK) background.

**Recommended optional programme components:**

Especially recommended to take before Master's level project courses.

**Recommended or required reading:**

Provided when the course starts.

**Assessment methods and criteria:**

Active participation in the lectures and exercises; learning diary.

**Grading:**

Pass or fail.

**Person responsible:**

Arto Lanamäki

## 811391A: Requirements Engineering, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Jouni Markkula

**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 3. It is recommended to complete the course in the 2nd study year.

**Learning outcomes:**

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

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

**Target group:**

B.Sc. students.

**Prerequisites and co-requisites:**

We assume the basic skills from the following courses: 811167P Introduction to Information System Design, 812342A Object-Oriented Analysis and Design, 811395A Basics of Databases, 811346A Software Engineering.

**Recommended optional programme components:**

**Recommended or required reading:**

S. Lauesen, Software Requirements – Styles and Techniques. Pearson Education 2002. A.M. Davis, Just Enough Requirements Management, Dorset House Publishing 2005. Lecture slides.

**Assessment methods and criteria:**

Two ways of passing: 1) Active participation: weekly assignments and project assignment (only for Finnish-speaking students); 2) Exam.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Jouni Markkula

## 813630S: Software Business Development, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Karin Väyrynen

**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 in the 1st spring semester.

**Learning outcomes:**

The course provides insights to software business development on a business, company and industry level. After completing the course, the student is able to plan how software business is being developed over the whole life cycle of the business and company; conduct market and business analyses; identify different sources of financing for business operation; evaluate different strategic business options; select a business model adequate for the present and future situation of the company; and write a business plan.

**Contents:**

The course takes three points of view: company start-up, established business, and software industry. The course introduces the concepts of business idea, business plan, software business models and strategies, and the software value network.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 21 h, course assignments 63 h, (home) exam 25 h. The course assignments will be conducted as group work.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree and basic knowledge of software business.

**Recommended optional programme components:**

It is recommended, but not mandatory, to complete the following courses prior to enrolling for the course unit: 811174P Introduction to Software Business, 813316A Business Process Modelling and 813620S Software Business Management.

**Recommended or required reading:**

Lecture slides and literature announced during the course implementation.

**Assessment methods and criteria:**

This course unit utilizes continuous assessment. Lectures are for the most part voluntarily, but participation is recommended. The students will write course assignments which will be assessed. In addition, there will be a (home) exam at the end of the course which will be assessed. The assessment of the course unit is based on the learning outcomes of the course unit.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Karin Väyrynen

**Working life cooperation:**

Usually visiting lecture from industry.

## 902140Y: Cross-Cultural Competence and Communication Skills, 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:**

-

**Status:**

-

**Required proficiency level:**

-

**ECTS Credits:**

2 ECTS credits

**Language of instruction:**

English

**Timing:**

1<sup>st</sup> year of Master's studies, autumn semester

**Learning outcomes:**

By the end of the course students will be able to:

- demonstrate understanding and awareness of cultural differences and their effect on communication especially in the working life
- act and behave appropriately in different kind of situations by taking into consideration cultural differences
- demonstrate the ability to analyze one's own culture and discuss it with others
- show an understanding of communication in Finnish working life and culture

**Contents:**

This course is designed to bring about an understanding of intercultural competence as well as awareness of one's own competence with cultural differences. In the course the background theory will be examined and one's own skills will be assessed. In the course negotiating skills across cultures will be studied using the 12 variables of negotiating. Cross-cultural differences in business correspondence will also be examined.

**Mode of delivery:**

Lectures, study groups, Optima

**Learning activities and teaching methods:**

Contact lessons (24 h) and homework. The course will also have a short study group segment to practice cross-cultural communicative activities.

**Target group:**

The students of International Master's Programme GS3D, Departement of Information Processing Science

**Prerequisites and co-requisites:**

-

**Recommended optional programme components:**

-

**Recommended or required reading:**

Will be provided by the teacher.

**Assessment methods and criteria:**

Participation in the class room sessions, homework and study group assignments.

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

**Grading:**

pass/fail

**Person responsible:**

Anne Koskela and Jaana Sorvari

**Working life cooperation:**

-

**Other information:**

Sign-up in WebOodi.

## **817604S: ICT and Organizational Change, 5 op**

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Karin Väyrynen

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course the student is able to distinguish various roles of information and communication technology (ICT) in change of organization and its context, and is able to analyze the role of ICT in relation with change taking place in an organization.

**Contents:**

The course studies organisations at four levels: individuals, practices, organizational structures and transformations, and the societal context of organisations. The organizational role of ICT and the relation between ICT and knowledge are also discussed. The role of power, trust and control in the change process is discussed. The different aspects of change agents are presented and analysed. Students familiarize themselves with 7 organizational theories.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 28 h, individual work 105 h (for self-studying for weekly in-class exams - or optionally a traditional exam), and a review and analysis of selected course materials and writing a case analysis).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Recommended to take Emerging Technologies and Issues before this course.

**Recommended optional programme components:**

**Recommended or required reading:**

A list of research articles will be provided for the lectures and assignments.

**Assessment methods and criteria:**

Week exams and weekly case analysis (or traditional exam at end of the course), course assignment (literature review, case analysis).

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Karin Väyrynen

## **813607S: IPS (TOL), Maturity Test for Master's Degree, 0 op**

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

## **812349A: IT Infrastructure, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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



**Opettajat:** Petri Pulli

**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.

**Learning outcomes:**

After completing the course, students are able to judge, compare and apply data communications concepts and computing solutions to various situations encountered in industry; identify general concepts and techniques of data communications in different organizational environment; Explain core elements of IT infrastructure, principles underlying layered system architectures and the technology of the Internet; identify the most important server and storage architectures and the main mechanisms for providing high-capacity processing and storage capacity; Understand the principles of service virtualization, and concepts of IP networks and protocols; Explain structure of large-scale organizational IT infrastructure, and role of IT service management as organizational IT infrastructure solution; Understand opportunities for virtual computing service and configure IT infrastructure and security solution for small organization. The course aims to enable effective communication with technical, operational, managerial and service provider communities through improvement in technical knowledge and terminology. The course provides IT consultants with capabilities to make intelligent decisions regarding computing platform and service architectures by considering organizational flexibility.

**Contents:**

1. Introduction to IT Infrastructure 1.1. System Architecture & System Organizing Structure 1.2. Components of computer-based systems 1.3. Role of IT Infrastructure in a modern organization 2. Architecture, Technologies, Services and Standards in IT Infrastructure 2.1. Operating system 2.2. Networking 2.3. Data Centers 2.4. Securing IT Infrastructure 2.5. Grid computing 2.6. Cloud computing 3. Emerging Technologies and Trends 3.1. Internet of Things (IoT) 3.2. Distributed Ledger and Blockchain Technologies 3.3. Augmented Reality / Virtual Reality 3.4. Wearable Technologies.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 20 h, Student project guidance and seminar 12 h, student project work 71 h and examination 30 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge on computer, network and Internet architecture.

**Recommended optional programme components:**

**Recommended or required reading:**

Lecture notes, scientific papers and technology articles.

**Assessment methods and criteria:**

Accepted project work and examination.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Petri Pulli

**Working life cooperation:**

Two industrial guest lecturers.

## **813623S: Information Security Policy and Management in Organisations, 5 op**

**Voimassaolo:** 01.08.1950 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Xiuyan Shao

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course at the 2nd autumn semester.

**Learning outcomes:**

After completing the course, the student is able to:

- Develop BCM (Business Continuity Management) and SA (Systems Availability) strategy;
- Develop organization specific information security policies in organizations;
- Conduct Information Security (and risk) Analysis;
- Conduct Information Security Audits;
- Understand information security standards, regulations, and policies;
- Improving employees' compliance with the information security procedures through training, campaigning and other means;
- Certifications related to information security (such as ISO27001);
- Public-key infrastructure (PKI), Digital signature, & Certification authority (CA).

**Contents:**

1. Business Continuity Management (BCM) and Systems Availability (SA)
2. Information Security Life Cycle
3. Conduct Information Security (and risk) Analysis
4. Information security standards, regulations, and policies
5. Information security investment management
6. Insider threats in information security management
7. Security Audits (Active Security Assessment)
8. Information Security Certification (ISO27001) & Certification authority (CA).

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures (24 h), exercises (23 h), homework (30 h), essay (20 h), examination (36 h).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Understanding of information security issues, principles, techniques, or similar knowledge, is helpful.

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

Raggad, Bel G.: Information security management, Concepts and practice, CRC Press 2010, Chapters 1, 2.7. – 2.13, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, and 15.

**Assessment methods and criteria:**

Examination.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Xiuyan Shao

**813613S: Master's Thesis, 30 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Diploma thesis

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

**813627S: Master's Thesis Seminar, 2 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**Required proficiency level:**

**ECTS Credits:**

2 ECTS credits / 53 hours of work (1 ECTS / 27 hours of work for GS3D students).

**Language of instruction:**

English

**Timing:**

The course is held throughout the study year, in all periods. It is recommended to start the course during the 1st study year, before Master's Thesis.

**Learning outcomes:**

By completing this course the student can

- plan a scientific study,
- present own research in various stages, and
- give feedback of peers' research plans and results.

**Contents:**

The course consists of three phases following the structure and progress of a Master's Thesis work: 1) previous research and initial research methods (research plan), 2) data gathering and analysis, as well as 3) discussions and conclusions (thesis). In each phase, a student is required to participate first as a peer reviewer, and then present his / her own research.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Planning and presenting the student's own research and giving feedback of peers' plans and results 53 h (27 h for GS3D students).

**Target group:**

MSc students

**Recommended optional programme components:**

813613S Master's Thesis.

**Recommended or required reading:**

Guidelines to producing a Master's thesis.

**Assessment methods and criteria:**

Active participation in at least nine (six for GS3D students) seminar sessions. One session lasts about three hours and they are arranged during the semesters according to the plan published on the website.

**Grading:**

Pass or fail.

**Person responsible:**

Henrik Hedberg

## **815657S: Open Source Software Development, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After passing the course, a student will be able to

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

**Contents:**

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

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Independent personal and group work about 40 h, weekly meetings and seminars about 30 h, seminar article and presentation about 60 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work.

**Recommended or required reading:**

Fogel, K. (2017): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media;  
Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

**Assessment methods and criteria:**

Active participation, seminar article and other assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Henrik Hedberg

## 811392A: Preparatory Course for MSc Studies, 5 op

**Voimassaolo:** 01.03.2014 - 31.12.2018

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Arto Lanamäki

**Opintokohteen kielet:** English

**ECTS Credits:**

2 ECTS credits / 53 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 in the 1st autumn semester.

**Learning outcomes:**

After completing the course, the student is able to participate in courses requiring basic knowledge of project work. The student is able to apply the basic concepts of project work, act in different roles in projects and is able to describe the significance of the different project outcomes, such as project plan, mid-reports and final reports. The student is able to define the principles of project coordination and communication with the project interest groups. Additionally, the student is able to consider the principles of referenced and scientific writing.

**Contents:**

The focus of the course is in the people, process and tools of a project in information technology field. Course covers the basic principles of project management, planning, coordination and communication within the project as well as outside the project. Course presents the different outcomes of the project, related to internal and external communication – project plans, mid-report, final reports and other project specific outcomes, as well as internal reports, memos and non-written communication and coordination techniques in a project. The latter include unofficial and official meetings held within the project as well as among the external interest groups of the project (for example, customers and the project steering group). Finally, the course presents the basics of written referenced and scientific communication – how to use references, how to acknowledge work of others, how to format an article and what is plagiarism and how to avoid plagiarism.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Lectures and exercises 20h, independent learning methods 34h.

**Target group:**

Msc students. The course is mandatory for GS3D students, and recommended for students with a Finnish University of Applied Sciences (AMK) background.

**Recommended optional programme components:**

Especially recommended to take before Master's level project courses.

**Recommended or required reading:**

Provided when the course starts.

**Assessment methods and criteria:**

Active participation in the lectures and exercises; learning diary.

**Grading:**

Pass or fail.

**Person responsible:**

Arto Lanamäki

## 813621S: Research Methods, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Arto Lanamäki

**Opintokohteen kielet:** English

**Leikkaavuudet:**

521146S    Research Methods in Computer Science    5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information processing sciences. The student is able to identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching, lecture videos.

**Learning activities and teaching methods:**

Lectures 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:**

Completion of Bachelor's studies.

**Recommended or required reading:**

Lecture slides and specified literature.

**Assessment methods and criteria:**

Accepted learning diary.

**Grading:**

Pass or fail.

**Person responsible:**

Arto Lanamäki

**817602S: Software Development in Global Environment, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Kuvaja

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student can define the key success factors of Global Software Design (GSD) and the potential problems in coordination of projects where teams are separated by physical and / or temporal distance; can define and evaluate the collaborative technologies, which in the best way support distributed software development; can choose the methods and tools for distributed software development; can apply the practices of GSD in a student project and use the supporting tools throughout the project life cycle.

**Contents:**

Some of the topics covered are strategic issues in distributed development (off-shoring, near-shoring, outsourcing, OSS); cost-benefit-risk analysis; the triad of coordination, control and communication; team building (e.g. virtual teams); software process paradigms in the global environment (planned, agile); methods and tools for distributed software development; issues related to allocation of tasks; communication issues that arise due to distance and time zone differences; infrastructure support; geographical dispersion; lack of information communication; coordination complexity; cultural issues; technical issues related to information and artefact sharing; architectural design; and finally knowledge management issues. The lectures and seminars also review current research aspects of the GSD and related case studies from industry. The exercises demonstrate distributed software development as a virtual team with the support of appropriate methods and tools.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars involving all the students as well as lecture assignments (reading articles and writing analyses) 70 h (20 h lecture attendances, 30 h lecture assignments, 20 h additional reading), and exercises 65 h. For lecture assignments each student will read, summarize and analyse selected academic articles. The exercises include laboratory demonstrations of different supporting tools for distributed software development. The students train in project software development and planning practices in a distributed environment. The student project groups are organised into virtual (distributed) teams of 4 students.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of academic writing technique is needed. Basic understanding of software business is an advantage.

**Recommended or required reading:**

To be announced during the course implementation.

**Assessment methods and criteria:**

By active participation or alternatively exam, based on the course study materials.

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Veikko Seppänen

**Other information:**

Course does not have any lectures or exercises in academic year 2019-2020. It is still possible to do course, please sent email to Professor Veikko Seppänen veikko.seppanen@oulu.fi

## **815662S: Software Engineering Management, Measurement and Improvement, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd autumn semester.

**Learning outcomes:**

After completing the course the student understands the fundamental principles of software processes and their development in professional software engineering. The course extends the understanding of quality based on individual techniques (e.g. reviews) so that after completing the course the student is able to:

- Understand professional software development processes in agile, lean and traditional environments
- Evaluate different methods and techniques
- Select from them appropriate ones for different software engineering environments
- Have capabilities to participate in systematic efforts for improvement in software companies.

**Contents:**

The course covers the most fundamental process centred software quality improvement and management approaches, methods and latest research results, as well as approaches to software measurement. The topics of the course include: traditional waterfall, agile (extreme programming, Scrum, Rational unified process, crystal, feature driven development, adaptive software development, dynamic systems development method) and lean methods, process improvement approaches, software process and product measurement, agile and lean practices, process improvement at the enterprise level and practical examples from software industry.

**Mode of delivery:**

Face-to-face teaching + Seminars.

**Learning activities and teaching methods:**

9 Lectures (30 hours), 7 Seminars (30 hours), Individual weekly assignments (43 hours), Group work (30 hours).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree and basic knowledge of software engineering.

**Recommended or required reading:**

- Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004
- Dingsøyr T., Dybå T., Moe N.B., Agile Software Development: Current Research and Future Directions, Springer, 2010
- C. Jones, Applied Software Measurement: Global Analysis of Productivity and Quality, 3rd ed. McGraw-Hill Osborne Media, 2008

- Craig Larman and Bas Vodde, Scaling Lean & Agile Development: Thinking and Organizational Tools for Large-Scale Scrum, Addison-Wesley, 2009
- CMMI: Guidelines for Process Integration and Product Improvement. Mary Beth Chrissis, Mike Konrad, Sandy Shrum. Addison-Wesley, ISBN 032-115496-7, 2004.

**Assessment methods and criteria:**

Active and regular participation to lectures and seminars AND report evaluation AND seminar presentations.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

**Working life cooperation:**

Visiting lecture from industry.

## 817614S: Software Factory Project, 10 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Kuvaja

**Opintokohteen kielet:** English

**ECTS Credits:**

10 ECTS credits / 267 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.

**Learning outcomes:**

After completing the course, the students should demonstrate their abilities to work on a challenging ICT project. Students will learn to acquire and apply professional expertise in the topic of the project. Students will also demonstrate their skills to conduct an ICT project in a professional way. By completing this course, students are able to act as independent professional members of an ICT project and have advanced professionalism in project work and management. The topics for the course can be anything from the ICT field. As a professional expert conducting a successful project in a managed way, the student is able to: collectively produce, monitor and update the plan of the project (project with fixed time and human resources); search up to date information on the subject matter of the project in order to build professional expertise on the topic and apply this in the project work; build professional working knowledge and skills focused in the subject area of the project (e.g. software development, user experience evaluation); develop analytical and creative skills for successful completion of the project; monitor and communicate the status (time & human resources used) of the project in real time within the project team (weekly/daily meetings); use systematic means (e.g. ICT tools) to enable communication and transparency of the project work; develop skills to communicate with the customer in a professional context; manage a successful project review with the steering group/project team organization; report and explain the status (progress, results and future estimations of the project) to the steering group to support the decision making and problem resolution concerning the project's future; work as responsible project team member; as an expert and/or project manager; work as a project team member with people from different technical and/or cultural backgrounds; produce a realistic outcome in relation to the project time and human resources (ok, good, excellent); reflect the relationship between the process model(s) selected for the project (waterfall, evolutionary, agile etc.) and the management practices followed in the project.

**Contents:**

Starting lectures (4 x 2 h) and two workshops (2 x 8 h), where the steps of carrying out the course will be described together with other important information. Allocation of the project teams will immediately follow the starting lectures. The project work will take two periods (one semester). Unique project material provided by the customer of the project and / or material to be collected and studied by the project team.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Project work 260 h per student. Working hours reported during the project. Attendance at the starting lectures (8 h) and workshops (16 h) is mandatory.



**Target group:**

MSc students.

**Prerequisites and co-requisites:**

Mandatory: B.Sc. degree or other equivalent degree. Students enrolling directly to the Master's programme should take the "Preparatory course for MSc studies (811392A)" course first (see the timetable for the autumn semester, period 1) or otherwise master the basics of project work and management as in Pressman, R.S. Software Engineering: A Practitioner's Approach, the chapters related to project management.

**Recommended or required reading:**

Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004. - R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005 -Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.

**Assessment methods and criteria:**

Skills will be reported by a project portfolio. Details about the assessment criteria will be given at the starting lecture and they will also be available in the web-based learning environment

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Pasi Kuvaja

**Working life cooperation:**

Learning by doing, i.e. managing authentic, resource-limited project work and integrating the practices of an academic expert into the unique project assignment.

**Other information:**

Enrollment for the course is well beforehand, i.e. until the end of December during 1st study year.

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

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Karppinen

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

E-exam.

**Learning outcomes:**

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

**Contents:**

Information Systems Strategy, Information Systems Development Life Cycle (SDLC), Information systems success, Soft Systems Methodology (SSM), Socio-Technical Approach, Evolutionary development, Agile methodologies.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Bachelor studies recommended.

**Recommended optional programme components:****Assessment methods and criteria:**

E-exam

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Pasi Karppinen

## 813625S: Information Systems Theory, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Netta Iivari

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English.

**Timing:**

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

**Learning outcomes:**

After completing the course, students will have a good knowledge and understanding of a broad array of research topics and themes within the field of information systems; will have good knowledge and understanding of information systems research and the process by which that research is produced; will have competence in critiquing research articles published in some of the leading academic journals and conference proceedings; will have competence in critical thinking, and analysis and synthesis of academic sources; will have competence in verbally presenting arguments in an academic fashion; will know how to write a literature review on an information systems research topic.

**Contents:**

Information Systems Research Overview, A contemporary selection of Information Systems research themes.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, seminars 10 h, individual and group assignments 100 h; or self-study: opening lecture 2 h, assignments 132 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Bachelor's degree or similar, Research Methods course. Recommended to take before Master's Thesis.

**Recommended optional programme components:**

**Recommended or required reading:**

Lectures and Selection of scientific articles.

**Assessment methods and criteria:**

Accepted assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Netta Iivari

## 815663S: Software Engineering Research, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Muhammad Ahmad, Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course the student will know the current research areas in software engineering and the most important software engineering research methods. The student understands academic research and publishing in software engineering, and is able to critically analyse scientific articles from the viewpoint of the content and research methods used in the article. The student is able to present academic research and actively participate in an academic discussion of research papers and research results.

**Contents:**

State of the art research methods and topics in software engineering.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars 28 h, exercises / assignments 78 h, weekly study 42 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree.

**Recommended or required reading:**

**Assessment methods and criteria:**

Active participation in lectures and attendance. Final grade is composed of attendance, assignments and term paper. No remote participation or distance learning.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

## 813630S: Software Business Development, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Karin Väyrynen

**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 in the 1st spring semester.

**Learning outcomes:**

The course provides insights to software business development on a business, company and industry level. After completing the course, the student is able to plan how software business is being developed over the whole life cycle of the business and company; conduct market and business analyses; identify different sources of financing for business operation; evaluate different strategic business options; select a business model adequate for the present and future situation of the company; and write a business plan.

**Contents:**

The course takes three points of view: company start-up, established business, and software industry. The course introduces the concepts of business idea, business plan, software business models and strategies, and the software value network.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 21 h, course assignments 63 h, (home) exam 25 h. The course assignments will be conducted as group work.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree and basic knowledge of software business.

**Recommended optional programme components:**

It is recommended, but not mandatory, to complete the following courses prior to enrolling for the course unit:

811174P Introduction to Software Business, 813316A Business Process Modelling and 813620S Software Business Management.

**Recommended or required reading:**

Lecture slides and literature announced during the course implementation.

**Assessment methods and criteria:**

This course unit utilizes continuous assessment. Lectures are for the most part voluntarily, but participation is recommended. The students will write course assignments which will be assessed. In addition, there will be a (home) exam at the end of the course which will be assessed. The assessment of the course unit is based on the learning outcomes of the course unit.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Karin Väyrynen

**Working life cooperation:**

Usually visiting lecture from industry.

## 813620S: Software Business Management, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Marianne Kinnula

**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 in the 1st spring semester.

**Learning outcomes:**

Upon completion of the course, the student will be able to assess the main problem areas in software business management and is able to describe how to manage these problems; will be able to use different kinds of tools for managing this diverse and ambiguous environment; will understand the differences between leading and managing and be able to apply these to practice; will be able to analyse a company situation in a continually changing, unpredictable and even hostile environment, and is able to make well-grounded recommendations for the company courses of action.

**Contents:**

The software business environment and context is complex and under continuous change. Competences and creativity of company employees are needed for creating value and growth to the company. Managing a software business is a challenging task as traditional, rational management models are often inadequate for the needs of the

managers. This course provides an overview of the strategic management of the software business in a software company.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and exercises 24 h, course assignments 72 h, (home) exam 30 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of academic writing technique is needed. Basic understanding of software business is an advantage.

**Recommended optional programme components:**

**Recommended or required reading:**

Lecture slides and specified literature.

**Assessment methods and criteria:**

Participation in lectures / exercises, group work, course assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Marianne Kinnula

## 815303A: Embedded Software Development Environments, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Juustila, Antti Juhani

**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.

**Learning outcomes:**

After completing the course, a student is able to work with the essential software development tools of a selected embedded platform. The student is able to implement memory and power efficient applications by exploiting existing libraries and knowledge of the programming interfaces provided by the platform.

**Contents:**

The focus of the course is in the software development environments and tools for mobile and embedded platforms, such as Android and iOS. In addition, the course covers memory and power management, core services of the platform, networking and the utilisation of existing libraries. One platform will be selected for deeper study, and the course introduces its essential software development tools and libraries. The emphasis is on application development for the platform as an exercise.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Lectures and exercises about 40 h, exercises and exercise work 93 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Course "815309A Real-time Distributed Software Development", C/C++ and / or Java programming skills or similar knowledge obtained from other courses.

**Recommended or required reading:**

Course material, the documentation of selected technologies, and other related literature.

**Assessment methods and criteria:**

Exercise work.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Antti Juustila

## 811600S: Emerging Trends in Software Engineering, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student understands the recent trends in software engineering. The student is able to perform computer supported trend mining to discover new trends of any given topic. The student is able to critically think about the trends.

**Contents:**

- Software engineering trends (varies yearly)
- Automated trend mining from online databases
- Writing, arguing and discussing about the trends.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 18 h, essays 30 h, project 30 h, independent study 31 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basics on software engineering.

**Recommended or required reading:**

Articles + lectures.

**Assessment methods and criteria:**

Active lecture participation, exercises, assignments, essays.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mika Mäntylä

## 811601S: Emerging Trends in Software Testing, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**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.

**Learning outcomes:**

After completing the course, a student gets an overview of advanced software testing (ST) techniques, as well as their benefits and limitations. Each student will conduct a deeper investigation of one of the ST subjects as part of the course assignment.

**Contents:**

Advanced testing techniques: Model-based testing, search-based testing, defect prediction, exploratory testing, combinatorial testing, static testing, static analyzers, virtualization, test automation

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures and exercises 24 h, individual weekly assignments 48 h, term project 61 h

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basics on software testing

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

Articles + lectures.

**Assessment methods and criteria:**

Active lecture participation, exercises, assignments, term project

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Alireza Haghighatkhah, Iflaah Salman

**812349A: IT Infrastructure, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Petri Pulli

**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.

**Learning outcomes:**

After completing the course, students are able to judge, compare and apply data communications concepts and computing solutions to various situations encountered in industry; identify general concepts and techniques of data communications in different organizational environment; Explain core elements of IT infrastructure, principles underlying layered system architectures and the technology of the Internet; identify the most important server and storage architectures and the main mechanisms for providing high-capacity processing and storage capacity; Understand the principles of service virtualization, and concepts of IP networks and protocols; Explain structure of large-scale organizational IT infrastructure, and role of IT service management as organizational IT infrastructure solution; Understand opportunities for virtual computing service and configure IT infrastructure and security solution

for small organization. The course aims to enable effective communication with technical, operational, managerial and service provider communities through improvement in technical knowledge and terminology. The course provides IT consultants with capabilities to make intelligent decisions regarding computing platform and service architectures by considering organizational flexibility.

**Contents:**

1. Introduction to IT Infrastructure 1.1. System Architecture & System Organizing Structure 1.2. Components of computer-based systems 1.3. Role of IT Infrastructure in a modern organization 2. Architecture, Technologies, Services and Standards in IT Infrastructure 2.1. Operating system 2.2. Networking 2.3. Data Centers 2.4. Securing IT Infrastructure 2.5. Grid computing 2.6. Cloud computing 3. Emerging Technologies and Trends 3.1. Internet of Things (IoT) 3.2. Distributed Ledger and Blockchain Technologies 3.3. Augmented Reality / Virtual Reality 3.4. Wearable Technologies.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 20 h, Student project guidance and seminar 12 h, student project work 71 h and examination 30 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge on computer, network and Internet architecture.

**Recommended optional programme components:**

**Recommended or required reading:**

Lecture notes, scientific papers and technology articles.

**Assessment methods and criteria:**

Accepted project work and examination.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Petri Pulli

**Working life cooperation:**

Two industrial guest lecturers.

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

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Denzil Teixeira Ferreira

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521046A Mobile Computing 5.0 op

521045S Mobile Computing 5.0 op

Ei opintojaksokuvauksia.

## 815657S: Open Source Software Development, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English



**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After passing the course, a student will be able to

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

**Contents:**

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

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Independent personal and group work about 40 h, weekly meetings and seminars about 30 h, seminar article and presentation about 60 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work.

**Recommended or required reading:**

Fogel, K. (2017): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media;  
Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

**Assessment methods and criteria:**

Active participation, seminar article and other assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Henrik Hedberg

**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, transactional/non-transactional databases , RESTful clients (HTML5 and Javascript).

**Mode of delivery:**

Web-based teaching and face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 4 h, guided laboratory work 15 h, the rest as self-study and group work. Each group implements programs and writes a report.

**Target group:**

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

**Prerequisites and co-requisites:**

Elementary programming (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:**

This course unit utilizes continuous assessment. The project work is divided in different deadlines that students must meet to pass the course. Each deadline will be assessed after completion.

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

**Grading:**

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

**Person responsible:**

Ivan Sanchez Milara

**Working life cooperation:**

None.

**Other information:**

This course replaces the course "521260S Representing structured information".

## 815305A: Real Time Distributed Software Development, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Petri Pulli

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during periods 1 and 2.

**Learning outcomes:**

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

**Contents:**

Introduction 1. Characteristics of real-time systems; 2. Resource management; 3. Safety and reliability; 4. Time constraints; 5. Concurrency; 6. Scheduling; 7. Interrupts Characteristics of Distribution 1. Distribution architectures 2. Concept of time; 3. Synchronisation; 4. Latency and jitter; 5. Quality of service; 6. Service discovery; 7. Networking primitives Real-Time UML Modelling Methodology Real-Time Design Patterns Design Examples: Embedded, Ubiquitous, Mobile, Web / Internet, Blockchain and Bitcoin.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

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

**Target group:**

MSc students

**Prerequisites and co-requisites:**

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

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Exam and project evaluation.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Petri Pulli

**Working life cooperation:**

One or two industrial guest lecturers.

## 817602S: Software Development in Global Environment, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Kuvaja

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student can define the key success factors of Global Software Design (GSD) and the potential problems in coordination of projects where teams are separated by physical and / or temporal distance; can define and evaluate the collaborative technologies, which in the best way support distributed software development; can choose the methods and tools for distributed software development; can apply the practices of GSD in a student project and use the supporting tools throughout the project life cycle.

**Contents:**

Some of the topics covered are strategic issues in distributed development (off-shoring, near-shoring, outsourcing, OSS); cost-benefit-risk analysis; the triad of coordination, control and communication; team building (e.g. virtual teams); software process paradigms in the global environment (planned, agile); methods and tools for distributed software development; issues related to allocation of tasks; communication issues that arise due to distance and time zone differences; infrastructure support; geographical dispersion; lack of information communication; coordination complexity; cultural issues; technical issues related to information and artefact sharing; architectural design; and

finally knowledge management issues. The lectures and seminars also review current research aspects of the GSD and related case studies from industry. The exercises demonstrate distributed software development as a virtual team with the support of appropriate methods and tools.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars involving all the students as well as lecture assignments (reading articles and writing analyses) 70 h (20 h lecture attendances, 30 h lecture assignments, 20 h additional reading), and exercises 65 h. For lecture assignments each student will read, summarize and analyse selected academic articles. The exercises include laboratory demonstrations of different supporting tools for distributed software development. The students train in project software development and planning practices in a distributed environment. The student project groups are organised into virtual (distributed) teams of 4 students.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of academic writing technique is needed. Basic understanding of software business is an advantage.

**Recommended or required reading:**

To be announced during the course implementation.

**Assessment methods and criteria:**

By active participation or alternatively exam, based on the course study materials.

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Veikko Seppänen

**Other information:**

Course does not have any lectures or exercises in academic year 2019-2020. It is still possible to do course, please sent email to Professor Veikko Seppänen veikko.seppanen@oulu.fi

## **815662S: Software Engineering Management, Measurement and Improvement, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd autumn semester.

**Learning outcomes:**

After completing the course the student understands the fundamental principles of software processes and their development in professional software engineering. The course extends the understanding of quality based on individual techniques (e.g. reviews) so that after completing the course the student is able to:

- Understand professional software development processes in agile, lean and traditional environments
- Evaluate different methods and techniques
- Select from them appropriate ones for different software engineering environments
- Have capabilities to participate in systematic efforts for improvement in software companies.

**Contents:**

The course covers the most fundamental process centred software quality improvement and management approaches, methods and latest research results, as well as approaches to software measurement. The topics of the course include: traditional waterfall, agile (extreme programming, Scrum, Rational unified process, crystal, feature driven development, adaptive software development, dynamic systems development method) and lean methods, process improvement approaches, software process and product measurement, agile and lean practices, process improvement at the enterprise level and practical examples from software industry.

**Mode of delivery:**

Face-to-face teaching + Seminars.

**Learning activities and teaching methods:**

9 Lectures (30 hours), 7 Seminars (30 hours), Individual weekly assignments (43 hours), Group work (30 hours).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree and basic knowledge of software engineering.

**Recommended or required reading:**

- Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004
- Dingsøyr T., Dybå T., Moe N.B., Agile Software Development: Current Research and Future Directions, Springer, 2010
- C. Jones, Applied Software Measurement: Global Analysis of Productivity and Quality, 3rd ed. McGraw-Hill Osborne Media, 2008
- Craig Larman and Bas Vodde, Scaling Lean & Agile Development: Thinking and Organizational Tools for Large-Scale Scrum, Addison-Wesley, 2009
- CMMI: Guidelines for Process Integration and Product Improvement. Mary Beth Chrissis, Mike Konrad, Sandy Shrum. Addison-Wesley, ISBN 032-115496-7, 2004.

**Assessment methods and criteria:**

Active and regular participation to lectures and seminars AND report evaluation AND seminar presentations.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

**Working life cooperation:**

Visiting lecture from industry.

## 815312A: Software Production and Maintenance, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**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 in the 1st spring semester.

**Learning outcomes:**

After completing the course, the student:

- Can apply the framework of product line engineering in large scale software production
- Can apply the maintenance process and techniques in software production.

**Contents:**

Product line engineering: 1. Product line variability; 2. Domain engineering; 3. Application engineering; 4. Transition strategies and organisational issues. Principles and practices of software evolution and maintenance.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises/ assignments 18 h, weekly study and learning diary 4 2h, term project 45 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of software engineering and software architectures.

**Recommended or required reading:**

Pohl, K., Böckle, G., van der Linden, F. Software Product Line Engineering. Foundations, Principles, and Techniques, Springer-Verlag, 2005; chapters 1-5, 10, 15, 19-20. Chastek G.J., Donohoe P., McGregor J.D., Formulation of a

Production Strategy for a Software Product Line, Technical Note CMU/SEI-2009-TN-025, Carnegie Mellon, 2009.  
Software Evolution and Maintenance, Priyadarshi Tripathy, Kshirasagar Naik, ISBN: 978-0-470-60341-3, 416 pages, January 2015.

**Assessment methods and criteria:**

Active participation to lectures and attendance. Final grade is composed of attendance, learning diary, assignments and term project.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mika Mäntylä

## 815311A: Software Quality and Testing, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Umar Farooq

**Opintokohteen kielet:** English

**Leikkaavuudet:**

ay815311A Software Quality and Testing (OPEN UNI) 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 in the 1st autumn semester.

**Learning outcomes:**

The student understands different views on software quality and the role of testing as a part of software engineering validation and verification activities, and defect identification / removal techniques. The student knows testing levels, strategies and techniques, can create test cases and conduct unit testing with appropriate testing tools. The student knows the basics of test driven development and test automation.

**Contents:**

Software quality and quality assurance. Software quality management and metrics. Fundamental concepts of software testing. Functional and structural testing. Unit, integration, system, acceptance and regression testing. Hands on test-driven development. Test automation.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises / assignments 24 h, weekly study 42 h, term project 42 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Working knowledge of Java programming language is required. Basic knowledge of software engineering.

**Recommended optional programme components:**

**Recommended or required reading:**

Pezze M., Young M., "Software Testing and Analysis: Process, Principles and Techniques", John Wiley&Sons, 2008  
\*\*\* Lasse Koskela, "Test Driven: Practical TDD and Acceptance TDD for Java Developers", Manning Publications, 2007  
\*\*\* Galin D., "Software Quality Assurance: From theory to implementation", Addison-Wesley, 2004.

**Assessment methods and criteria:**

Active Participation to lectures and exercises. Final grade is composed of attendance, assignments and term project.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Umar Farooq

**Working life cooperation:**

Usually visiting lecture from industry.

## 813607S: IPS (TOL), Maturity Test for Master's Degree, 0 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

## 812331A: Interaction Design, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Minna Pakanen

**Opintokohteen kielet:** English

### 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.

### Learning outcomes:

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

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

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

### Contents:

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

### Mode of delivery:

Face-to-face teaching.

### Learning activities and teaching methods:

Lectures 20 h, exercises and seminar 25 h, individual and group assignments 90 h; or self-study: an opening lecture 2 h, one larger assignment 110 h and individual tasks 21 h.

### Target group:

MSc students

### Prerequisites and co-requisites:

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

### Recommended or required reading:

Sharp et al. (2015) Interaction Design, chapters 1-2, 4-5, 7-13 (pages 1-64, 100-157, 226-473).

**Assessment methods and criteria:**

Accepted assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Minna Pakanen

**Working life cooperation:**

Invited lectures, assignments.

**813613S: Master's Thesis, 30 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Diploma thesis

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

**813627S: Master's Thesis Seminar, 2 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**Required proficiency level:****ECTS Credits:**

2 ECTS credits / 53 hours of work (1 ECTS / 27 hours of work for GS3D students).

**Language of instruction:**

English

**Timing:**

The course is held throughout the study year, in all periods. It is recommended to start the course during the 1st study year, before Master's Thesis.

**Learning outcomes:**

By completing this course the student can

- plan a scientific study,
- present own research in various stages, and
- give feedback of peers' research plans and results.

**Contents:**

The course consists of three phases following the structure and progress of a Master's Thesis work: 1) previous research and initial research methods (research plan), 2) data gathering and analysis, as well as 3) discussions and conclusions (thesis). In each phase, a student is required to participate first as a peer reviewer, and then present his / her own research.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Planning and presenting the student's own research and giving feedback of peers' plans and results 53 h (27 h for GS3D students).

**Target group:**

MSc students

**Recommended optional programme components:**



813613S Master's Thesis.

**Recommended or required reading:**

Guidelines to producing a Master's thesis.

**Assessment methods and criteria:**

Active participation in at least nine (six for GS3D students) seminar sessions. One session lasts about three hours and they are arranged during the semesters according to the plan published on the website.

**Grading:**

Pass or fail.

**Person responsible:**

Henrik Hedberg

## 817609S: Project Seminar, 3 op

**Voimassaolo:** 01.08.2013 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Tonja Molin-Juustila

**Opintokohteen kielet:** English

**ECTS Credits:**

3 ECTS credits / 80 hours of work.

**Language of instruction:**

English.

**Timing:**

The timing of the course is dependent on the Research and Development Project (817612S) course and will immediately follow the project in the next spring semester, during period 3. It is recommended to complete the course at the 2nd spring semester.

**Learning outcomes:**

After completing the course, the students should demonstrate their abilities to work as academic experts in challenging ICT projects. Students will learn to acquire and apply research articles and other new knowledge like an academic expert in a selected topic of their project ("Research and Development Project" course). Students will also learn to analyse and report their experience-based new knowledge on the topic to peer students. By completing this course, students are able to act as reflective, independent academic experts in ICT projects and have learnt expertise in some topic area of their project. As an expert in the selected topic area, the student is able to: search research articles and literature on the topic (review); report practical experiences gained during the project on the topic; evaluate the results of the project and reflect the practical experiences against previous literature and research on the topic; disseminate the (increased) expertise in the topic in a credible way to peers both by a written report and orally.

**Contents:**

Starting lecture, independent analysis and reporting of the expertise on the selected project topic and an expert seminar (2 full days) with the presentations of each topic.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Attendance at the starting lecture (4 h) and the expert seminar (2 full days) is mandatory. Independently writing the seminar paper and preparing the seminar presentation (abt. 50 h).

**Target group:**

MSc students.

**Prerequisites and co-requisites:**

Mandatory: Research and Development Project (817612S) during autumn semester, periods 1 & 2. This course will immediately follow the project course on the project topics. For the students of the Master's degree programme on Software, Systems, and Service Development (GS3D), Software Factory Project Course (817611S) is mandatory before this course.

**Recommended or required reading:**

Research articles and materials are to be independently collected and studied by the students.

**Assessment methods and criteria:**

Expertise in the topic area will be reported on the seminar paper. Seminar presentation will also be evaluated. Assessment criteria in detail will be given at the starting lecture and in the web-based learning environment for the course.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Tonja Molin-Juustila

**Working life cooperation:**

Seminar topics are related to the Master's students projects all of which are authentic project works in unique R&D project assignments from real customers (university, companies and organizations like schools, library etc.).

**Other information:**

Enrollment by contacting the responsible person of the course and outlining a draft of the seminar paper until end of the period 2 (i.e. before the course starts).

## 817614S: Software Factory Project, 10 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Kuvaja

**Opintokohteen kielet:** English

**ECTS Credits:**

10 ECTS credits / 267 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.

**Learning outcomes:**

After completing the course, the students should demonstrate their abilities to work on a challenging ICT project. Students will learn to acquire and apply professional expertise in the topic of the project. Students will also demonstrate their skills to conduct an ICT project in a professional way. By completing this course, students are able to act as independent professional members of an ICT project and have advanced professionalism in project work and management. The topics for the course can be anything from the ICT field. As a professional expert conducting a successful project in a managed way, the student is able to: collectively produce, monitor and update the plan of the project (project with fixed time and human resources); search up to date information on the subject matter of the project in order to build professional expertise on the topic and apply this in the project work; build professional working knowledge and skills focused in the subject area of the project (e.g. software development, user experience evaluation); develop analytical and creative skills for successful completion of the project; monitor and communicate the status (time & human resources used) of the project in real time within the project team (weekly/daily meetings); use systematic means (e.g. ICT tools) to enable communication and transparency of the project work; develop skills to communicate with the customer in a professional context; manage a successful project review with the steering group/project team organization; report and explain the status (progress, results and future estimations of the project) to the steering group to support the decision making and problem resolution concerning the project's future; work as responsible project team member; as an expert and/or project manager; work as a project team member with people from different technical and/or cultural backgrounds; produce a realistic outcome in relation to the project time and human resources (ok, good, excellent); reflect the relationship between the process model(s) selected for the project (waterfall, evolutionary, agile etc.) and the management practices followed in the project.

**Contents:**

Starting lectures (4 x 2 h) and two workshops (2 x 8 h), where the steps of carrying out the course will be described together with other important information. Allocation of the project teams will immediately follow the starting lectures. The project work will take two periods (one semester). Unique project material provided by the customer of the project and / or material to be collected and studied by the project team.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Project work 260 h per student. Working hours reported during the project. Attendance at the starting lectures (8 h) and workshops (16 h) is mandatory.

**Target group:**

MSc students.

**Prerequisites and co-requisites:**

Mandatory: B.Sc. degree or other equivalent degree. Students enrolling directly to the Master's programme should take the "Preparatory course for MSc studies (811392A)" course first (see the timetable for the autumn semester, period 1) or otherwise master the basics of project work and management as in Pressman, R.S. Software Engineering: A Practitioner's Approach, the chapters related to project management.

**Recommended or required reading:**

Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004. - R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005 -Avison, D., Fitzgerald, G. (2006) Information Systems Development, methodologies, techniques & tools. Fourth Edition. London: McGraw-Hill.

**Assessment methods and criteria:**

Skills will be reported by a project portfolio. Details about the assessment criteria will be given at the starting lecture and they will also be available in the web-based learning environment

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Pasi Kuvaja

**Working life cooperation:**

Learning by doing, i.e. managing authentic, resource-limited project work and integrating the practices of an academic expert into the unique project assignment.

**Other information:**

Enrollment for the course is well beforehand, i.e. until the end of December during 1st study year.

## 813627S: Master's Thesis Seminar, 2 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**Required proficiency level:**

**ECTS Credits:**

2 ECTS credits / 53 hours of work (1 ECTS / 27 hours of work for GS3D students).

**Language of instruction:**

English

**Timing:**

The course is held throughout the study year, in all periods. It is recommended to start the course during the 1st study year, before Master's Thesis.

**Learning outcomes:**

By completing this course the student can

- plan a scientific study,
- present own research in various stages, and
- give feedback of peers' research plans and results.

**Contents:**

The course consists of three phases following the structure and progress of a Master's Thesis work: 1) previous research and initial research methods (research plan), 2) data gathering and analysis, as well as 3) discussions and conclusions (thesis). In each phase, a student is required to participate first as a peer reviewer, and then present his / her own research.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Planning and presenting the student's own research and giving feedback of peers' plans and results 53 h (27 h for GS3D students).

**Target group:**

MSc students

**Recommended optional programme components:**

813613S Master's Thesis.

**Recommended or required reading:**

Guidelines to producing a Master's thesis.

**Assessment methods and criteria:**

Active participation in at least nine (six for GS3D students) seminar sessions. One session lasts about three hours and they are arranged during the semesters according to the plan published on the website.

**Grading:**

Pass or fail.

**Person responsible:**

Henrik Hedberg

## 813621S: Research Methods, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Arto Lanamäki

**Opintokohteen kielet:** English

**Leikkaavuudet:**

521146S Research Methods in Computer Science 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information processing sciences. The student is able to identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching, lecture videos.

**Learning activities and teaching methods:**

Lectures 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:**

Completion of Bachelor's studies.

**Recommended or required reading:**

Lecture slides and specified literature.

**Assessment methods and criteria:**

Accepted learning diary.

**Grading:**

Pass or fail.

**Person responsible:**

Arto Lanamäki

## 815663S: Software Engineering Research, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Muhammad Ahmad, Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course the student will know the current research areas in software engineering and the most important software engineering research methods. The student understands academic research and publishing in software engineering, and is able to critically analyse scientific articles from the viewpoint of the content and research methods used in the article. The student is able to present academic research and actively participate in an academic discussion of research papers and research results.

**Contents:**

State of the art research methods and topics in software engineering.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars 28 h, exercises / assignments 78 h, weekly study 42 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree.

**Recommended or required reading:**

**Assessment methods and criteria:**

Active participation in lectures and attendance. Final grade is composed of attendance, assignments and term paper. No remote participation or distance learning.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

## 813607S: IPS (TOL), Maturity Test for Master's Degree, 0 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

**813613S: Master's Thesis, 30 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Diploma thesis

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

**813627S: Master's Thesis Seminar, 2 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**Required proficiency level:**

**ECTS Credits:**

2 ECTS credits / 53 hours of work (1 ECTS / 27 hours of work for GS3D students).

**Language of instruction:**

English

**Timing:**

The course is held throughout the study year, in all periods. It is recommended to start the course during the 1st study year, before Master's Thesis.

**Learning outcomes:**

By completing this course the student can

- plan a scientific study,
- present own research in various stages, and
- give feedback of peers' research plans and results.

**Contents:**

The course consists of three phases following the structure and progress of a Master's Thesis work: 1) previous research and initial research methods (research plan), 2) data gathering and analysis, as well as 3) discussions and conclusions (thesis). In each phase, a student is required to participate first as a peer reviewer, and then present his / her own research.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Planning and presenting the student's own research and giving feedback of peers' plans and results 53 h (27 h for GS3D students).

**Target group:**

MSc students

**Recommended optional programme components:**

813613S Master's Thesis.

**Recommended or required reading:**

Guidelines to producing a Master's thesis.

**Assessment methods and criteria:**

Active participation in at least nine (six for GS3D students) seminar sessions. One session lasts about three hours and they are arranged during the semesters according to the plan published on the website.

**Grading:**

Pass or fail.

**Person responsible:**

Henrik Hedberg

## 817609S: Project Seminar, 3 op

**Voimassaolo:** 01.08.2013 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Tonja Molin-Juustila

**Opintokohteen kielet:** English

### **ECTS Credits:**

3 ECTS credits / 80 hours of work.

### **Language of instruction:**

English.

### **Timing:**

The timing of the course is dependent on the Research and Development Project (817612S) course and will immediately follow the project in the next spring semester, during period 3. It is recommended to complete the course at the 2nd spring semester.

### **Learning outcomes:**

After completing the course, the students should demonstrate their abilities to work as academic experts in challenging ICT projects. Students will learn to acquire and apply research articles and other new knowledge like an academic expert in a selected topic of their project ("Research and Development Project" course). Students will also learn to analyse and report their experience-based new knowledge on the topic to peer students. By completing this course, students are able to act as reflective, independent academic experts in ICT projects and have learnt expertise in some topic area of their project. As an expert in the selected topic area, the student is able to: search research articles and literature on the topic (review); report practical experiences gained during the project on the topic; evaluate the results of the project and reflect the practical experiences against previous literature and research on the topic; disseminate the (increased) expertise in the topic in a credible way to peers both by a written report and orally.

### **Contents:**

Starting lecture, independent analysis and reporting of the expertise on the selected project topic and an expert seminar (2 full days) with the presentations of each topic.

### **Mode of delivery:**

Blended teaching.

### **Learning activities and teaching methods:**

Attendance at the starting lecture (4 h) and the expert seminar (2 full days) is mandatory. Independently writing the seminar paper and preparing the seminar presentation (abt. 50 h).

### **Target group:**

MSc students.

### **Prerequisites and co-requisites:**

Mandatory: Research and Development Project (817612S) during autumn semester, periods 1 & 2. This course will immediately follow the project course on the project topics. For the students of the Master's degree programme on Software, Systems, and Service Development (GS3D), Software Factory Project Course (817611S) is mandatory before this course.

### **Recommended or required reading:**

Research articles and materials are to be independently collected and studied by the students.

### **Assessment methods and criteria:**

Expertise in the topic area will be reported on the seminar paper. Seminar presentation will also be evaluated. Assessment criteria in detail will be given at the starting lecture and in the web-based learning environment for the course.

### **Grading:**

Numerical scale 1-5 or fail.

### **Person responsible:**

Tonja Molin-Juustila

### **Working life cooperation:**

Seminar topics are related to the Master's students projects all of which are authentic project works in unique R&D project assignments from real customers (university, companies and organizations like schools, library etc.).

### **Other information:**

Enrollment by contacting the responsible person of the course and outlining a draft of the seminar paper until end of the period 2 (i.e. before the course starts).

## 813621S: Research Methods, 5 op

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Arto Lanamäki

**Opintokohteen kielet:** English

**Leikkaavuudet:**

521146S Research Methods in Computer Science 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

Having completed the course, the student is able to explain the general principles of scientific research and the practices of scientific methodology. The student is also able to generate research problems in information processing sciences. The student is able to identify and describe the main research approaches and methods in information processing sciences, and choose the appropriate approach and method for a research problem. The student is also able to evaluate the methodological quality of a research publication. After the course the student is able to choose and apply the proper approach and method for his or her Master's thesis and find more information on the method from scientific literature.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching, lecture videos.

**Learning activities and teaching methods:**

Lectures 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:**

Completion of Bachelor's studies.

**Recommended or required reading:**

Lecture slides and specified literature.

**Assessment methods and criteria:**

Accepted learning diary.

**Grading:**

Pass or fail.

**Person responsible:**

Arto Lanamäki

## 817612S: Research and Development Project, 10 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP



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

**Opettajat:** Tonja Molin-Juustila

**Opintokohteen kielet:** English

**ECTS Credits:**

10 ECTS credits / 267 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the students should demonstrate their abilities to work on a challenging ICT project. Students will learn to acquire and apply professional expertise in the topic of the project. Students will also demonstrate their skills to conduct an ICT project in a professional way. By completing this course, students are able to act as independent professional members of an ICT project and have advanced professionalism in project work and management. The topics for the course can be anything from the ICT field. As a professional expert conducting a successful project in a managed way, the student is able to: collectively produce, monitor and update the plan of the project (project with fixed time and human resources); search up to date information on the subject matter of the project in order to build professional expertise on the topic and apply this in the project work; build professional working knowledge and skills focused in the subject area of the project (e.g. software development, user experience evaluation); develop analytical and creative skills for successful completion of the project; monitor and communicate the status (time & human resources used) of the project in real time within the project team (weekly/daily meetings); use systematic means (e.g. ICT tools) to enable communication and transparency of the project work; develop skills to communicate with the customer in a professional context; manage a successful project review with the steering group/project team organization; report and explain the status (progress, results and future estimations of the project) to the steering group to support the decision making and problem resolution concerning the project's future; work as responsible project team member; as an expert and/or project manager; work as a project team member with people from different technical and/or cultural backgrounds; produce a realistic outcome in relation to the project time and human resources (ok, good, excellent); reflect the relationship between the process model(s) selected for the project (waterfall, evolutionary, agile etc.) and the management practices followed in the project. management practices followed in the project.

**Contents:**

Starting lecture, where the steps of carrying out the course will be described together with other important information. Allocation of the project teams will immediately follow the starting lecture. The project work will take two periods (one semester).

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Project work 260 h per student. Working hours reported during the project. Attendance at the starting lecture (4 h) is mandatory. Preparing a project portfolio in the end (3 h).

**Target group:**

MSc students.

**Prerequisites and co-requisites:**

Mandatory: B.Sc. degree or other equivalent degree. Students enrolling directly to the Master's programme should take the "Preparatory course for MSc studies (811392A)" course first (see the timetable for the autumn semester, period 1) or otherwise master the basics of project work and management as in Pressman, R.S. Software Engineering: A Practitioner's Approach, the chapters related to project management. The expertise gained during this project course will be further elaborated during the "Project Seminar (817609S)" course, which will immediately follow this course during spring semester, period 3.

**Recommended or required reading:**

Unique project material provided by the customer of the project and / or material to be collected and studied by the project team.

**Assessment methods and criteria:**

Skills will be reported by a project portfolio. Details about the assessment criteria will be given at the starting lecture and they will also be available in the web-based learning environment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Tonja Molin-Juustila

**Working life cooperation:**

Learning by doing, i.e. managing authentic, resource-limited project work and integrating the practices of an academic expert into the unique project assignment.

**Other information:**

Enrollment for the course is well beforehand, i.e. until the end of July between 1st and 2nd study year.

**815303A: Embedded Software Development Environments, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Juustila, Antti Juhani

**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.

**Learning outcomes:**

After completing the course, a student is able to work with the essential software development tools of a selected embedded platform. The student is able to implement memory and power efficient applications by exploiting existing libraries and knowledge of the programming interfaces provided by the platform.

**Contents:**

The focus of the course is in the software development environments and tools for mobile and embedded platforms, such as Android and iOS. In addition, the course covers memory and power management, core services of the platform, networking and the utilisation of existing libraries. One platform will be selected for deeper study, and the course introduces its essential software development tools and libraries. The emphasis is on application development for the platform as an exercise.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Lectures and exercises about 40 h, exercises and exercise work 93 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Course "815309A Real-time Distributed Software Development", C/C++ and / or Java programming skills or similar knowledge obtained from other courses.

**Recommended or required reading:**

Course material, the documentation of selected technologies, and other related literature.

**Assessment methods and criteria:**

Exercise work.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Antti Juustila

**811600S: Emerging Trends in Software Engineering, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student understands the recent trends in software engineering. The student is able to perform computer supported trend mining to discover new trends of any given topic. The student is able to critically think about the trends.

**Contents:**

- Software engineering trends (varies yearly)
- Automated trend mining from online databases
- Writing, arguing and discussing about the trends.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 18 h, essays 30 h, project 30 h, independent study 31 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basics on software engineering.

**Recommended or required reading:**

Articles + lectures.

**Assessment methods and criteria:**

Active lecture participation, exercises, assignments, essays.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mika Mäntylä

**815657S: Open Source Software Development, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Henrik Hedberg

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After passing the course, a student will be able to

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

**Contents:**

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

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Independent personal and group work about 40 h, weekly meetings and seminars about 30 h, seminar article and presentation about 60 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Compulsory prerequisites are Bachelor degree or other equivalent degree and basic knowledge on software engineering and research work.

**Recommended or required reading:**

Fogel, K. (2017): Producing Open Source Software - How to Run a Successful Free Software Project, O'Reilly Media; Rosen L. (2004): Open Source Licensing: Software Freedom and Intellectual Property Law, Prentice Hall; scientific articles covering the topic.

**Assessment methods and criteria:**

Active participation, seminar article and other assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Henrik Hedberg

**817602S: Software Development in Global Environment, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Kuvaja

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student can define the key success factors of Global Software Design (GSD) and the potential problems in coordination of projects where teams are separated by physical and / or temporal distance; can define and evaluate the collaborative technologies, which in the best way support distributed software development; can choose the methods and tools for distributed software development; can apply the practices of GSD in a student project and use the supporting tools throughout the project life cycle.

**Contents:**

Some of the topics covered are strategic issues in distributed development (off-shoring, near-shoring, outsourcing, OSS); cost-benefit-risk analysis; the triad of coordination, control and communication; team building (e.g. virtual teams); software process paradigms in the global environment (planned, agile); methods and tools for distributed software development; issues related to allocation of tasks; communication issues that arise due to distance and time zone differences; infrastructure support; geographical dispersion; lack of information communication; coordination complexity; cultural issues; technical issues related to information and artefact sharing; architectural design; and finally knowledge management issues. The lectures and seminars also review current research aspects of the GSD and related case studies from industry. The exercises demonstrate distributed software development as a virtual team with the support of appropriate methods and tools.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars involving all the students as well as lecture assignments (reading articles and writing analyses) 70 h (20 h lecture attendances, 30 h lecture assignments, 20 h additional reading), and exercises 65 h. For lecture assignments each student will read, summarize and analyse selected academic articles. The exercises include laboratory demonstrations of different supporting tools for distributed software development. The students

train in project software development and planning practices in a distributed environment. The student project groups are organised into virtual (distributed) teams of 4 students.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of academic writing technique is needed. Basic understanding of software business is an advantage.

**Recommended or required reading:**

To be announced during the course implementation.

**Assessment methods and criteria:**

By active participation or alternatively exam, based on the course study materials.

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Veikko Seppänen

**Other information:**

Course does not have any lectures or exercises in academic year 2019-2020. It is still possible to do course, please sent email to Professor Veikko Seppänen veikko.seppanen@oulu.fi

## **815662S: Software Engineering Management, Measurement and Improvement, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd autumn semester.

**Learning outcomes:**

After completing the course the student understands the fundamental principles of software processes and their development in professional software engineering. The course extends the understanding of quality based on individual techniques (e.g. reviews) so that after completing the course the student is able to:

- Understand professional software development processes in agile, lean and traditional environments
- Evaluate different methods and techniques
- Select from them appropriate ones for different software engineering environments
- Have capabilities to participate in systematic efforts for improvement in software companies.

**Contents:**

The course covers the most fundamental process centred software quality improvement and management approaches, methods and latest research results, as well as approaches to software measurement. The topics of the course include: traditional waterfall, agile (extreme programming, Scrum, Rational unified process, crystal, feature driven development, adaptive software development, dynamic systems development method) and lean methods, process improvement approaches, software process and product measurement, agile and lean practices, process improvement at the enterprise level and practical examples from software industry.

**Mode of delivery:**

Face-to-face teaching + Seminars.

**Learning activities and teaching methods:**

9 Lectures (30 hours), 7 Seminars (30 hours), Individual weekly assignments (43 hours), Group work (30 hours).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree and basic knowledge of software engineering.

**Recommended or required reading:**

- Agile Project Management with Scrum. Ken Schwaber, Microsoft Press, ISBN 0-7356-1993-X. 2004

- Dingsøy T., Dybå T., Moe N.B., Agile Software Development: Current Research and Future Directions, Springer, 2010
- C. Jones, Applied Software Measurement: Global Analysis of Productivity and Quality, 3rd ed. McGraw-Hill Osborne Media, 2008
- Craig Larman and Bas Vodde, Scaling Lean & Agile Development: Thinking and Organizational Tools for Large-Scale Scrum, Addison-Wesley, 2009
- CMMI: Guidelines for Process Integration and Product Improvement. Mary Beth Chrissis, Mike Konrad, Sandy Shrum. Addison-Wesley, ISBN 032-115496-7, 2004.

**Assessment methods and criteria:**

Active and regular participation to lectures and seminars AND report evaluation AND seminar presentations.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

**Working life cooperation:**

Visiting lecture from industry.

## 815663S: Software Engineering Research, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Muhammad Ahmad, Oivo, Markku Tapani

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course the student will know the current research areas in software engineering and the most important software engineering research methods. The student understands academic research and publishing in software engineering, and is able to critically analyse scientific articles from the viewpoint of the content and research methods used in the article. The student is able to present academic research and actively participate in an academic discussion of research papers and research results.

**Contents:**

State of the art research methods and topics in software engineering.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars 28 h, exercises / assignments 78 h, weekly study 42 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree.

**Recommended or required reading:**

**Assessment methods and criteria:**

Active participation in lectures and attendance. Final grade is composed of attendance, assignments and term paper. No remote participation or distance learning.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Markku Oivo

## 815312A: Software Production and Maintenance, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**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 in the 1st spring semester.

**Learning outcomes:**

After completing the course, the student:

- Can apply the framework of product line engineering in large scale software production
- Can apply the maintenance process and techniques in software production.

**Contents:**

Product line engineering: 1. Product line variability; 2. Domain engineering; 3. Application engineering; 4. Transition strategies and organisational issues. Principles and practices of software evolution and maintenance.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises/ assignments 18 h, weekly study and learning diary 4 2h, term project 45 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of software engineering and software architectures.

**Recommended or required reading:**

Pohl, K., Böckle, G., van der Linden, F. Software Product Line Engineering. Foundations, Principles, and Techniques, Springer-Verlag, 2005; chapters 1-5, 10, 15, 19-20. Chastek G.J., Donohoe P., McGregor J.D., Formulation of a Production Strategy for a Software Product Line, Technical Note CMU/SEI-2009-TN-025, Carnegie Mellon, 2009. Software Evolution and Maintenance, Priyadarshi Tripathy, Kshirasagar Naik, ISBN: 978-0-470-60341-3, 416 pages, January 2015.

**Assessment methods and criteria:**

Active participation to lectures and attendance. Final grade is composed of attendance, learning diary, assignments and term project.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mika Mäntylä

## 815311A: Software Quality and Testing, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Umar Farooq

**Opintokohteen kielet:** English

**Leikkaavuudet:**

ay815311A Software Quality and Testing (OPEN UNI) 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 in the 1st autumn semester.

**Learning outcomes:**

The student understands different views on software quality and the role of testing as a part of software engineering validation and verification activities, and defect identification / removal techniques. The student knows testing levels, strategies and techniques, can create test cases and conduct unit testing with appropriate testing tools. The student knows the basics of test driven development and test automation.

**Contents:**

Software quality and quality assurance. Software quality management and metrics. Fundamental concepts of software testing. Functional and structural testing. Unit, integration, system, acceptance and regression testing. Hands on test-driven development. Test automation.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises / assignments 24 h, weekly study 42 h, term project 42 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Working knowledge of Java programming language is required. Basic knowledge of software engineering.

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

Pezze M., Young M., "Software Testing and Analysis: Process, Principles and Techniques", John Wiley&Sons, 2008

\*\*\* Lasse Koskela, "Test Driven: Practical TDD and Acceptance TDD for Java Developers", Manning Publications,

2007 \*\*\* Galin D., "Software Quality Assurance: From theory to implementation", Addison-Wesley, 2004.

**Assessment methods and criteria:**

Active Participation to lectures and exercises. Final grade is composed of attendance, assignments and term project.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Umar Farooq

**Working life cooperation:**

Usually visiting lecture from industry.

**813626S: Emerging Technologies and Issues, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Xiuyan Shao

**Opintokohteen kielet:** English

**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 spring semester.

**Learning outcomes:**

After completing the course, the student is able to :

- Analyse the on-going changes in online and consumer behaviour, customer requirements, ICT markets and technological development;



- Evaluate key enabling web-based and other information technologies and become an effective participant in web-enabled business endeavours and initiatives;
- Design ways for leveraging information and communication technologies to improve intra- and inter-organisational processes and enhance a firm's competitive position;
- Plan ways for searching innovations; and
- Develop his / her skills for building careers and taking advantage of entrepreneurial opportunities through emerging technologies, in particular related to the web.

**Contents:**

- A shift in thinking about the web and emerging technologies
- How the social web is transforming businesses, software design, our perception of people as well as skills required of us
- How to accelerate innovation creation through web-based and other emerging technologies: Ecosystem thinking, strategies, core business values
- Transformation of the social web into humanized web.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 24 h, exercises 8 h, reflective personal exercises 21 h, independent work and exam (required reading) 80 h.

**Target group:**

MSc students

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

Oinas-Kukkonen H. & Oinas-Kukkonen H.: Humanizing the Web: Change and Social Innovation. Palgrave Macmillan, Basingstoke, UK, 2013 (required reading).

**Assessment methods and criteria:**

Exam.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Harri Oinas-Kukkonen

**812351A: Enterprise Systems, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Xiuyan Shao

**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.

**Learning outcomes:**

After completing the course, the student understands Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Inventory

Management, CRM, Knowledge Management, Online Business systems, Marketing systems, etc., and also understands the intellectual capital and

organizational competitive advantage. The student should be able to describe how processes integrate the internal functions of the firm and allow the firm to interact with its environment, and be able to recognize, model, and improve processes to help the firm achieve efficiency and effectiveness.

**Contents:**

1. Principles of enterprise systems, and business processes that integrate the internal functions of the enterprise and connect the enterprise with its business environment;
2. Manage enterprises' intellectual capital to achieve competitive advantage;
3. Enterprise resource planning (ERP);
4. Supply chain management (SCM);
5. Global supply chain & inventory management systems
6. Knowledge management systems;
7. Customer relationship management (CRM);
8. Internet-based Business and Marketing Systems;
9. Enterprise application integration (EAI)

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 20 h, exercises 18 h, homework 25 h, essays 34 h, examination 36 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Understanding of the business process modeling helps.

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

Refer to the course webpages

**Assessment methods and criteria:**

Exercises, assignments, essay, and examination.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Xiuyan Shao

**Working life cooperation:**

No

**817604S: ICT and Organizational Change, 5 op**

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Karin Väyrynen

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course the student is able to distinguish various roles of information and communication technology (ICT) in change of organization and its context, and is able to analyze the role of ICT in relation with change taking place in an organization.

**Contents:**

The course studies organisations at four levels: individuals, practices, organizational structures and transformations, and the societal context of organisations. The organizational role of ICT and the relation between ICT and knowledge

are also discussed. The role of power, trust and control in the change process is discussed. The different aspects of change agents are presented and analysed. Students familiarize themselves with 7 organizational theories.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 28 h, individual work 105 h (for self-studying for weekly in-class exams - or optionally a traditional exam), and a review and analysis of selected course materials and writing a case analysis).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Recommended to take Emerging Technologies and Issues before this course.

**Recommended optional programme components:**

**Recommended or required reading:**

A list of research articles will be provided for the lectures and assignments.

**Assessment methods and criteria:**

Week exams and weekly case analysis (or traditional exam at end of the course), course assignment (literature review, case analysis).

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Karin Väyrynen

## 812349A: IT Infrastructure, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Petri Pulli

**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.

**Learning outcomes:**

After completing the course, students are able to judge, compare and apply data communications concepts and computing solutions to various situations encountered in industry; identify general concepts and techniques of data communications in different organizational environment; Explain core elements of IT infrastructure, principles underlying layered system architectures and the technology of the Internet; identify the most important server and storage architectures and the main mechanisms for providing high-capacity processing and storage capacity; Understand the principles of service virtualization, and concepts of IP networks and protocols; Explain structure of large-scale organizational IT infrastructure, and role of IT service management as organizational IT infrastructure solution; Understand opportunities for virtual computing service and configure IT infrastructure and security solution for small organization. The course aims to enable effective communication with technical, operational, managerial and service provider communities through improvement in technical knowledge and terminology. The course provides IT consultants with capabilities to make intelligent decisions regarding computing platform and service architectures by considering organizational flexibility.

**Contents:**

1. Introduction to IT Infrastructure 1.1. System Architecture & System Organizing Structure 1.2. Components of computer-based systems 1.3. Role of IT Infrastructure in a modern organization 2. Architecture, Technologies, Services and Standards in IT Infrastructure 2.1. Operating system 2.2. Networking 2.3. Data Centers 2.4. Securing IT Infrastructure 2.5. Grid computing 2.6. Cloud computing 3. Emerging Technologies and Trends 3.1. Internet of Things (IoT) 3.2. Distributed Ledger and Blockchain Technologies 3.3. Augmented Reality / Virtual Reality 3.4. Wearable Technologies.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 20 h, Student project guidance and seminar 12 h, student project work 71 h and examination 30 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge on computer, network and Internet architecture.

**Recommended optional programme components:**

**Recommended or required reading:**

Lecture notes, scientific papers and technology articles.

**Assessment methods and criteria:**

Accepted project work and examination.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Petri Pulli

**Working life cooperation:**

Two industrial guest lecturers.

## 813623S: Information Security Policy and Management in Organisations, 5 op

**Voimassaolo:** 01.08.1950 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Xiuyan Shao

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course at the 2nd autumn semester.

**Learning outcomes:**

After completing the course, the student is able to:

- Develop BCM (Business Continuity Management) and SA (Systems Availability) strategy;
- Develop organization specific information security policies in organizations;
- Conduct Information Security (and risk) Analysis;
- Conduct Information Security Audits;
- Understand information security standards, regulations, and policies;
- Improving employees' compliance with the information security procedures through training, campaigning and other means;
- Certifications related to information security (such as ISO27001);
- Public-key infrastructure (PKI), Digital signature, & Certification authority (CA).

**Contents:**

1. Business Continuity Management (BCM) and Systems Availability (SA)
2. Information Security Life Cycle
3. Conduct Information Security (and risk) Analysis
4. Information security standards, regulations, and policies
5. Information security investment management
6. Insider threats in information security management
7. Security Audits (Active Security Assessment)
8. Information Security Certification (ISO27001) & Certification authority (CA).

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures (24 h), exercises (23 h), homework (30 h), essay (20 h), examination (36 h).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Understanding of information security issues, principles, techniques, or similar knowledge, is helpful.

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

Raggad, Bel G.: Information security management, Concepts and practice, CRC Press 2010, Chapters 1, 2.7. – 2.13, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, and 15.

**Assessment methods and criteria:**

Examination.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Xiuyan Shao

**813625S: Information Systems Theory, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Netta Iivari

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English.

**Timing:**

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

**Learning outcomes:**

After completing the course, students will have a good knowledge and understanding of a broad array of research topics and themes within the field of information systems; will have good knowledge and understanding of information systems research and the process by which that research is produced; will have competence in critiquing research articles published in some of the leading academic journals and conference proceedings; will have competence in critical thinking, and analysis and synthesis of academic sources; will have competence in verbally presenting arguments in an academic fashion; will know how to write a literature review on an information systems research topic.

**Contents:**

Information Systems Research Overview, A contemporary selection of Information Systems research themes.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, seminars 10 h, individual and group assignments 100 h; or self-study: opening lecture 2 h, assignments 132 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Bachelor's degree or similar, Research Methods course. Recommended to take before Master's Thesis.

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

Lectures and Selection of scientific articles.

**Assessment methods and criteria:**

Accepted assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Netta Iivari

## 812331A: Interaction Design, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Minna Pakanen

**Opintokohteen kielet:** English

**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.

**Learning outcomes:**

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

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

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 20 h, exercises and seminar 25 h, individual and group assignments 90 h; or self-study: an opening lecture 2 h, one larger assignment 110 h and individual tasks 21 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

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

**Recommended or required reading:**

Sharp et al. (2015) Interaction Design, chapters 1-2, 4-5, 7-13 (pages 1-64, 100-157, 226-473).

**Assessment methods and criteria:**

Accepted assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Minna Pakanen

**Working life cooperation:**

Invited lectures, assignments.

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

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Pasi Karppinen

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

E-exam.

**Learning outcomes:**

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

**Contents:**

Information Systems Strategy, Information Systems Development Life Cycle (SDLC), Information systems success, Soft Systems Methodology (SSM), Socio-Technical Approach, Evolutionary development, Agile methodologies.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Bachelor studies recommended.

**Recommended optional programme components:**

**Assessment methods and criteria:**

E-exam

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Pasi Karppinen

## 812649S: Advanced Research Methods, 5 op

**Voimassaolo:** 01.08.2016 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Faculty of Information Technology and Electrical Engineering

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

**Opettajat:** Netta Iivari

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**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 master's studies.

**Learning outcomes:**

Having completed the course, the student understands the background, philosophical assumptions and guiding principles of quantitative, qualitative and design science research, their role in information systems and software engineering research and the variety involved in them. The student can evaluate the strengths and weaknesses of the research approaches and

methods in relation to her or his research topic as well as select the suitable approach and methods. The student is familiar with and able to use more advanced data analysis methods. The student can prepare a research plan for a research project, including formulating research problems, specifying research designs and choosing appropriate data collection and analysis methods for solving the problems. The student is familiar with state-of-the-art ways of reporting the results as well as able to evaluate the methodological quality of her or his research and research publications more generally. The student is able to search more information on research methods from scientific literature as well as to adapt and refine methods for her or his research problems and interests.

**Contents:**

Introduction to qualitative, quantitative and design science research in information systems and software engineering, their scientific background, philosophical assumptions and guiding principles, variety involved in them, relationships between the research approaches and associated frameworks, methods, processes and practices, advanced data analysis methods, reporting and evaluating research within the approaches.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 16 h, exercises 12 h, seminar 18 h, individual and group assignments 100 h

**Target group:**

MSc students, PhD students

**Prerequisites and co-requisites:**

Research methods course, basic knowledge about research methods, preliminary thesis topic. Recommended to take before Master's thesis.

**Recommended or required reading:**

Selected scientific articles or research method books.

**Assessment methods and criteria:**

Assignments

**Grading:**

Pass or fail

**Person responsible:**

Netta Iivari

## 812650S: Advanced Topics in Human-Centred 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. Master's students can take this course either on the 1st or the 2nd year.

**Learning outcomes:**

After completing the course, students are familiar with some state-of-the-art research results related to current themes and contexts in human-centred design, they understand the strengths and limitations of various methods and frameworks used in human-centred design and they can acquire knowledge and critically read relevant research articles on human-centred design research topics.

**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:**

Course "812335A Interaction Design" or similar knowledge.

**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

**811600S: Emerging Trends in Software Engineering, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

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

**Learning outcomes:**

After completing the course, the student understands the recent trends in software engineering. The student is able to perform computer supported trend mining to discover new trends of any given topic. The student is able to critically think about the trends.

**Contents:**

- Software engineering trends (varies yearly)
- Automated trend mining from online databases
- Writing, arguing and discussing about the trends.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 18 h, essays 30 h, project 30 h, independent study 31 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basics on software engineering.

**Recommended or required reading:**

Articles + lectures.

**Assessment methods and criteria:**

Active lecture participation, exercises, assignments, essays.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mika Mäntylä

**811601S: Emerging Trends in Software Testing, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mika Mäntylä

**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.

**Learning outcomes:**

After completing the course, a student gets an overview of advanced software testing (ST) techniques, as well as their benefits and limitations. Each student will conduct a deeper investigation of one of the ST subjects as part of the course assignment.

**Contents:**

Advanced testing techniques: Model-based testing, search-based testing, defect prediction, exploratory testing, combinatorial testing, static testing, static analyzers, virtualization, test automation

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures and exercises 24 h, individual weekly assignments 48 h, term project 61 h

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basics on software testing

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

Articles + lectures.

**Assessment methods and criteria:**

Active lecture participation, exercises, assignments, term project

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Alireza Haghighatkhah, Iflaah Salman

**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 autumn semester, during period 2.

**Learning outcomes:**

After successfully completing the course, a student will be able to

-analyze methods and techniques that are used in and for ICT-based persuasion

-apply these methods in an ethical manner as design guidelines for developing applications that target change in human behaviour or attitudes.

**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. Positive examples of persuasive systems include motivating knowledge workers to do their work better or safer and embracing citizens for healthy living habits. Negative examples include games that inflict addiction. Both sides of influence will be discussed.

**Mode of delivery:**

Blended teaching

**Learning activities and teaching methods:**

Lectures 24h, reflective personal exercises 27h, independent work 82h (of which reading for lectures 27h and assignments 55h).

**Target group:**

MSc students

**Prerequisites and co-requisites:**

-

**Recommended optional programme components:**

The BSc course "Humans as Users and Developers of Information Technology", or similar understanding and the MSc course "Emerging Technologies and Issues" would be helpful, but are not required

**Recommended or required reading:**

Research articles to be announced more specifically 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

**Working life cooperation:**

-

**811392A: Preparatory Course for MSc Studies, 5 op**

**Voimassaolo:** 01.03.2014 - 31.12.2018

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Arto Lanamäki

**Opintokohteen kielet:** English

**ECTS Credits:**

2 ECTS credits / 53 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 in the 1st autumn semester.

**Learning outcomes:**

After completing the course, the student is able to participate in courses requiring basic knowledge of project work. The student is able to apply the basic concepts of project work, act in different roles in projects and is able to describe the significance of the different project outcomes, such as project plan, mid-reports and final reports. The student is able to define the principles of project coordination and communication with the project interest groups. Additionally, the student is able to consider the principles of referenced and scientific writing.

**Contents:**

The focus of the course is in the people, process and tools of a project in information technology field. Course covers the basic principles of project management, planning, coordination and communication within the project as well as outside the project. Course presents the different outcomes of the project, related to internal and external communication – project plans, mid-report, final reports and other project specific outcomes, as well as internal reports, memos and non-written communication and coordination techniques in a project. The latter include unofficial and official meetings held within the project as well as among the external interest groups of the project (for example, customers and the project steering group). Finally, the course presents the basics of written referenced and scientific communication – how to use references, how to acknowledge work of others, how to format an article and what is plagiarization and how to avoid plagiarization.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Lectures and exercises 20h, independent learning methods 34h.

**Target group:**

Msc students. The course is mandatory for GS3D students, and recommended for students with a Finnish University of Applied Sciences (AMK) background.

**Recommended optional programme components:**

Especially recommended to take before Master's level project courses.

**Recommended or required reading:**

Provided when the course starts.

**Assessment methods and criteria:**

Active participation in the lectures and exercises; learning diary.

**Grading:**

Pass or fail.

**Person responsible:**

Arto Lanamäki

## 811330A: Project management, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Lappalainen, Jouni Esko Antero, Antti Siirtola

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 ECTS

**Timing:**

4th year, period x.

**Learning outcomes:**

Objectives: The student acts as the project manager in charge of the Project 1 -course project, leading and guiding the project planning, internal project management and supervision, and reporting to the steering group. The department-appointed member of staff acts as the supervisor and a tutor in conjunction with the person in charge of this course.

Learning outcomes: After the successful completion of this course, the student can identify the project management practices from the viewpoint of a project manager, apply them in to practice and manage a team of software engineers in a software project. In addition, the student knows the principal concepts of project management and can analyze his or her own accomplishments as a project manager in relation to those concepts.

**Contents:**

The student acts as the project manager in charge of the Project 1 -course project. In addition, the student must analyze his or her own work and role as a project manager in relation to the theories of project management, either by producing a written report or attending and presenting his or her analysis in a course seminar.

**Learning activities and teaching methods:**

project work 130h, seminar attendance / written work 20h.

**Recommended optional programme components:**

Compulsory prerequisites: Project 1 -course and the Introduction to Project Work -course. This course cannot be taken while completing the Project 1 -course.

**Recommended or required reading:**

notified during the course, the material from Introduction to Project Work -course serves as a fundamental reference.

**Assessment methods and criteria:**

The student must participate to the project working by managing the project team at least by the amount of hours specified above, as well as produce a written work (or the corresponding seminar presentation and -attendance).

**Grading:**

pass / fail

**Person responsible:**

Jouni Lappalainen

## 815305A: Real Time Distributed Software Development, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Petri Pulli

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

English

**Timing:**

The course is held in the autumn semester, during periods 1 and 2.

**Learning outcomes:**

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

**Contents:**

Introduction 1. Characteristics of real-time systems; 2. Resource management; 3. Safety and reliability; 4. Time constraints; 5. Concurrency; 6. Scheduling; 7. Interrupts Characteristics of Distribution 1. Distribution architectures 2. Concept of time; 3. Synchronisation; 4. Latency and jitter; 5. Quality of service; 6. Service discovery; 7. Networking primitives Real-Time UML Modelling Methodology Real-Time Design Patterns Design Examples: Embedded, Ubiquitous, Mobile, Web / Internet, Blockchain and Bitcoin.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

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

**Target group:**

MSc students

**Prerequisites and co-requisites:**

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

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Exam and project evaluation.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Petri Pulli

**Working life cooperation:**

One or two industrial guest lecturers.

**816630S: Scientific paper writing, 1 - 3 op**

**Voimassaolo:** 01.08.2008 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** English

Ei opintojaksokuvauksia.

**813630S: Software Business Development, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Karin Väyrynen

**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 in the 1st spring semester.

**Learning outcomes:**

The course provides insights to software business development on a business, company and industry level. After completing the course, the student is able to plan how software business is being developed over the whole life cycle of the business and company; conduct market and business analyses; identify different sources of financing for business operation; evaluate different strategic business options; select a business model adequate for the present and future situation of the company; and write a business plan.

**Contents:**

The course takes three points of view: company start-up, established business, and software industry. The course introduces the concepts of business idea, business plan, software business models and strategies, and the software value network.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 21 h, course assignments 63 h, (home) exam 25 h. The course assignments will be conducted as group work.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

BSc or other equivalent degree and basic knowledge of software business.

**Recommended optional programme components:**

It is recommended, but not mandatory, to complete the following courses prior to enrolling for the course unit:

811174P Introduction to Software Business, 813316A Business Process Modelling and 813620S Software Business Management.

**Recommended or required reading:**

Lecture slides and literature announced during the course implementation.

**Assessment methods and criteria:**

This course unit utilizes continuous assessment. Lectures are for the most part voluntarily, but participation is recommended. The students will write course assignments which will be assessed. In addition, there will be a (home) exam at the end of the course which will be assessed. The assessment of the course unit is based on the learning outcomes of the course unit.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Karin Väyrynen

**Working life cooperation:**

Usually visiting lecture from industry.

**813620S: Software Business Management, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Marianne Kinnula

**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 in the 1st spring semester.

**Learning outcomes:**

Upon completion of the course, the student will be able to assess the main problem areas in software business management and is able to describe how to manage these problems; will be able to use different kinds of tools for managing this diverse and ambiguous environment; will understand the differences between leading and managing and be able to apply these to practice; will be able to analyse a company situation in a continually changing, unpredictable and even hostile environment, and is able to make well-grounded recommendations for the company courses of action.

**Contents:**

The software business environment and context is complex and under continuous change. Competences and creativity of company employees are needed for creating value and growth to the company. Managing a software business is a challenging task as traditional, rational management models are often inadequate for the needs of the managers. This course provides an overview of the strategic management of the software business in a software company.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and exercises 24 h, course assignments 72 h, (home) exam 30 h.

**Target group:**

MSc students

**Prerequisites and co-requisites:**

Basic knowledge of academic writing technique is needed. Basic understanding of software business is an advantage.

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

Lecture slides and specified literature.

**Assessment methods and criteria:**

Participation in lectures / exercises, group work, course assignments.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Marianne Kinnula

**812670S: The Next Generation of the Web, 5 op**

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Michael Oduor

**Opintokohteen kielet:** English

**ECTS Credits:**

5 ECTS credits /133 hrs of work

**Language of instruction:**

English

**Timing:**

The course is held in the spring semester, during period 3.

**Learning outcomes:**

After the course the student will be able to: Apply the lessons learned for web design, organisational purposes and entrepreneurial activities; and Analyse issues related to web's development stages and trends and potentially even to predict potential future web; Develop businesses based on technology road mapping, scenario thinking, future forecasting, and research methods and theories of technological innovation and diffusion.

**Contents:**

The course will help the student to recognise and reflect on on-going and potential future web development trends. It will build upon understanding of the contemporary web, its conceptual background, and the changes that lead to the web we see today. The ultimate goal for the course is to foresee the potential future of the web for the upcoming five years. Thus, the name of the course is The Next Generation of the Web.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures/seminars 24 h, independent work (reading and essay writing) 109 h

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

Course "813619S Emerging Technologies and Issues" (strongly recommended).

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

Scientific articles, the web. More sources to be announced specifically during the course implementation.

**Assessment methods and criteria:**

Participation in the lectures, student paper (only in English).

**Grading:**

1-5 or fail

**Person responsible:**

Piiastiina Tikka

**Working life cooperation:**

No



## 812671S: Usability Testing, 5 op

**Voimassaolo:** 01.08.2011 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mikko Rajanen

**Opintokohteen kielet:** English

### ECTS Credits:

5 ECTS credits / 133 hours of work.

### Language of instruction:

English and Finnish

### Timing:

The course is held in the spring semester, during periods 3 and 4.

### Learning outcomes:

After completing the course, the student can:

- Design and follow through a usability testing process;
- Design usability test scenarios and tasks;
- Select test subjects;
- Plan and follow through usability tests as laboratory tests or field tests;
- Analyse and report the findings from usability tests.

### Contents:

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

Student is familiar with most common user interface design terms, design and evaluation methods as in "Introduction to Human-Computer Interactions" course.

### 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:

Numerical scale 1-5 or fail.

### Person responsible:

Mikko Rajanen

### Working life cooperation:

No

### Other information:

## 814601S: Work Experience in ICT responsibilities, 5 op

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Advanced Studies

**Laji:** Practical training

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Tonja Molin-Juustila

**Opintokohteen kielet:** Finnish

### ECTS Credits:

3-5 ECTS credits / 2–4 months of full time work

### Language of instruction:

Finnish or English.

### Timing:

Timing of this course is free. Recommended to take as a summer course. The course is also suitable for the supported work placement studies. In that case, it is recommended to search for the work placement and apply for the support already at the turn of the year.

### Learning outcomes:

After completing the course, the student: - will master certain part of professional ICT work in enterprises or public organisations - can analyse and reflect on the work experience with Information Processing Science studies; - can write an informative report on his/her work experience.

### Contents:

Working from two to four months in professional ICT responsibilities that require university level studies.

### Mode of delivery:

The student is responsible for making the needed arrangements for the internship: search for the work placement, negotiate job contract, prepare the support application when needed, follow the agreed labor agreement, work within the agreed responsibilities as well as study independently the needed professional skills and knowledge. In addition, the student documents his/her internship according to the course requirements.

### Learning activities and teaching methods:

Search for the work placement, job contract negotiation, work within the professional ICT responsibilities and reflecting the work experience and learning by reporting; possibly also applying support, planning and weekly reporting the internship experience.

### Target group:

MSc students

### Prerequisites and co-requisites:

Information Processing Science or related studies, which enable their practical application in the context of professional ICT responsibilities.

### Recommended or required reading:

Studies and selected course materials related to the internship in professional ICT responsibilities.

### Assessment methods and criteria:

Working in professional ICT responsibilities from two to four months. Work experience can be realized in several periods, which all are processed as independent internship periods. The work experience is proved by delivering a signed letter of reference from the employer(s). The letter of reference contains details of the internship period and the student's primary duties and responsibilities. After the internship period, experiences are reported as soon as possible. An internship report consists of description of realized work and analysis of learning outcomes in relation to the studies taken in Information Processing Science. The studies are proved by delivering an up-to-date transcript of records. Proposals to develop Information Processing Science studies are included in the report as well. Based on the internship period, student will gain 3-5 ECTS credits (2 months = 3, 3 months = 4, 4 months = 5). In addition to above, student may also document his/her personal plan and learning goals for the internship period as well as report weekly implementation status of those plans and goals. In this case, 5 ECTS credits will be gained already from 2 months' internship period. For applying the financial support, this documentation is mandatory.

### Grading:

Pass/fail

### Person responsible:

Tonja Molin-Juustila

**Working life cooperation:**

Working on professional ICT responsibilities.

**Other information:**

Documenting guidelines and templates are available in the course materials. Before the internship starts, the support application must be recorded in the university systems with the copy of the internship agreement. The letter of reference from the employer(s) will be recorded together with the credits.

**810020Y: Orientation Studies, 2 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** General Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

2 ECTS credits / 53 hours of work.

**Language of instruction:**

Finnish

**Timing:**

The course is held in the autumn semester, during periods 1 and 2. The course is taken at the beginning of the studies.

Tutor teaching activity continues throughout the whole first study year.

**Learning outcomes:**

After passing the course a student:

- Recognizes from the viewpoint of his / her university studies the actions and services of the most important units, organizations and societies and his / her action possibilities in them
- Recognizes the characteristics of the university-level studies, own curriculum and the discipline of Information Processing Science from the viewpoint of his / her studies and their planning
- Is able to discuss on the purpose of his / her studies and the upcoming study path;
- Is able to create and present his / her own Personal Study Plan (PSP);
- Knows the city of Oulu and its services.

**Contents:**

1. Common occasions and lectures, 2. Small group activities (student tutoring), 3. PSP process, 4. Library and Oula database, 5. Teacher tutoring.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Common occasions and lectures 16 h, small-group activities (student tutoring) 15 h, PSP process 4 h, independent personal work 8 h, teacher tutoring 10 h.

**Target group:**

BSc students.

**Recommended or required reading:**

Lecture materials, www pages, study guides, brochures and forms.

**Assessment methods and criteria:**

Active participation in lectures, common occasions, small group activities (student tutoring) and teacher tutoring. Creating and returning PSP to WebOodi.

**Grading:**

Pass or fail.

**Person responsible:**

Leena Ventä-Olkkonen

**902162Y: English Communication for Information Processing / ECIP, 5 op**

**Voimassaolo:** 01.01.2018 -

**Opiskelumuoto:** Language and Communication Studies

**Laji:** Course

**Vastuuyksikkö:** Languages and Communication

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

**Opintokohteen kielet:** English

**Voidaan suorittaa useasti:** Kyllä

**Proficiency level:**

B2/C1 on the [Common European Framework of Reference](#) scale

**Status:**

This course is mandatory for students of Information Processing Science B.Sc. degree students who begin their studies in Autumn 2017.

**Required proficiency level:**

The students taking this course must have had English as an A1 or A2 language or equivalent English skills.

**ECTS Credits:**

5 ECTS credits / 130 hours of work

**Language of instruction:**

English

**Timing:**

Information Processing Science, 2<sup>nd</sup> year Autumn (periods 1 & 2)

**Learning outcomes:**

In the reading skills component of the course (ECIP-A), you will learn to read more extensive academic - general or discipline-specific - text with increased confidence and at sufficient speed and to process it critically.

In the oral communication component of the course (ECIP-B) you will focus on developing your academic and professional communication skills in English.

**Learning outcomes:** By the end of the course you are expected to demonstrate the ability to:

- distinguish parts of words to infer meanings
- utilize your knowledge of text structure and cohesion markers to understand academic texts,
- extract information and learn content from English readings in academic and professional contexts,
- appropriate strategies and techniques for communicating effectively in English in an academic context,
- present field-related subjects using appropriate academic vocabulary.

**Contents:**

The reading skills component of the course will focus on both reading strategies and vocabulary learning. In the academic communication component of the course, skills in oral interaction, including presenting academic topics to classmates are practiced in the classroom, where there is a strong focus on working in pairs and small groups. Homework tasks include extensive reading tasks, online listening tasks, writing, and preparation for classroom discussions.

**Mode of delivery:**

Contact teaching and independent work

**Learning activities and teaching methods:**

The scope of the course is 5 op (130 hours student workload)

**Target group:**

2<sup>nd</sup> year students of Information Processing Science

**Prerequisites and co-requisites:**

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.

**Recommended optional programme components:**

-

**Recommended or required reading:**

Materials will be provided by the teacher in electronic format or will be accessible from the university library.

**Assessment methods and criteria:**

Student work is monitored by *continuous assessment*. You are required to participate regularly and actively in all contact teaching provided, and successfully complete all required coursework, as prescribed by the teacher. In addition, three *Reading for Academic Purposes* lessons, at monthly intervals, will start with a short test on material covered so far.

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

**Grading:**

Pass / fail

**Person responsible:**

Karen Niskanen

**Working life cooperation:**

-

**900105Y: Launch your career through communication, 5 op**

**Voimassaolo:** 01.01.2017 -

**Opiskelumuoto:** Language and Communication Studies

**Laji:** Course

**Vastuuyksikkö:** Languages and Communication

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

**Opintokohteen kielet:** Finnish

**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

**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

## **810122P: Computer Architecture, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Ilkka Räsänen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521267A Computer Engineering 4.0 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.

**Learning outcomes:**

After completing the course, students understand and manage the building blocks of computer architectures, the execution and performance of computer platforms as well as activities related to performance, resource needs, and error situations. Students master the basic vocabulary, which is required in communication and documentation in software development, particularly in the close to device level applications such as embedded software, mobile systems, multimedia and scientific computing.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 32 h, homework assignments 21 h, laboratory exercises 15 h, examination either through two intermediate exams (preparation 65 h) or through final exam (preparation 65 h).

**Target group:**

BSc students.

**Recommended or required reading:**

Comer, D.E., Essentials of Computer Architecture. Pearson/Prentice Hall. ISBN 0-13-106426-7. 2005. 369 s.  
 Luennoilla esimerkkejä kirjoista: Tanenbaum A.S., Structured Computer Organisations. 4 thEdition. Prentice Hall. 1999. 700 s. Stallings, W., Computer Organization and Architecture. 5 th Edition. Prentice Hall. 2000. 768 s.

**Assessment methods and criteria:**

Active participation and mid-term exams (2) or final exam.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Ilkka Räsänen.

**811120P: Discrete Structures, 5 op**

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Ari Vesanen

**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 1st autumn semester.

**Learning outcomes:**

After completing the course, the student is able to

- interpret and use simple mathematical notation
- rigorously define and describe the most important concepts related to the contents of the course (cf. contents)
- understand the central results and (algorithmic) methods related to previously mentioned concepts
- apply the results and methods from above in simple example cases.

**Contents:**

1. Basics of algorithms
2. Number systems and their conversions
3. Logic (propositional calculus, basics of predicate logic)
4. Set theory, relations, and functions
5. Basic number theory (divisibility and related algorithms)
6. Combinatorics (counting).

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 48 h, exercises 21 h, independent work about 64 h.

**Target group:**

BSc students.

**Recommended or required reading:**

Peter Grossman, Discrete Mathematics for Computing, Second Revised Edition, Palgrave Macmillan, 2002. ISBN: 978-0333981115.

**Assessment methods and criteria:**

Mid-term exams (2) or final exam.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Ari Vesanen

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

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Tonja Molin-Juustila

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay811177P Humans as Users and Developers of Information Technology (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 at the 1st autumn semester.

**Learning outcomes:**

After completing the course, students will be able to examine humans as both users and developers of information technology. The student learns core concepts of the phenomenon, and understands their meaning in relation to practice. Students are also familiar with the background of usability research and some of its scientific theories.

**Contents:**

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

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

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

**Target group:**

BSc students.

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Home assignments, individual essay, and optional advanced assignment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Tonja Molin-Juustila

## **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:** Mari Karjalainen

**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 4. It is recommended to complete the course in the 2nd spring semester.

**Learning outcomes:**

After completing the course a student is able to define essential information security concepts, is aware of the common types of security threats, and their managerial and technical protection mechanisms. The student recognizes the different phases of secure systems development and can describe the fundamental characteristics of risk management. The student gets familiar with basics of technical information security methods and cryptography.

**Contents:**

1. Basic concepts of information security 2. Information security threats, vulnerabilities, and risks 3. Legal issues and information security frameworks 4. Risk management 5. Cryptography 6. Security technologies 7. Behavioral information security research.

**Mode of delivery:**

Face-to-face-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.

**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:**

Lecture tasks or exam, weekly assignments and essay.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mari Karjalainen

## 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. Another implementation, targeted especially for Open University and minor students, is held in the spring semester, during period 3.

**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,

- retrieve, analyse, contest and classify information related to those, as well as
- discuss and report in written form on those.

**Contents:**

The course consists of lectures on disciplines, essential concepts, historically significant and current research as well practical work life 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:**

Blended teaching.

**Learning activities and teaching methods:**

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

**811167P: Introduction to Information Systems Design, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Mikko Rajanen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

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

**ECTS Credits:**

5 ECTS credits / 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.

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st study year.

**Learning outcomes:**

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 27 h, exercises 21 h, assignment 85 h, exam 3 h.

Lectures (27h), Exercises (21h), Assignment (85h), Exam (3h).

**Target group:**

BSc students.

**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. painos.

**Assessment methods and criteria:**

Exam and mandatory assignment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Mikko Rajanen

**811122P: Introduction to Programming, 5 op**

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Ilkka Räsänen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay811122P Introduction to Programming (OPEN UNI) 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish

**Timing:**

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

**Learning outcomes:**

- After completing the course the student is able to design a programme by splitting main problem into solvable sub problems.
- The outcome of design process is modules which she / he is able to write by using chosen programming language.
- Student is able to use selection and loop structures to control execution of a module and control execution between modules.
- Student is able to use basic data types for saving and processing data and she / he is able to use right operations to this data.
- Student is able to use arrays to handle large amounts of same type of data and is able to use control structures to flexibly manipulate the data of arrays.
- Student is able to use pointers for example to enhance passing large amount of data between modules and at the same time taking care of the risks of using pointers.
- Student is able to use structured data types that contain fields of different data types and is able to manipulate the fields of these data structures.
- Student is able to programmatically use files to save permanently large amount of data she/he is able programmatically read data from files for further processing.

**Contents:**

1. Software design method (waterfall) 2. Problem solving 3. Stepwise refinement 4. Control structures 5. Modular programming, calling modules, communication between modules 6. Data types 7. Arrays 8. Pointers 9. Character strings 10. Data structures 11. File processing.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 40 h, home programming assignment 24 h, self-study 70 h.

**Target group:**

BSc students

**Recommended or required reading:**

Course book: Deitel, Deitel: C HOW TO PROGRAM; Pearson Education Inc. 2007, or a newer edition. Lecture slides.

**Assessment methods and criteria:**

1. Final exam and exercise points and programming assignment. OR 2. Mid-term exams (2) and exercise points and home programming assignment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Ilkka Räsänen

## **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 4. It is recommended to complete the course at the 1st spring semester.

**Learning outcomes:**

After completing the course, a student can:

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

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

**Target group:**

BSc students.

**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

**813307A: IPS (TOL), Maturity Test for Bachelor 's Degree, 0 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

**812339A: Advanced Object-Oriented Programming, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Antti Siirtola

**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.

**Learning outcomes:**

After completing the course, a student can construct programs that apply inheritance, composition, polymorphism, generics, and library routines. The student also can construct programs corresponding to given UML diagrams and vice versa. Furthermore, the student is able to describe the most common design patterns and to design and construct programs that contain the design patterns presented in the course. Finally, the student has the basics of version control, can apply the principles of unit testing to an object-oriented program, is able to document a program, and can exploit program analysis tools.

**Contents:**

Software development tools, the basics of object-oriented programming, documenting, unit testing, composition, exceptions, memory management, inheritance, polymorphism, UML charts and code, generics, libraries, containers, and design patterns.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 32 h, laboratory exercises 24 h, weekly assignments and independent work 72 h.

**Target group:**

BSc students.

**Prerequisites and co-requisites:**

Compulsory prerequisites: 811122P Introduction to Programming or a corresponding course and 812341A Object-Oriented Programming. Recommended prerequisites: 812342A Object Oriented Analysis and Design 811312A Data Structures and Algorithms.

**Recommended or required reading:**

Bruce Eckel: Thinking in C++ Volume 1, 2nd edition Bruce Eckel: Thinking in C++ Volume 2. The manuals of the tools used throughout the course. Other material announced during 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:**

Antti Siirtola

**811383A: Bachelor Thesis, 7 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

7 ECTS credits/187 hours of work

**Language of instruction:**

**Timing:**

3rd year, timing is free

**Learning outcomes:**

After completing the course, a student is able to:

- Produce their own research work, stage a concrete plan and refine it as the work progresses;
- Find the source materials as well as the library electronic databases;
- Analyse scientific texts and make them a source of criticism;
- Produce well-structured scientific text;
- Identify their work against future problems;
- Ask for advice and the counsellor will use the guidance in favour of work-testing plan.

**Contents:**

Each student will be guided based on the research literature.

**Mode of delivery:**

Guided self-motivated work

**Learning activities and teaching methods:**

Students prepare calendars of work as part of the research plan. The student has personal meetings with the supervisor or instructor to discuss topic selection and scoping, the research plan, the final review of the literature and a thesis draft. The director, depending on the thesis, may also be associated with other students via meetings for interaction.

**Target group:**

Bachelor level students.

**Prerequisites and co-requisites:**

Compulsory basic studies in the major subject (about 60 credits) completed, in particular an introduction to research work-study modules to prepare the thesis for BSc. During the course or immediately after, the course is part of the pre-Master's thesis. Written final test conducted on the research topic.

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

The student's self-written material, institution and the instructor advice and scientific research and support material. Written work must be in compliance with the institution's formal guidelines.

**Assessment methods and criteria:**

Course requires a Bachelor's thesis preparation. In addition, the course may be included in the pilot, as determined by scientific research-related tasks.

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

**Grading:**

Approved / failed

**Person responsible:**

Raija Halonen

**Working life cooperation:**

No

**811395A: Basics of Databases, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** lisakka, Juha Veikko

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.

**Timing:**

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st spring semester.

**Learning outcomes:**

After completing the course, students will understand what the databases are and what are their relevance to information systems. They know the concept model for building databases, design a relational database with a good quality and make queries. Students understand the transactions, schedules, serialiseability and recovery options.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

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

**Target group:**

BSc students.

**Prerequisites and co-requisites:**

The student knows basics of programming.

**Recommended or required reading:**

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

**Assessment methods and criteria:**

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

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Juha Iisakka

**811379A: Basics of Human Computer Interaction, 5 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Netta Iivari

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

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

812327A Introduction to HCI design 4.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course at the 2nd autumn semester.

**Learning outcomes:**

Upon completion of the course, the student will be able to define basic concepts of user interface design, introduce basic design process with design and evaluation methods and tasks, and apply graphical user interface design from the viewpoint of a certain user group and system.

**Contents:**

Basic concepts of user interface design and usability evaluation; user-centred design process; gathering of user data, analysis, expert evaluation and design by prototyping, user-based evaluation; universal design and user support; user interface description.



**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 20 h, guided group assignment tasks in exercises 21 h and without guidance in assignment groups 58 h; seminar 3 h; individual tasks 31 h.

**Target group:**

BSc students.

**Prerequisites and co-requisites:**

Humans as Users and Developers of Information Technology (811177P) -course or related knowledge.

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

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

**Assessment methods and criteria:**

During the course, the students will be compiling the group assignments and individual integration tasks on their implementation. 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

**811344A: Basics of Statistical Data Analysis for Information Processing Science, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Ari Vesanen

**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 in the 2nd autumn semester.

**Learning outcomes:**

After completion of the course, the student can identify and describe the basic properties and types of statistical data and is able to apply them in tasks related to information processing sciences. The student is able to specify metrics and handle statistical variables. She or he is also able to describe and analyse statistical data with basic methods and report the results. The student knows also basics of R-language and is able to use it for conducting statistical analysis.

**Contents:**

Types of statistical data, measurement and variables, data collection methods, sampling, management of statistical data, descriptive statistics, hypothesis testing, basics of data analysis, graphical presentation of statistical data, reporting of statistical analyses, basics of R.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 32 h, exercises 24 h, independent work 77 h.

**Target group:**

BSc students.

**Recommended or required reading:**

Lecture slides, given literature and exercise tasks.

Literature:

- Blaikie (2003), Analyzing Quantitative Data; Wild & Seber (2000), Chance Encounters; Venables, Smith & the R Core Team (2014), An Introduction to R
- Other literature specified in the course.

**Assessment methods and criteria:**

The course is evaluated based on passed exam and acceptable exercise tasks. The exam can be replaced with weekly assignments during the course.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Ari Vesanen

## 813316A: Business Process Modeling, 5 op

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Karin Väyrynen

**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 3rd spring semester.

**Learning outcomes:**

After completing the course, students are able to model and design business processes. The student is able to use a computer-based process modeling tool. The student is able to distinguish between business process change on the enterprise level, business process level and the implementation level. The student is able to design process architecture in teamwork with other students.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 26 h (or exam), exercises 13 h, individual assignments (lecture assignments, small process model, etc.) 34 h, large process model (group work) 60 h.

**Target group:**

BSc students.

**Recommended or required reading:**

Harmon, Paul (2007). Business Process Change. A Guide for Business Managers and BPM and Six Sigma Professionals. Morgan Kaufmann Publishers. Additional material to be announced during the course.

**Assessment methods and criteria:**

This course unit utilizes continuous assessment. Students can either participate in the lectures (min. 85 % attendance required) or take the exam. All students will write lecture assignments, and will create a process architecture / model with a software tool. The assessment of the course unit is based on the learning outcomes of the course unit.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Karin Väyrynen.

**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:** Ari Vesanen

**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. One English exercise group will be arranged.

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course in the 2nd autumn semester.

**Learning outcomes:**

After completing the course the student is able to

- describe the concept of algorithm
- explain correctness and time complexity of an algorithm
- describe the complexity classes of the sorting algorithms presented
- prove algorithm correctness
- estimate the running time of an algorithm related to the size of the input
- describe the data structures presented
- argue how to choose a data structure or an algorithm to an application
- apply basic graph algorithms
- construct a program that applies appropriate data structures to solve a given problem.

**Contents:**

1. Algorithms and their analysis 2. Search and sort algorithms and their time complexity 3. Basic data structures 4. Hash tables 5. Binary search trees 6. Graphs and their algorithms 7. 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:**

811120P Discrete structures or similar knowledge. Basic skills in programming.

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

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

**Assessment methods and criteria:**

Exam and assignment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Ari Vesanen

**811394A: Database systems, 5 op****Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Information Processing Science DP**Arvostelu:** 1 - 5, pass, fail**Opettajat:** lisakka, Juha Veikko**Opintokohteen kielet:** Finnish**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish, partly in English.

**Timing:**

The course is held in the spring semester, during period 4. It is recommended to complete the course in the 2nd spring semester.

**Learning outcomes:**

The students have knowledge of some modern database principles - such as non-relational database structures and they have prefatory knowledge of making use of those non-relational databases (such as data mining and techniques). Moreover, after completing the course, students have constructed a small (object-)relational database application.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures and seminars 41 h, computer exercises 54 h, self-study 32 h.

**Target group:**

Bachelor students.

**Prerequisites and co-requisites:**

Basics of database -course (such as 811395A) and Object-Oriented Programming course (such as 812341A) are compulsory prerequisites.

**Recommended or required reading:**

Will be announced in lectures.

**Assessment methods and criteria:**

Will be announced in lectures.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Juha lisakka.

**812332A: Information Systems Design, 5 op****Voimassaolo:** 01.08.2015 -**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 spring semester, during period 3. It is recommended to complete the course in the 3rd year spring semester.

**Learning outcomes:**

After completing the course, the student is able to understand the link between information system design and organizational development, and to apply such a system design method in an organizational context.

**Contents:**

During the course the students complete a group exercise (typically in groups of 4 persons) using Contextual Design method and its design stages that lead to actual information systems implementation.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 24 h, exercises 18 h, seminar 12 h.

**Target group:**

BSc students

**Prerequisites and co-requisites:**

Prerequisite is 811169P Introduction to Information Systems Design.

**Recommended or required reading:**

Preferable: Holtzblatt, K., & Beyer, H. (2016). Contextual design: Design for life. Morgan Kaufmann. Alternative: Beyer, H. Holtzblatt, K. (1998): Contextual Design: Defining Customer-Centered Systems. San Francisco: Morgan Kaufmann Publishers, Inc.

**Assessment methods and criteria:**

The course is normally completed as group work, and the output is presented in a course seminar. The work follows the stages of Contextual Design method and the exercise assignments support the completion of the course work. Course work reports are presented and reviewed in a final seminar. In special circumstances the course can also be completed as individual work.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Pasi Karppinen

## 812305A: Information Systems in Organisations, 5 op

**Voimassaolo:** 01.08.2015 -

**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 1st autumn semester.

**Learning outcomes:**

After completing the course, the student:

- is able to explain the importance of information systems in organizations,

- is able to define the conditions for the successful operation of the information in the organization.

**Contents:**

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

**Mode of delivery:**

Face-to-face 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.

**Recommended or required reading:**

Lectures and Wallace, Patricia: Information Systems in Organizations, People, Technology, and Processes. Pearson 2013.

**Assessment methods and criteria:**

Active participation in lectures. Weekly tasks and scientific essay.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Pasi Karppinen

## 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:** Ojala, Timo Kullervo, 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 completing the course the student:

1. is able to explain internet's design principles, architecture, functionality and challenges
2. understands the role of the data link layer role and most important access network technologies
3. is able to explain the structure and most important protocols of the TCP/IP protocol stack
4. understands how most important internet applications and their protocols function
5. understands the principles of internet security and multimedia applications
6. is able to solve simple internet related problems
7. is able to program a small internet application

**Contents:**

Internet's design principles and architecture, data link layer and most important access network technologies, TCP/IP protocol stack and its most important protocols, most important Internet applications, principles of Internet security and multimedia, internet's challenges and Future Internet.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 32 h / problem solving exercises 14 h / laboratory exercises 12 h / course work 25 h / self-study 50 h.

Problem solving exercises, laboratory exercises and course work are completed as group work.

**Target group:**

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

**Prerequisites and co-requisites:**

None.

**Recommended optional programme components:**

None.

**Recommended or required reading:**

Announced at the beginning of the course.

**Assessment methods and criteria:**

The course uses continuous assessment so that there are 3 intermediate exams. Alternatively, the course can also be passed with a final exam. The course includes a mandatory course work.

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

**Grading:**

The course uses numerical grading scale 1-5.

**Person responsible:**

Professor Timo Ojala.

**Working life cooperation:**

None.

## 811393A: Introduction to research work, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Halonen, Raija Helena

**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.

**Learning outcomes:**

The student understands the role of science in the community and at the university, and knows how the research of the curriculum is situated in the discipline. The student can name the phases of a research process and how they are connected with each other. The student understands the significance of scientific publishing, identifies different forums for publishing, and knows at least two ways to evaluate research - the quality of the forum and number of citations. The student understands the value of scientific argumentation, knows its structure and can analyse simple argumentation structures. The student identifies the role of empirical research material in research and knows some main data collection and analysis methods and reasons to choose them. The student can write search strings into databases and use them.

**Contents:**

Introduction, nature of knowledge, concept of research, deception, basics of qualitative, quantitative, constructive and literature research methods, reporting and argumentation, research process and evaluation, reporting of own study and commenting others'.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 18 h, exercise 33 h, independent work 82 h.

**Target group:**

BSc students.

**Recommended optional programme components:**

Information Skills (030005P), Written and Oral Communication Skills (900050Y), BSc thesis (811383A).

**Recommended or required reading:**

[Lecture notes](#), [additional articles](#).

**Assessment methods and criteria:**

Active implementation based on activity and presense & written thesis as guided, active doing during excercise hours, or independent study according to separate guidelines.

**Grading:**

Numerical scale 1-5 or fail; pass or fail for independent study.

**Person responsible:**

Raija Halonen

**Working life cooperation:**

No

**812342A: Object Oriented Analysis and Design, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** lisakka, Juha Veikko

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

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

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish. If at least four non-Finnish students take the course, an English exercise group will be organised.

**Timing:**

The course is held in the autumn semester, during period 1. It is recommended to complete the course in the 2nd autumn semester.

**Learning outcomes:**

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures (in Finnish) 30 h, exercises and assignments 28 h, independent work 85 h.

**Target group:**

BSc students.

**Prerequisites and co-requisites:**

Elementary course of object-oriented programming is a compulsory prerequisite. Basic knowledge of object programming and information systems analysis and design are assumed.

**Recommended or required reading:**

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

**Assessment methods and criteria:**

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

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Juha lisakka



## 812341A: Object-Oriented Programming, 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Ilkka Räsänen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay812341A Object-oriented Programming (OPEN UNI) 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish

**Timing:**

The course is held in the spring semester, during period 3. It is recommended to complete the course in the 1st spring semester.

**Learning outcomes:**

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 32 h, laboratory exercises 21 h, weekly assignments and independent work 82 h.

**Target group:**

BSc students.

**Prerequisites and co-requisites:**

Course Introduction to Programming or similar knowledge.

**Recommended or required reading:**

- Timothy Budd: Introduction to object-oriented programming, 3rd edition.
- Bruce Eckel: Thinking in Java 3rd edition or later.

**Assessment methods and criteria:**

Weekly assignments (preferred) or final exam + programming assignment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Ilkka Räsänen

## 811366A: Project Work, 10 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Antti Siirtola

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

811311A	Project Management Principles	3.0 op
811365A	Project I	7.0 op
811108P	Basics of Project Work and Management	3.0 op
811308A	Principles of Project Work	4.0 op

**ECTS Credits:**

10 ECTS credits / 267 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 in the 3rd spring semester.

**Learning outcomes:**

Upon completion of the course, the student will be able to tell about concepts and methods related to software projects, split a project into phases and tasks, resource and schedule the tasks, gather information on the progress of a project and based on it, make project related decisions, apply theory on project work and management in practice, recognise risks of software projects and prepare for them, work as a member of a project team, communicate with stakeholders by using both written and spoken language and apply his/her experience on design, implementation and testing to software and/or academic research projects.

**Contents:**

Project as a working method, splitting a project into phases and tasks, resourcing, and scheduling, recognising and preparing for risks, project management tools, the follow-up of a project, reporting, meeting skills, practical work in a software or academic research project.

**Mode of delivery:**

Face-to face teaching.

**Learning activities and teaching methods:**

Info lecture 1 h, lectures 20 h, assignments and practical project work 240 h.

**Target group:**

BSc students.

**Prerequisites and co-requisites:**

The compulsory prerequisites are Introduction to Programming (811122P), Object-Oriented Programming (812347A), Advanced Object-Oriented Programming (812339A), Object-Oriented Analysis and Design (812346A), Data Structures and Algorithms (811312A), Basics of Databases (811380A) and Software Engineering (811335A).

**Recommended optional programme components:**

The recommended prerequisites are User Interface Programming (811375A), Software Architectures (815345A), and Database systems (811384A).

**Recommended or required reading:**

Lecture slides, R. Pressman, Software Engineering: A Practitioner's Approach. McGraw-Hill, 2005 and all other material given / presented during the course.

**Assessment methods and criteria:**

The assessment of the course unit is based on the learning outcomes of the course unit. The student must complete all assignments and work toward the completion of the project tasks for the required amount of time. More detailed assessment criteria are available in the learning environment of the course.

**Grading:**

Pass or fail

**Person responsible:**

Antti Siirtola

**Working life cooperation:**

The students will work in projects ordered by customer organisations while simulating software development as authentically as possible in a real working environment.

**Other information:**

Enrollment by the end of November. Enrollment is binding. There will be an info lecture in December before the course starts.

## 811391A: Requirements Engineering, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Jouni Markkula

**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 3. It is recommended to complete the course in the 2nd study year.

**Learning outcomes:**

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

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

**Target group:**

B.Sc. students.

**Prerequisites and co-requisites:**

We assume the basic skills from the following courses: 811167P Introduction to Information System Design, 812342A Object-Oriented Analysis and Design, 811395A Basics of Databases, 811346A Software Engineering.

**Recommended optional programme components:**

**Recommended or required reading:**

S. Lauesen, Software Requirements – Styles and Techniques. Pearson Education 2002. A.M. Davis, Just Enough Requirements Management, Dorset House Publishing 2005. Lecture slides.

**Assessment methods and criteria:**

Two ways of passing: 1) Active participation: weekly assignments and project assignment (only for Finnish-speaking students); 2) Exam.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Jouni Markkula

## 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:** Juustila, Antti Juhani

**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 periods 3 and 4. It is recommended to complete the course at the 3rd spring semester.

**Learning outcomes:**

The goal of the course is to give the students an overview of the concepts and techniques related to software architectures. The focus of the architectural solutions is in the object oriented systems, but the course addresses also generic architectural models and techniques supporting architectures. After the course, the student is able to identify and analyse different architectural solutions and understands the pros and cons of these, from the perspective of building and running software, as well as from the viewpoint of quality and maintainability. The student is able to describe architectural solutions and elements of these, as well as different interfaces, using the modeling techniques of UML. The student is able to create alternative architectural solutions based on functional and non-functional requirements, using different design methods and techniques of architectural design, as well as evaluate the solutions' fit to use. The student is able to differentiate the design of product and product family architectures from the design of more usual software architectures.

**Contents:**

The fundamentals of software architectures. Documenting software architectures. Components and interfaces, Software dependencies. Design patterns. Architectural styles. Product line architectures. Frameworks, Evaluation methods of software architectures.

**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 knowledge of the software development process in general, the basics of UML in modelling, introductory experience in object oriented programming (e.g. courses 811335A Software engineering, 812346A Object Oriented Analysis and Design, 812347A Object-Oriented Programming). Recommended previous course is the 812339A Advanced Object-Oriented Programming.

**Recommended or required reading:**

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

**Assessment methods and criteria:**

The evaluation of the course is based on the learning outcomes of the course. The course is passed by participating in the course assignments as well as by evaluation of the exercise work. Detailed evaluation principles are announced in the wiki page of the course.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Antti Juustila

**Other information:**

Course is potentially implemented in cooperation with the Tampere university.

**811346A: Software Engineering, 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Lappalainen, Jouni Esko Antero

**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 periods 1 and 2. It is recommended to complete the course in the 2nd study year.

**Learning outcomes:**

After completing the course, a student

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures (in Finnish) 32 h, exercises 24 h, study group working 40 h (or alternatively essay 60 h) and self-study 24 h.

**Target group:**

BSc students.

**Prerequisites and co-requisites:**

Course Introduction to Information Systems Design and Object Oriented Analysis and Design or similar knowledge.

**Recommended optional programme components:**

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Essay and assignment, or study group work and assignment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Jouni Lappalainen

**Working life cooperation:**

A guest lecture by an industry representative, where he discusses his work and some aspect of software engineering in it. The intent is that the representative is a dept. alumnus.

## 811375A: User Interface Programming, 5 op

**Voimassaolo:** 01.08.2010 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Lappalainen, Jouni Esko Antero

**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 periods 3 and 4. It is recommended to complete the course at the 2nd spring semester.

**Learning outcomes:**

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

**Contents:**

User interface elements, foundations of user interface libraries, user interface design principles, user interface layout, the relationship between user interfaces and software architectures, event-driven programming, web usability, web user interfaces, web programming.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Exercise 24 h, coursework 75 h, independent study 35 h.

**Target group:**

BSc students

**Prerequisites and co-requisites:**

Fundamentals of user interface design. In addition, the knowledge and skills of object-oriented programming are needed.

**Recommended optional programme components:**

**Recommended or required reading:**

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 during the course).

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Jouni Lappalainen

## **814339A: Education and adp support training, 1 - 5 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Practical training

**Vastuuyksikkö:** Information Processing Science DP

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

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

## **814312A: Exchange in abroad, 1 - 3 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Iisakka, Juha Veikko

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

## 814311A: Internship in ICT-duties, 3 - 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Practical training

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Tonja Molin-Juustila

**Opintokohteen kielet:** Finnish

### ECTS Credits:

3 - 5 ECTS credits / 2 – 4 months of full time work.

### Language of instruction:

Finnish or English

### Timing:

Timing of the course is free. Recommended to take as a summer course. The course is also suitable for the supported work placement studies. In that case, it is recommended to search for the work placement and apply for the support already at the turn of the year.

### Learning outcomes:

After completing the course, the student:

- has gained work experience in typical professional ICT duties;
- has developed practical expertise in the ICT field by applying in practice what she / he has learnt during previous studies;
- understands as well as is able to describe and analyze ICT related work in order to improve his / her expertise in the future.

### Contents:

Training from two to four months in professional ICT duties that include orientation with the tasks and guiding when needed.

### Mode of delivery:

The student is responsible for making the needed arrangements for the internship: search for the work placement, negotiate the job contract, prepare the support application when needed, follow the agreed labor agreement, work within the agreed duties as well as study independently the needed professional skills and knowledge. In addition, the student documents his / her internship according to the course requirements.

### Learning activities and teaching methods:

Search for the work placement, job contract negotiation, internship, and reflecting the experience and learning by reporting; possibly also applying support, planning and weekly reporting the internship experience.

### Target group:

BSc students

### Prerequisites and co-requisites:

Information Processing Science or related studies, which enable their practical application in the context of professional ICT duties.

### Recommended or required reading:

Course materials and text books related to the internship duties.

### Assessment methods and criteria:

Working in professional ICT duties from two to four months. Internship can be realized in several periods, which all are processed as independent internship periods. Internship is proved by delivering a signed letter of reference from the employer(s). The letter of reference contains details of the internship period and the student's primary duties. After the internship period, experiences are reported as soon as possible. An internship report consists of description of realized work and analysis of learning outcomes in relation to the studies taken in Information Processing Science. The studies are proved by delivering an up-to-date transcript of records. Proposals to develop Information Processing Science studies are included in the report as well. Based on the internship period, student will gain 3-5 ECTS credits (2 months = 3, 3 months = 4, 4 months = 5). In addition to above, student may also document his/her personal plan and learning goals for the internship period as well as report weekly implementation status of those plans and goals. In this case, 5 ECTS credits will be gained already from 2 months' internship period. For applying the financial support, this documentation is mandatory.

### Grading:

Pass or fail

### Person responsible:

Tonja Molin-Juustila

**Working life cooperation:**

Working on professional ICT duties.

**Other information:**

Documenting guidelines and templates are available in the course materials. Before the internship starts, the support application must be recorded in the university systems with the copy of the internship agreement. The letter of reference from the employer(s) will be recorded together with the credits.

## 815338A: Principles of Programming Languages, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Umar Farooq

**Opintokohteen kielet:** Finnish

**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.

**Learning outcomes:**

After completing the course the student is able to

- describe the basic principles and constructs related to design and implementation of a programming language
- explain the influence of the aforementioned principles on the use and implementation of a programming language
- compare different programming languages
- describe the basic features of imperative programming languages
- describe the basic principles of abstract data types and object-oriented programming
- describe the basic principles of exception handling
- explain the basic concepts of functional programming
- explain the basic concepts of logic programming
- explain the basic concepts of concurrent programming.

**Contents:**

1. Evaluation principles of programming languages
2. History of programming languages
3. Syntax and semantics of programming languages
4. Imperative programming languages
5. Abstract data types and object-oriented programming
6. Exception handling
7. Functional programming
8. Logic programming
9. Concurrent programming.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 32 h, exercises 21 h, independent work 82 h

**Target group:**

MSc or BSc students

**Prerequisites and co-requisites:**

811122P Introduction to programming or similar knowledge, Knowledge of C, C++ and Java programming languages is required.

**Recommended or required reading:**

- Sebesta, Robert W.: Concepts of Programming Languages 5th edition, Addison-Wesley 2002 (or later).

**Assessment methods and criteria:**

Exam, Active participation in lecture and exercises, Assignments and Deliverables.

**Grading:**

Numerical scale 1-5 or fail



**Person responsible:**

Umar Farooq

**814341A: Research experience, 2 - 5,5 op****Opiskelumuoto:** Intermediate Studies**Laji:** Practical training**Vastuuyksikkö:** Information Processing Science DP**Arvostelu:** 1 - 5, pass, fail**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

**814340A: Small-Group Tutoring, 3 op****Opiskelumuoto:** Intermediate Studies**Laji:** Course**Vastuuyksikkö:** Information Processing Science DP**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Leena Ventä-Olkkonen**Opintokohteen kielet:** Finnish**ECTS Credits:**

3 ECTS credits / 80 hours of work.

**Language of instruction:**

Finnish and English.

**Timing:**

The course can be taken during 2nd–5th study year, in autumn and spring semesters, during periods 1-4.

**Learning outcomes:**

After passing the course a student (tutor) is able to draw up a supervision plan for his/her small group, put into effect his/her supervision from the viewpoint of students and based on the given tutor training and take responsibility for his /her own supervision work. In addition, after passing the course student receives experience on supervision and guidance.

**Contents:**

1. Group training, occasions and meetings 25 h
2. Planning and implementation of small-group tutoring 45 h
3. Writing his / her own report diary 10 h.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Lectures, exercises and meetings. Practice as a small-group tutor in co-operation with other tutors, Blanko student organisation, library and own department's tutor teachers. Independent personal work.

**Target group:**

BSc or MSc students

**Recommended or required reading:**

Training materials, forms and own reports.

**Assessment methods and criteria:**

Active participation in tutor-training, implementing small-group tutoring and drawing up the supervision plan and the report diary.

**Grading:**

Pass / fail

**Person responsible:**

Leena Ventä-Olkkonen

**812315A: Software Construction, 10 op**

**Voimassaolo:** 01.08.2014 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Information Processing Science DP

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

**Opettajat:** Antti Siirtola

**Opintokohteen kielet:** Finnish

**ECTS Credits:**

10 ECTS credits / 267 hours of work.

**Language of instruction:**

Finnish

**Timing:**

The course is held in the summer. It is recommended to complete the course on the summer between 2nd or 3rd study years.

**Learning outcomes:**

After completing the course, the student

- knows the difference between imperative and functional programming and is able to create simple functional programs
- is able to increase the stability of his / her programs
- has built a code library that enables the reuse of components
- can construct a program with control of concurrent processing
- can create a distributed network application.

**Contents:**

The course consists of five modules each having kick-off and conclusion seminars. Between the seminars, a student is working on an assignment.

1. Functional programming
2. Defensive programming
3. Code libraries and reuse of components
4. Concurrent programming
5. Programming of distributed systems.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Seminars 60 h, independent work / group work 207 h.

**Target group:**

BSc students majoring Information Processing Science

**Prerequisites and co-requisites:**

Software Engineering, Object-Oriented Programming, Advanced Object-Oriented Programming, Object-oriented Analysis and Design, Data Structures and Algorithms, Computer Architecture.

**Recommended optional programme components:**

Principles of Programming Languages, Operating Systems

**Recommended or required reading:**

Announced the before the kick-off seminar of each module.

**Assessment methods and criteria:**

Five programming assignments and attending the seminars, grading is based on programming assignments.

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Antti Siirtola

## **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 credits / 27 hours of work

**Language of instruction:**

Finnish

**Timing:**

Architecture 3. spring semester, period I; Biochemistry 3. autumn semester; Biology 3. autumn semester, period I; Chemistry 3. autumn semester, period II; Computer Science and Engineering 2. spring semester, period IV; Electronics and Communications Engineering 3. spring semester; Geosciences 2. spring semester, period IV; Geography 1. and 3. spring semester, period III; Industrial Engineering and Management 3. year (Master's degree students in Industrial Engineering and Management 1st year.); Information Processing Sciences 1. 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.

**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 RefWorks 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.

**Prerequisites and co-requisites:**

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**Recommended optional programme components:**

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**Recommended or required reading:**

Web learning material Tieteellisen tiedonhankinnan opas <http://libguides oulu.fi/tieteellinentiedonhankinta> (in Finnish)

**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

**Working life cooperation:**

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**Other information:**

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