Opasraportti

Degree programme in Computer Science and Engineering (2011 - 2012)

Tietotalo 1 student affairs office (TS 110 - TS114) is open daily 9.30 - 14.00.

More on studies

Tutkintorakenteet

MSc. Engineering, Computer Science and Engineering

Tutkintorakenteen tila: published

Lukuvuosi: 2011-12

Lukuvuoden alkamispäivämäärä: 01.08.2011

Option (60 - 80 op)

Compulsory, choose one of the options. Advanced modules are approximately 30 ects in total.

Information networks

H452224: Module of the Option, Information Networks, 60 - 80 op
- *Module of the option, all compulsory*
  - A452222: Module of the Option, Information Networks, 35 op
    - *All compulsory*
      - 521266S: Distributed Systems, 6 op
      - 521340S: Communications Networks I, 5 op
      - 521479S: Software Project, 7 op
      - 521260S: Representing Structured Information, 5 op
      - 521488S: Multimedia Systems, 6 op
      - 521496S: Information Networks System Design, 5 op
- *Advanced module information network systems, compulsory courses*
  - A452277: Advanced Module/Information Networks, Information Network Systems (obligatory), 10 op
    - *obligatory courses*
      - 521385S: Mobile Telecommunication Systems, 5 op
        - *Compulsory*
          - 521385S-01: Mobile Telecommunications systems, exam, 0 op
          - 521385S-02: Mobile Telecommunication Systems, exercisework, 0 op
      - 521496S: Information Networks System Design, 5 op
- *Avanced module information network systems, optional courses*
  - A452278: Advanced Module/Information Networks, Information Network Systems (optional), 25 op
    - *Optional courses, module size approx. 35 cr*

521264S: Human-Computer Interaction Techniques, 5 op
521340S: Communications Networks I, 5 op
521377S: Communications Networks II, 7 op
811380A: Basics of Databases, 7 op
815309A: Real Time Distributed Software Development, 6 op
815618S: Component-based Software Production, 6 op

Advanced module Information networks Service business for information networks

A452279: Advanced Module/Information Networks, Service Business for Information Networks (obligatory), 15 op

Obligatory courses

721412P: Product and Market Strategies, 5 op
721419P: Consumer Behavior, 5 op
721704A: Business Logistics, 5 op

Advanced module Information networks Service business for Information networks

A452280: Advanced Module/Information Networks, Service Business for Information Networks (optional), 20 op

Optional courses, module size approx. 35 cr

721462S: Network Theory, 6 op
555344S: Management Information Systems, 5 op
806109P: Basic Methods in Statistics I, 9 op
521340S: Communications Networks I, 5 op
521489S: Research Work on Information Processing, 8 op

Embedded Systems

H452225: Module of the Option, Embedded Systems, 60 - 80 op

Module of the option, all courses compulsory

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

All compulsory

521404A: Digital Techniques 2, 5 op
521423S: Embedded System Project, 5 op
521279S: Signal Processing Systems, 5 op
521340S: Communications Networks I, 5 op
521479S: Software Project, 7 op
521485S: DSP-laboratory Work, 3,5 op

Advanced module embeddeds ystems electronics, compulsory courses

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

Obligatory courses

521281S: Application Specific Signal Processors, 5 op
521306A: Circuit Theory 2, 4 op
521432A: Electronics Design I, 5 op
521445S: Digital Techniques 3, 6 op

Advanced module embedded systems electronics, optional courses

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

Optional courses, module size approx. 40 cr

521405A: Electronic System Design, 5 op
521331A: Filters, 4 op
521443S: Electronics Design II, 5 op
521450S: Optoelectronics, 4 op
521484A: Statistical Signal Processing, 5 op
521385S: Mobile Telecommunication Systems, 5 op

Compulsory

521385S-01: Mobile Telecommunications systems, exam, 0 op
521385S-02: Mobile Telecommunication Systems, exercisework, 0 op

521320S: Wireless Communications 2, 8 op
521369A: Simulations and Tools for Telecommunications, 3 op
521489S: Research Work on Information Processing, 8 op

Advanced module, embedded systems softare, compulsory courses

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

Obligatory courses

812346A: Object Oriented Analysis and Design, 6 op
812347A: Object-Oriented Programming, 6 op
521260S: Representing Structured Information, 5 op

Advanced module embedded systems software, optional courses
A452284: Advanced Module/Embedded Systems, Embedded Systems Software (optional), 23 - 35 op
Optional courses, module size approx. 40 cr
521488S: Multimedia Systems, 6 op
521266S: Distributed Systems, 6 op
521281S: Application Specific Signal Processors, 5 op
521264S: Human-Computer Interaction Techniques, 5 op
521489S: Research Work on Information Processing, 8 op
521320S: Wireless Communications 2, 8 op
521369A: Simulations and Tools for Telecommunications, 3 op

Information Technology

H452226: Module of the Option, Information Technology, 60 - 80 op
Module of the option, all compulsory
A452221: Module of the Option, Information Technology, 34 - 35 op
All compulsory
521279S: Signal Processing Systems, 5 op
521259S: Digital Video Processing, 5 op
521466S: Machine Vision, 5 op
031025A: Introduction to Optimization, 5 op
521488S: Multimedia Systems, 6 op
521497S: Pattern Recognition and Neural Networks, 5 op
521260S: Representing Structured Information, 5 op
Advanced module signal processing, compulsory courses
A452271: Advanced Module/Information Technology, Signal Processing (obligatory), 13,5 - 20 op
Obligatory courses
521404A: Digital Techniques 2, 5 op
521321S: Elements of Information Theory and Coding, 5 op
521280S: DSP Laboratory Work, 5 op
Advanced module signal processing, optional courses
A452272: Advanced Module/Information Technology, Signal Processing (optional), 15 - 22 op
Optional courses, dodule size approx. 35 cr
521273S: Biosignal Processing, 5 op
521281S: Application Specific Signal Processors, 5 op
521445S: Digital Techniques 3, 6 op
521320S: Wireless Communications 2, 8 op
521373S: Communication Signal Processing I, 6 op
521360S: Communication Signal Processing II, 4 op
521489S: Research Work on Information Processing, 8 op
470444S: Advanced Control Methods, 6 op
521493S: Computer Graphics, 7 op
Advanced module intelligent systems, compulsory courses
A452273: Advanced Module/Information Technology, Intelligent Systems (obligatory), 14 - 17 op
Obligatory courses
521493S: Computer Graphics, 7 op
477505S: Fuzzy-neuromethods in Process Automation, 4 op
Advanced module intelligent systems, optional courses
A452274: Advanced Module/Information Technology, Intelligent Systems (optional), 18 - 25 op
Optional courses, module size apporx. 35 cr
477605S: Digital Control Theory, 4 op
521489S: Research Work on Information Processing, 8 op
802633S: Statistical Pattern Recognition, 10 op
521273S: Biosignal Processing, 5 op
470444S: Advanced Control Methods, 6 op
521264S: Human-Computer Interaction Techniques, 5 op
Advanced module biomedical information engineering, compulsory courses
A452275: Advanced Module/Information Technology, Biomedical Information Engineering (obligatory), 11 - 20 op
Obligatory courses
521273S: Biosignal Processing, 5 op
521107S: Biomedical Instrumentation, 6 op
Advanced module biomedical information engineering, optional courses

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

Optional courses, module size approx. 35 cr

521489S: Research Work on Information Processing, 8 op
764638S: Basic Neuroscience, 5 op
750340A: Basics of bioinformatics, 3 op
080910A: Applied Diagnostic Radiology, 4 op
080901A: Introduction to Technology in Clinical Medicine, 5 op
764103P: Introduction to biophysics, 2 op

Supplementary module (15 - 30 op)

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

Advanced practical training (3 op)

521013A: Advanced Practical Training, 3 op

Master's Thesis (30 op)

Choose one of the following options:

521981SDI/Information technology; 522984S Information networks; 521984S Embedded systems; 522985S Applied computing

The Master's Thesis requires a written maturity test.

Master's Thesis

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

Degree Programme in Information Engineering, B.Sc.(E)

Tutkintorakenteen tila: published

Lukuvuosi: 2011-12

Lukuvuoden alkamispäivämäärä: 01.08.2011

Basic and Intermediate Studies (120 - 130 op)

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

Second domestic language

901008P: Second Official Language (Swedish), 2 op
900009P: Second Official Language (Finnish), 2 op

Compulsory studies

030001P: Orientation Course for New Students, 1 op
030005P: Information Skills, 1 op
902011P: Technical English 3, 6 op
031010P: Calculus I, 5 op
031011P: Calculus II, 6 op
031019P: Matrix Algebra, 3,5 op
031021P: Probability and Mathematical Statistics, 5 op
031018P: Complex Analysis, 4 op
031023P: Mathematical Structures for Computer Science, 5 op
031050A: Signal Analysis, 4 op
031017P: Differential Equations, 4 op

761101P: Basic Mechanics, 4 op
761102P: Basic Thermodynamics, 2 op
761103P: Electricity and Magnetism, 4 op
761104P: Wave Motion, 3 op
521412A: Digital Techniques 1, 6 op
521109A: Electrical Measurement Principles, 5 op
521141P: Elementary Programming, 5 op
521267A: Computer Engineering, 4 op
521150A: Introduction to Internet, 5 op
521142A: Embedded Systems Programming, 5 op
521457A: Software Engineering, 5 op
521277A: Embedded Systems, 4 op
521144A: Algorithms and Data Structures, 6 op
521453A: Operating Systems, 5 op
521275A: Embedded Software Project, 8 op
521361A: Telecommunication Engineering II, 3 op

Module preparing for the option (vähintään 20 op)

Information Networks

A452122: Module Preparing for the Option, Information Networks, 10 - 30 op
Compulsory studies
812346A: Object Oriented Analysis and Design, 6 op
812347A: Object-Oriented Programming, 6 op
521316A: Wireless Communications 1, 4 op
521495A: Artificial Intelligence, 5 op

Information Technology

A452121: Module Preparing for the Option, Information Technology, 10 - 30 op
Compulsory studies
521337A: Digital Filters, 5 op
031022P: Numerical Analysis, 5 op
521495A: Artificial Intelligence, 5 op
521467A: Digital Image Processing, 5 op
521484A: Statistical Signal Processing, 5 op

Embedded Systems

A452123: Module Preparing for the Option, Embedded Systems, 10 - 30 op
Compulsory studies
521302A: Circuit Theory 1, 5 op
521431A: Principles of Electronics Design, 5 op
521337A: Digital Filters, 5 op
521467A: Digital Image Processing, 5 op

BSc thesis and related studies (10 op)

The extent of the BSc thesis is 8 credits.

521032A: Information Engineering Study, 3 - 8 op
900060A: Technical Communication, 2 op

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

Supplementary modules

Opintojaksojen kuvaukset

Tutkintorakenteisiin kuuluvien opintokohteiden kuvaukset

H452224: Module of the Option, Information Networks, 60 - 80 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Module of the option, all compulsory

A452222: Module of the Option, Information Networks, 35 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

All compulsory

521266S: Distributed Systems, 6 op

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

521290S Distributed Systems 5.0 op

Language of instruction:
In English.
Timing:
Period 5-6.

Learning outcomes:

The course provides the key principles of distributed systems and the major design paradigms used in implementing distributed

systems.

Learning outcomes:

Upon completing the course the student is able to explain the key principles of distributed systems, apply them in evaluating the

major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and

implement a small distributed system

Contents:

Architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security,

distributed object-based systems, distributed file systems, distributed object-based systems, distributed coordination-based systems

Learning activities and teaching methods:

Lectures, exercises and practical work.

The course is passed with a final exam or with a set of intermediate exams, together with an approved practical work.

Recommended optional programme components:

Computer networks, Operating systems, Software Engineering.

Recommended or required reading:

Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems - Principles and Paradigms, Second Edition, Prentice Hall, 2007.

Lecture slides and exercises.

521340S: Communications Networks I, 5 op

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

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

The aim is to present the fundamentals of the structure of digital data transmission systems. Operation adapted according to the telephone network also considered. Technical implementation and application of the common data and local networks are discussed.
Learning outcomes: Upon completing the required coursework, the student is able to list the functionalities of different layers of OSI and TCP/IP protocol models. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE IEEE802.11 systems. The student is able to describe the basic protocol model of the UMTS radio interface and radio access network. The student will achieve skills to describe the main principles of mobility control, network security, crosslayer optimization and routing in ad hoc networks. The course also gives the student the ability to explain the essential features of sensor networks.

Contents:

Communications architecture and protocols, adaptive network and transportation layers, mobility management, network security, network management, ad hoc and sensor networks, cross-layer optimization, examples of wireless communication networks.

Learning activities and teaching methods:

Two hours of lectures in a week. The course is passed with final examination and accepted design exercise. The course is lectured in English.

Recommended or required reading:

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

521479S: Software Project, 7 op

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

Learning outcomes:

The student is familiarised with the phases of the software engineering process and project work. The theories from earlier studies are implemented in practice. The student gains experience of real-life software development and testing.
Learning outcomes: After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

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

Learning activities and teaching methods:

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

Recommended optional programme components:

521457A Software Engineering, 521453A Operating Systems, 521482A Programming Exercise and varying project related background reading.

Recommended or required reading:

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

521260S: Representing Structured Information, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S	Programmable Web Project (OPEN UNI)	5.0 op

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

Learning outcomes: Upon completing the required coursework, the student is able to read XML-based descriptions; to identify their elements and relations between them. The student is able to evaluate and compare existing descriptions. Moreover, the student is able to design and document descriptions and to implement programs that use existing and self made descriptions. Finally, the student is able to create Web Services that utilize XML representations.

Contents:

XML and XML Schema, parsing XML, XML & Web Services, tools for writing XML, processing XML in programs, implementing programs processing XML.

Learning activities and teaching methods:

Lectures, programming exercises and project work

Recommended optional programme components:

Programming

Recommended or required reading:

Will be announced later

521488S: Multimedia Systems, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Language of instruction:

In Finnish.

Timing:

Period 2-3.

Learning outcomes:

The aim of the course is to provide advanced knowledge of multimedia technologies, and applying them in designing and implementing a multimedia system.
Learning objectives: Student can determine specifics of different multimedia elements and can explain basic techniques for presentation of multimedia. Student can describe novel multimedia communication techniques and recognize different functional domains, and how to apply them in the design and implementation of novel multimedia applications and services.

Contents:

key concepts, multimedia elements: image, voice, video, and animation techniques; resource management, real-time multimedia, quality of service, synchronization, multimedia communication techniques, multimedia databases, reference models, standardization, applications, watermarking, design and implementation of multimedia system.

Learning activities and teaching methods:

Lectures and course exercise related to multimedia systems (emphasis either on implementation, research or design). Course is passed with final examination and accepted course exercise. In addition group exam for additional points to exam. Course materials and group work instructions are available at OPTIMA.
Further information: http://www.ee.oulu.fi/research/tklab/courses/521488S/

Recommended optional programme components:

recommended courses include basic courses in computer science and mathematics, Operating systems (521453A), Digital Image Processing (521467S), Computer networks (521476S), Software Engineering (521457A) and Knowledge Engineering (521468S).
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Recommended or required reading:

Multimedia Communications: Applications, Networks, Protocols and Standards. F. Halsall, Addison-Wesley 2001, chapters 1-5. Lecture slides provide appendices and show the focus areas in more detail.
Supportive reading **:** Multimedia: Computing, Communications and Applications. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995, chapters 1-6, 9.1.-9.4, 10.1, 11,12 and 15. Open Distributed Processing and Multimedia. G. Blair and J. Stefani, Addison-Wesley 1998, chapters 2-4 and 8. Principles of Multimedia Database Systems. V. Subrahmanian, Morgan Kaufman 1998, chapters 1,5, 9 and 15. Multimedia: Computing, Communications and Application. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995. Chapters 1-6, 9.1.-9.3, 10.1, 11-13, 15, 17.

521496S: Information Networks System Design, 5 op

Voimassaolo: 01.08.2005 - 31.12.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:

In Finnish.

Timing:

Period 1-6.

Learning outcomes:

The aim of the course is to provide students advanced knowledge on the design criteria, implementation and testing of the systems hardware level architecture.
Learning objectives: Student can produce design and requirement specification and other related project documentation. Student can implement system integration and other required hardware or software components based on the architecture specification, and also functional testing.

Contents:

Information networks systems design and implementation work, include the following three aspects:

1. Architecture specification design and requirement specification for the implemented system
2. Implementation the hardware and software components based on the architecture specification, to achieve system integration goals
3. Functional testing of the systems and project reporting

Learning activities and teaching methods:

Course is done as independent design work within 1-3 member groups, for topic of novel systems areas. Work involves design and implementation of whole or part of information network system by case studying a service example. Further information: http://www.ee.oulu.fi/research/tklab/courses /521496S/

Recommended optional programme components:

courses included in the B.Sc level for software and electronics courses.

Recommended or required reading:

Depending on the topic, including standards specifications and software/hardware API documentations

Advanced module information network systems, compulsory courses

A452277: Advanced Module/Information Networks, Information Network Systems (obligatory), 10 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

obligatory courses

521385S: Mobile Telecommunication Systems, 5 op

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

Language of instruction:

In English.

Timing:

Period 4-6.

Learning outcomes:

To get the basic understanding of mobile communication systems dimensioning and performance. To learn some of the current and developing mobile communication system standards and to prepare students to understand the structure, functionality and dimensioning of these systems. Learning outcomes: Upon completing the required coursework, the student is able to determine the values of the main parameters of WCDMA physical layer and power control. The student can also determine 3G channel model and derive the CDMA cellular network capacity. In addition, the student can determine the main component used in the CDMA network planning. The course gives skills to describe mobility management, adaptive recourse control and dynamic recourse allocation in CDMA networks.

Contents:

Concept and structure of mobile communications system. Basics of CDMA radio network planning and capacity, channel modeling, distributed transmission power control, mobility management, adaptive recourse control, cooperative transmission, transmission diversity, dynamic recourse allocation. Examples of digital mobile telecommunication systems in practice.

Learning activities and teaching methods:

Two hours of lectures in a week and exercises. The course is passed with final examination and accepted laboratory exercise. The course is lectured in English.

Recommended optional programme components:

Telecommunication Engineering II

Recommended or required reading:

Parts of the following: S. Glisic: Wireless Networks:4G Technologies; S. Glisic: Adaptive WCDMA: Theory and Practice, S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technoloques (2 nd ed.), 2007

Compulsory

521385S-01: Mobile Telecommunications systems, exam, 0 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521385S-02: Mobile Telecommunication Systems, exercisework, 0 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha-Pekka Mäkelä
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521496S: Information Networks System Design, 5 op

Voimassaolo: 01.08.2005 - 31.12.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:

In Finnish.

Timing:

Period 1-6.

Learning outcomes:

The aim of the course is to provide students advanced knowledge on the design criteria, implementation and testing of the systems hardware level architecture.
Learning objectives: Student can produce design and requirement specification and other related project documentation. Student can implement system integration and other required hardware or software components based on the architecture specification, and also functional testing.

Contents:

Information networks systems design and implementation work, include the following three aspects:

1. Architecture specification design and requirement specification for the implemented system
2. Implementation the hardware and software components based on the architecture specification, to achieve system integration goals
3. Functional testing of the systems and project reporting

Learning activities and teaching methods:

Course is done as independent design work within 1-3 member groups, for topic of novel systems areas. Work involves design and implementation of whole or part of information network system by case studying a service example. Further information: http://www.ee.oulu.fi/research/tklab/courses /521496S/

Recommended optional programme components:

courses included in the B.Sc level for software and electronics courses.

Recommended or required reading:

Depending on the topic, including standards specifications and software/hardware API documentations

Avanced module information network systems, optional courses

A452278: Advanced Module/Information Networks, Information Network Systems (optional), 25 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses, module size approx. 35 cr

521264S: Human-Computer Interaction Techniques, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: A student is able to explain user-computer interaction principles types, mechanisms on the area of smartphones and interoperable smart environments, and the student is able to apply the methods in a creative and innovative way to the selected application areas. After the course the student is able evaluate critically the applicability of interaction techniques and provide solutions to interaction technique design challenges.

Contents:

D esign processes and guidelines to develop professional quality user interfaces. Techniques for physical selection interaction. Techniques for context aware interaction with multitude of context types. Techniques and principles for multimodal interaction (for example interaction based on mixture of modalities; gesture, graphics, audio, context and touch). Mechanisms for context-based interaction adaptivity.

Learning activities and teaching methods:

Lectures, Seminar presentations , Mandatory design excersice.

Recommended optional programme components:

Required skills: Programming skills, intelligent systems

Recommended or required reading:

Lecture material. Selected scientific publications.

Assessment methods and criteria:

To pass the course accepted written exam and accepted design excersice are required.

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic

Opintokohteen kielet: English

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

The aim is to present the fundamentals of the structure of digital data transmission systems. Operation adapted according to the telephone network also considered. Technical implementation and application of the common data and local networks are discussed.
Learning outcomes: Upon completing the required coursework, the student is able to list the functionalities of different layers of OSI and TCP/IP protocol models. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE IEEE802.11 systems. The student is able to describe the basic protocol model of the UMTS radio interface and radio access network. The student will achieve skills to describe the main principles of mobility control, network security, crosslayer optimization and routing in ad hoc networks. The course also gives the student the ability to explain the essential features of sensor networks.

Contents:

Communications architecture and protocols, adaptive network and transportation layers, mobility management, network security, network management, ad hoc and sensor networks, cross-layer optimization, examples of wireless communication networks.

Learning activities and teaching methods:

Two hours of lectures in a week. The course is passed with final examination and accepted design exercise. The course is lectured in English.

Recommended or required reading:

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

521377S: Communications Networks II, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic

Opintokohteen kielet: English

Language of instruction:

In English.

Timing:

Period 4-6.

Learning outcomes:

The aim is to help the student to understand the basic principles of networking by providing a balance between the description of existing networks and the development of analytical tools. The descriptive material is used to illustrate the underlying concepts, and the analytical material is used to generate a deeper and more precise understanding of the concepts. The course presents the basic principles of queueing theory giving mathematical tools to apply the theory to practical communication systems.
Learning outcomes: Upon completing the required coursework, the student is able to construct simple theoretical queueing theory models and analyze the simulation results of these models. The student achieves skills to explain simple Markovian birth-death process and apply that model in queueing systems. The course gives skills for the student to describe functionalities of a communication network with game theory. The student knows the decomposition methods of network utility function and is capable of using that knowledge for network optimization.

Contents:

Introduction to concepts in queuing theory, birth-death process, queueing systems and their measures of effectiveness, Little's result, blocking in queueing systems, open and closed (Jackson) queueing networks, advanced routing in data networks, multiple access techniques, network information theory, cognitive networks.

Learning activities and teaching methods:

Two hours of lectures in a week and exercises, The course is passed with final examination and accepted design exercise. The course is lectured in English.

Recommended optional programme components:

Communication Networks I, Stochastic Processes

Recommended or required reading:

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

811380A: Basics of Databases, 7 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Iisakka, Juha Veikko

Opintokohteen kielet: Finnish

Leikkaavuudet:

811318A	Introduction to Data Management	9.0 op
811318A-02	Introduction to data management, exam	0.0 op
811318A-01	Introduction to data management, exercise work	0.0 op

ECTS Credits:

7 ECTS

Language of instruction:

Finnish

Timing:

Timing: 2 nd year, autumn semester, period 2, and spring semester, period 3

Learning outcomes:

Objective: The course does relational databases, conceptual modelling of databases, as well as XML and object databases.

Learning Outcomes: After completing the course students are able to model conceptually, can take into account the design of databases and information systems, and can manage relational, XML, and Object-Oriented databases.

Contents:

Contents: Conceptual modelling (ER- and EER-diagrams), relational model (theory, databases, query techniques and normalisation), XML-databases, object-oriented databases, transactions.

Learning activities and teaching methods:

Mode of delivery: Lectures (45h), compulsory exercises (40h) and assignments (10h).

Target group:

Target group: Bachelor level students, compulsory

Recommended optional programme components:

Prerequisites: Course 812346A “Object Oriented Analysis and Design” or knowledge about object oriented class models.

Recommended or required reading:

Study materials: Silberschatz, Korth & Sudarshan: Database system concepts

Assessment methods and criteria:

Assessment methods: To be announced in course web pages.

Grading:

1-5

Person responsible:

Juha Iisakka

815309A: Real Time Distributed Software Development, 6 op

Voimassaolo: 01.08.2011 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Petri Pulli

Opintokohteen kielet: English

ECTS Credits:

6 ECTS

Language of instruction:

Language of instruction: English

Timing:

Timing: 1 st year of Master’s studies, autumn semester, periods 1 & 2

Learning outcomes:

Objective: The course presents the theoretic background of real-time distributed systems, a model-based development methodology, and embedded, ubiquitous and mobile design examples.

Learning Outcomes: After completing the course, the student:

- Is able to analyse the characteristic 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:

Contents:
Introduction:
- Characteristics of Real-Time Systems
- Timeliness
- Resource management
- Safety and Reliability
- Concurrency
- Security
- Multitasking, Interrupts
- Scheduling
- Hardware Interfaces

Characteristics of Distribution
- Centralised
- Client-server
- Clusters
- Cloud
- Peer-to-peer
- Ad hoc
- Concept of time
- Synchronisation
- Latency and jitter
- Quality of Service
- Service Discovery
- Networking primitives
- Networking frameworks

Real-Time UML Modelling Methodology
Real-Time Design Patterns
Design Examples: Embedded, Ubiquitous, Mobile, Web/Internet

Learning activities and teaching methods:

Mode of delivery: Lectures 45h, Design exercises 15h, Student projects 100h

Target group:

Target group: Master's level students of SE Oriented Module (compulsory), Master's level students of IS Oriented Module and GS ^{3}D students (optional)

Recommended optional programme components:

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

Recommended or required reading:

Study materials: Lecture notes based on reference books
- Douglass B.P. (1999) Doing Hard Time – Developing Real-Time Systems with UML – Objects, Frameworks. And Patterns. Addison-Wesley ISBN 0-201-49837-5. 749 p.
- Douglass B.P. (2007) Real-Time UML – Advances in the UML for Real-Time Systems. Third edition. Addison-Wesley ISBN 0-321-16076-2. 694 p.
- Douglass B.P. (2009) Real-Time Design Patterns – Robust Scalable Architecture for Real-Time Systems. Addison-Wesley ISBN 0-201-69956-7. 500 p.
- Douglass B.P. (2009) Real-Time Agility – The Harmony/ESW Method for Real-Time and Embedded Systems Development. Addison-Wesley ISBN 0-321-54549-4. 522 p.
- Douglass B.P. (2007) Real-Time UML Workshop for Embedded Systems. Elsevier. ISBN 978-0-7506-7906-0. 408 p.
- Comer D.E (2009) Computer networks and Internets. 5th edition. Pearson – Prentice Hall. ISBN 978-0-13-504583-1. 600 p.

Assessment methods and criteria:

Assessment methods: Exam and project evaluation.

Grading:

Grading: 1–5

Person responsible:

Responsible person: Petri Pulli

815618S: Component-based Software Production, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Information Processing Science

Arvostelu: 1 - 5, pass, fail

Opettajat: Krzanik Lech

Opintokohteen kielet: Finnish

ECTS Credits:

6 ECTS

Timing:

4th year, period 4

Learning outcomes:

Objective: The objective of this advanced course is to provide component-based software development concepts and methods. A wide range of common component models and techniques are discussed. The focus is on object ori-ented component systems.
Learning Outcomes: On completing the course the students are prepared to develop modular, flexible and reusable component software.

Contents:

Component software foundations, reusability, components and interfaces, component patterns and styles, product lines, application frameworks, COTS-based systems. Software product management, component project man-agement, agile component software development. EJB, .NET, services and other component platforms, EAI platforms. Component software development capabil-ity maturity models.

Learning activities and teaching methods:

Lectures, exercises, hands-on assignment, examination.

Target group:

4th year

Recommended optional programme components:

General knowledge of software development, UML basics and general experience with object-oriented programming (included in courses: 811335A Software engineering, 812346A Object oriented analysis and design, 815347A Software architectures)

Recommended or required reading:

Clemens Szyperski, Component Software: Beyond Object-Oriented Programming. Addison-Wesley, 2003; Web-pages (http://www.tol.oulu.fi/users/lech.krzanik/cbsd.htm).

Assessment methods and criteria:

Lectures, exercises, assignment, examination are evaluated on a point scale. Minimum levels: weekly exercises: 50% of tasks; assignment: pass.

Grading:

The normal grading scale is used. Active participation to exercises, approved as-signment, and a positive examination result are necessary to pass the course.

Person responsible:

Lech Krzanik

Advanced module Information networks Service business for information networks

A452279: Advanced Module/Information Networks, Service Business for Information Networks (obligatory), 15 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Module

Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

721412P: Product and Market Strategies, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Oulu Business School
Arvostelu: 1 - 5, pass, fail
Opettajat: Ilkka Ojansivu
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay721412P Product and Market Strategies (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ects.

Language of instruction:

Finnish.

Timing:

Period A.

Learning outcomes:

After having passed this course, students are able to identify the concepts and tools linked to product and market strategies. The course improves students' ability to evaluate different product and market situations among industries and propose solutions to strategic product/market decisions. Furthermore, students is able to explain the content and stages of marketing management process.

Contents:

1) Analyzing marketing opportunities, 2) Market segmentation, targeting and positioning, 3) Developing marketing strategies 4) Planning marketing programs

Learning activities and teaching methods:

25 h lectures, case exercises, group discussions and independent reading of the textbooks

Recommended or required reading:

Porter, M.E.: Competitive Advantage (1985); Kotler, P. & Keller, K.: Marketing Management. (2006 or newer) and other material named by the lecturer.

Check availability from here.

Assessment methods and criteria:

Lectures, literature examination and case exercise.

Grading:

1-5.

Person responsible:

Professor Jari Salo and doctoral student Ilkka Ojansivu.

Other information:

The number of students is limited.

721419P: Consumer Behavior, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Oulu Business School

Arvostelu: 1 - 5, pass, fail

Opintokohteen oppimateriaali:

Assael, Henry , , 1995

Solomon, Michael R. , , 2004

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay721419P Consumer Behavior (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

ECTS Credits:

5 ects.

Language of instruction:

Finnish.

Timing:

Period D.

Learning outcomes:

After having passed this course, students will have an overall picture of the consumer decision making process and an understanding of the factors affecting consumer decision making. In addition, students are able to combine these factors both in theory and in practice.

Contents:

Consumer decision making; the individual consumer, environmental influences to consumer decision making, marketing strategies connected with individual and group behaviour.

Learning activities and teaching methods:

24 h lectures, assignment and independent reading of the textbooks.

Recommended or required reading:

Assael, H.: Consumer Behavior & Marketing Action, 4th ed. 1992 (or newer), OR Solomon, M.R.: Consumer Behavior. Buying, having, being, 5th ed. (or newer) and material provided by lecturer.

Check availability from here.

Assessment methods and criteria:

Lecture and literature examination and written assignment.

Grading:

1-5.

Person responsible:

N.N.

Other information:

The number of students is limited.

721704A: Business Logistics, 5 op

Voimassaolo: - 31.07.2005
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Oulu Business School
Arvostelu: 1 - 5, pass, fail
Opettajat: Jari Juga
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Advanced module Information networks Service business for Information networks

A452280: Advanced Module/Information Networks, Service Business for Information Networks (optional), 20 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses, module size approx. 35 cr

721462S: Network Theory, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Oulu Business School
Arvostelu: 1 - 5, pass, fail
Opettajat: Satu Nätti
Opintokohteen kielet: English
Voidaan suorittaa useasti: Kyllä

ECTS Credits:
6 ects.

Language of instruction:
Finnish.

Timing:
Period C.

Learning outcomes:
Upon completion of the course, students have deepened their theoretical understanding of business networks. They are able to explain, why the different kinds of networks are important in business life and how they are able to coordinate them considering strategic goals of the company. They can critically apply different theories and conceptions to their business environment. They are able to analyse the underlying logic of different types of strategic nets, learning and knowledge transfer

within the network likewise sources of conflict and conflict resolution strategies. After passing this course, students are capable to evaluate and argue the relevance and usefulness of such theories in their Master's Thesis when needed.

Contents:

Lectures and related material include the following themes:
1) Principles of network thinking and basic concepts;
2) Networks and strategic thinking;
3) Different kind of strategic nets, their management mechanisms and capabilities needed (from subcontractor networks to development and innovation networks);
4) Learning and knowledge in the network context and
5) Sources of conflict in networks and conflict resolution.

Learning activities and teaching methods:

In order to participate the course, a pre-exam should be passed (from book Håkansson, H. & Snehota, I eds: Developing Relationships in Business Networks, 1995). Detailed information on the pre-exam will be given during the period B on Faculty´s web page. During the period C there will be 24 hours lectures including group work (article analysis and mini cases). In addition, independent reading of the textbooks.

Recommended optional programme components:

Subject studies in marketing.

Recommended or required reading:

The pre-exam: Håkansson, H. & Snehota, I (eds.): Developing Relationships in Business Networks, 1995 (sections given by the lecturer before the course). *The final exam:* Lecture material and Parolini, C.: The Value Net – A Tool for Competitive Advantage.
Check availability from here.

Assessment methods and criteria:

1) Pre-exam, 2) group work and 3) final exam.

Grading:

1-5.

Person responsible:

Assistant professor Satu Nätti.

Other information:

The number of students is limited.

555344S: Management Information Systems, 5 op

Voimassaolo: - 31.07.2015
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Industrial Engineering and Management
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English
Leikkaavuudet:

555314S	Management Information Systems	5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:

English

Learning outcomes:

The aim of the course is to provide readiness for enterprise information system designing, -purchasing, and development tasks. The aim is to familiarize a student with the significance of information and its management when controlling processes. Learning outcomes: After completing the course student knows the key concepts of management information systems and can explain these. The student can define the information needs of management processes and how information systems can meet these needs. The student can describe the key features of the following types of systems: DSS, GDSS, EIS, BI, and ERP. The student can analyse the state of the management in an organisation, and can suggest a suitable type of information system to support the management. After the course the student can take part in the organisational development from MIS points of view.

Contents:

The main content is based on exploiting information systems in decision making and leadership. The following topics are covered during the course; Decision Support Systems (DSS), Group Support Systems (GSS), and Executive Information Systems (EIS). Also covered are the effects of information technology in operations, examining the effects of information and communication technology on productivity, financial growth, and the formation of national competitiveness.

806109P: Basic Methods in Statistics I, 9 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Päkkilä

Opintokohteen oppimateriaali:

Grönroos, Matti (2) , , 2003
Heikkilä, Tarja , , 1998
Helenius, Hans , , 1989
Ranta, Esa (2) , , 1991
Wild, Christopher J. , , 2000

Opintokohteen kielet: Finnish

Leikkaavuudet:

806119P	A Second Course in Statistics	5.0 op
806116P	Statistics for Economic Sciences	5.0 op
806117P	Analysis of continuous response variable	5.0 op
ay806109P	Basic Methods in Statistics I (OPEN UNI)	9.0 op

ECTS Credits:

9 cr

Learning outcomes:

On successful completion of this course, the student will be able to
- use basic methods of collecting and describing data
- apply methods of statistical inference in some simple situations
- interpret listing of some statistical software

Contents:

Principles of collecting data and describing data with suitable tables, graphs and numerical measures are treated. The basic idea of estimation and statistical tests will be presented as well as some of the most common used confidence intervals and statistical tests. One aim is also to give basic knowledge from some statistical software.

Person responsible:

Marjatta Mankinen (economics) and Jari Päkkilä (others)

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic

Opintokohteen kielet: English

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

The aim is to present the fundamentals of the structure of digital data transmission systems. Operation adapted according to the telephone network also considered. Technical implementation and application of the common data and local networks are discussed.
Learning outcomes: Upon completing the required coursework, the student is able to list the functionalities of different layers of OSI and TCP/IP protocol models. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE IEEE802.11 systems. The student is able to describe the basic protocol model of the UMTS radio interface and radio access network. The student will achieve skills to describe the main principles of mobility control, network security, crosslayer optimization and routing in ad hoc networks. The course also gives the student the ability to explain the essential features of sensor networks.

Contents:

Communications architecture and protocols, adaptive network and transportation layers, mobility management, network security, network management, ad hoc and sensor networks, cross-layer optimization, examples of wireless communication networks.

Learning activities and teaching methods:

Two hours of lectures in a week. The course is passed with final examination and accepted design exercise. The course is lectured in English.

Recommended or required reading:

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

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: After passing the course the student is able to work as an active, responsible and initiative member of a project group. The student can apply the theoretical knowledge of his/her area in a creative way to solve a practical research problem, implement the methods needed in the work with a programming language, and document the results of the work in the form of a scientific publication.

Contents:

In this course a small-scale research work on information processing is carried our as a part of the activities of a research group. The topics are chosen according to the needs of current research projects. The main emphasis is in developing and applying information processing methods. Implementation of a method in Matlab, C or Java environment is usually required.

Learning activities and teaching methods:

The work is started by getting a short introduction to the goals and activities of the research group, and by agreeing with the advisor about the contents of the given work. Before starting the work, it should be agreed about its different phases, practical implementation and supervision. Typically the

work is divided into: studying the theory, programming, testing, preparing the document, and final presentation of the results.

Recommended optional programme components:

A good general success in studies is required. Good programming skill is a plus. Additional conditions can be set on the basis of the given problem.

Recommended or required reading:

Books and scientific articles related to the given research problem.

H452225: Module of the Option, Embedded Systems, 60 - 80 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Module of the option, all courses compulsory

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

All compulsory

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannu Heusala
Opintokohteen kielet: Finnish

Language of instruction:

In Finnish.

Timing:

Period 1-2.

Learning outcomes:

The goal of the cource is to familiarize students to the professional design flow, design methodology and implementaion options of digital integrated circuits.
Osaamistavoitteet: After the cource students are able to design high level architectures of digital systems and blocks of the system implemented by special hardware (ASIC and FPGA). Students are able to ably design methodologies and tools. Design verification and implementation analysis are emphasised. Students can simulate and model (VHDL

modelling and VHDL simulation) digital systems and critically revalue the design also from the implementation's point of view.

Contents:

1. Implementation technologies of digital circuits, 2. Description levels of digital systems, 3. VHDL modelling of digital circuits and systems, 4. System level specification and design, 5. Design of ASICs and FPGAs, 6. High level VHDL synthesis, 7. RTL-VHDL synthesis, 8. Planning of production test of digital ASICs.

521423S: Embedded System Project, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Learning outcomes:

The objective of this course is to familiarize students to modern embedded system development process with hands on approach.
Learning outcomes: Upon completing the required coursework, the student is able to do an embedded system development process from a requirement specification to a prototype. Based on the requirement specification the student can create a system level design, select components, design a printed circuit board and manufacture it, assemble the board, and design, implement, test and debug software for the system, and finally achieve a result that fulfills the given requirements.

Contents:

Creating a simple prototype level device, based on the Atmel AVR microcontroller. Demonstration of the prototype. Applicable components and tools: avr-gcc, Eagle/Orcad, AVR Studio, JTAG-ICE.

Learning activities and teaching methods:

The course is a project that is made with groups of three students. The proceeding of the project is monitored by meetings with assistants.

Recommended optional programme components:

Digital Techniques I, Computer Engineering, Embedded Systems. Also recommended Embedded Software Project, Principles of Electronics Design.

Recommended or required reading:

Assignment, component datasheets, manuals, www-pages.

521279S: Signal Processing Systems, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521340S: Communications Networks I, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Savo Glisic

Opintokohteen kielet: English

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

The aim is to present the fundamentals of the structure of digital data transmission systems. Operation adapted according to the telephone network also considered. Technical implementation and application of the common data and local networks are discussed.
Learning outcomes: Upon completing the required coursework, the student is able to list the functionalities of different layers of OSI and TCP/IP protocol models. The course gives the skills for the student to describe the basic structure of GSM, GPRS, EDGE IEEE802.11 systems. The student is able to describe the basic protocol model of the UMTS radio interface and radio access network. The student will achieve skills to describe the main principles of mobility control, network security, crosslayer optimization and routing in ad hoc networks. The course also gives the student the ability to explain the essential features of sensor networks.

Contents:

Communications architecture and protocols, adaptive network and transportation layers, mobility management, network security, network management, ad hoc and sensor networks, cross-layer optimization, examples of wireless communication networks.

Learning activities and teaching methods:

Two hours of lectures in a week. The course is passed with final examination and accepted design exercise. The course is lectured in English.

Recommended or required reading:

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

521479S: Software Project, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Learning outcomes:

The student is familiarised with the phases of the software engineering process and project work. The theories from earlier studies are implemented in practice. The student gains experience of real-life software development and testing.
Learning outcomes: After completing the course, students have demonstrated their capabilities to design, develop and test real-life software. Further, they have shown their proficiency in professionally documenting their work during the assignment.

Contents:

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

Learning activities and teaching methods:

The course is done in groups of 3-4 students. The clients are typically various companies and societies. Project progress is supervised in formal reviews, where the project teams present their work as it reaches the milestones: the software requirement specification, the project plan, the

software design specification, an operational prototype demonstration, the test documentation, and finally the functional software demonstration and release. In addition to formal reviews the project work is coordinated with steering group meetings. The work environment and development tools vary between projects. The number of students that can attend the course is limited.

Recommended optional programme components:

521457A Software Engineering, 521453A Operating Systems, 521482A Programming Exercise and varying project related background reading.

Recommended or required reading:

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

521485S: DSP-laboratory Work, 3,5 op

Voimassaolo: - 31.07.2012
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Miguel Bordallo Lopez
Opintokohteen kielet: English

Language of instruction:

In English.

Timing:

Period 2-6.

Learning outcomes:

The course concentrates on implementing basic algorithms and functions of digital signal processing using common modern programmable DSP processors.
Learning outcomes: After the course the student is able to use integrated design environments of digital signal processors for implementing and testing algorithms based on floating and fixed point representation.

Contents:

Sampling, quantization noise, signal generation, decimation and interpolation, FIR and IIR filter implementations, FFT and adaptive filter implementations.

Learning activities and teaching methods:

The course is based on a starting lecture and exercises that are done using development boards of modern 32-bit digital signal processors, and the respective software development tools. The course is passed by accepted and documented exercises

Recommended optional programme components:

Digital filters, computer engineering, programming skills.

Advanced module embeddeds ystems electronics, compulsory courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521281S: Application Specific Signal Processors, 5 op

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

Ei opintojaksokuvauksia.

521306A: Circuit Theory 2, 4 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish
Leikkaavuudet:

521303A Circuit Theory 2 5.0 op

Language of instruction:

The course and exercises are held in Finnish.

Timing:

Period 1-3.

Learning outcomes:

This course gives basic knowledge about the analysis and modelling of electrical circuits. After passing this course the student is capable of analyzing frequency responses of circuits implemented using lumped circuit elements.
Learning outcomes: After completing the course the student can use Laplace transform for solving transient and steady-state responses, can derive the transfer function of a continuous-time system, solve its poles and zeros, and understand their meaning, can draw the pole-zero map and Bode plots of a given transfer function, can construct and use a 2-port parameter presentation of a circuit, and understands the principles of circuit synthesis and limitations of linear circuit analysis.

Contents:

Use of Laplace transformation in circuit analysis. Properties of network functions, concept of poles and zeros. Pole-zero plot, Bode amplitude and phase plots. Behavioral modeling of electric circuits. One and two-port parameter presentations. Basics of network synthesis.

Learning activities and teaching methods:

This course includes 4 hours of lectures and exercises per week. The course is passed by a final exam.

Recommended optional programme components:

Circuit Theory I, Calculus I - II, Differential Equations.

Recommended or required reading:

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

521432A: Electronics Design I, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Language of instruction:

Finnish.

Timing:

Period 4-5.

Learning outcomes:

To give the student the basic information about analogue electronics design. The course is continuation to Principles of Electronics Design.
Learning outcomes: On completion of the study module students should be able to recount the principles governing the design of multistage amplifiers, analyse and set the frequency response of a transistor amplifier and make use of feedback to improve the properties of an amplifier in the desired manner. They should also be able to analyse the stability of a given degree of feedback amplification and to dimension an amplifier correctly to ensure stability. Students should similarly be able to describe the principles governing the design of power amplifiers, to make widespread use of operational amplifiers for realizing electronic structural blocks and to take account of the limitations imposed by the non-idealities inherent in operational amplifiers. They should be able to design low-frequency oscillators, to explain the operating principles of radio frequency oscillators and resonance amplifiers and to recount the basic principles governing the functions and properties of emitter-coupled logic.

Contents:

Frequency response of transistor amplifier, differential amplifier, feedback, stability and nonidealities of feedback amplifier, comparator, output stages and power amplifiers, application of operational amplifier, oscillators, tuned amplifiers and ECLlogic. Implementation: Lectures and exercises. This course is required when participating in Laboratory Exercises on Analogue Electronics. Final exam.

Recommended optional programme components:

Circuit Theory II, Principles of Electronics Design, Principles of Semiconductor Devices.

Recommended or required reading:

Handout. Sedra, Smith: Microelectronic Circuits (4th edition), Chapters 2, 6-12. OR Hambley: Electronics (2nd edition), chapter 2; chapters 7 - 12 to most part.

521445S: Digital Techniques 3, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jukka Lahti

Opintokohteen kielet: Finnish

Language of instruction:

In Finnish.

Timing:

Period 3-4.

Learning outcomes:

The goal of the cource is to familiarize students to the professional design flow, design methodology and implementaion options of digital integrated circuits.

Learning outcomes **:** After the cource students are able to design high level architectures of digital systems and blocks of the system implemented by special hardware (ASIC and FPGA). Students are able to ably design methodologies and tools. Design verification and implementation analysis are emphasised. Students can simulate and model (VHDL modelling and VHDL simulation) digital systems and critically revalue the design also from the implementation's point of view.

Contents:

1. Implementation technologies of digital circuits, 2. Description levels of digital systems, 3. VHDL modelling of digital circuits and systems, 4. System level specification and design, 5. Design of ASICs and FPGAs, 6. High level VHDL synthesis, 7. RTL-VHDL synthesis, 8. Planning of production test of digital ASICs.

Advanced module embedded systems electronics, optional courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses, module size approx. 40 cr

521405A: Electronic System Design, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Kari Määttä
Opintokohteen kielet: Finnish

Language of instruction:

Finnish.

Timing:

Periods 1-2.

Learning outcomes:

The main goal of the course is to introduce methods and techniques needed in designing larger electronic entities such as equipment and systems.
Learning outcomes: On completion of the study module a student is able to explain all the phases of a development project of an electronic device. He or she is able to explain how to protect results obtained during the development process and on the other hand the student is able to explain the restrictions caused by standards and patents of other companies. The student is able to choose the optimum method of the choices presented in the course in the field of power supply, thermal design, grounding, and routing of the high speed signals. The student is able to calculate problems, caused by electrical disturbances, crosstalk and nonidealities of electrical components. After passing the course the student can calculate reliability of an electrical device or system.

Contents:

Electronic product design process, patents, test design, and EMC/LVD standards, Characteristics of ASIC technology and design, Characteristics of highspeed digital design. Reliability engineering. Documentation design

Learning activities and teaching methods:

The course includes 3 h of lectures and 2 h of exercises per week. The course will be passed by means of a final exam.

Recommended optional programme components:

Circuit Theory I-II, Analogue Electronics I-II, Digital Techniques I-II, Filter Theory, Computer engineering, Embedded Systems.

Recommended or required reading:

Handout. Ward & Angus: Electronic Product Design, m Hall&Hall&McCall: Highspeed Digital Design, Montrose: EMC and the Printed Circuit Board, Ott: Noise Reduction Techniques.

521331A: Filters, 4 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Rahkonen, Timo Erkki

Opintokohteen kielet: Finnish

Leikkaavuudet:

521304A Filters 5.0 op

Language of instruction:

The course and exercises are held in Finnish

Timing:

Period 3-4.

Learning outcomes:

Learning Outcomes: After completing the course the student can construct a needed pole-zero map for a given frequency response, can perform frequency and impedance scaling, can choose an appropriate prototype filter and solve the required order of the filter. Further, he can synthesize simple passive and active filters, and understands the principles for optimising the dynamic range of active filters, and understands the basic limitations of various filter implementation technologies.

Contents:

Prototype filters (Butterworth, Chebychev, Bessel etc.), frequency transforms and impedance conversions. Implementations using lumped and distributed circuits. Active filters. Sensitivity analysis and optimizing the dynamic range of filter stages.

Learning activities and teaching methods:

Lectures and exercises together 5 hours per week. Design exercise and final exam.

Recommended optional programme components:

Knowledge in circuit theory and analog design.

Recommended or required reading:

Handouts. van Valkenburg: Analog Filter Design, chapters 1-14, 18, 20 Holt-Saunders 1982, OR Schauman, van Valkenburg: Design of Analog Filters, chapters 1-13, Oxford University Press 2001.

521443S: Electronics Design II, 5 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tarmo Ruotsalainen

Opintokohteen kielet: Finnish

Language of instruction:

In Finnish (In English if needed).

Timing:

Period 1-2.

Learning outcomes:

The goal is to reinforce and further develop the student's understanding of concepts of analogue circuit blocks and their application and use in the design of electronic equipment. The course also gives basic skills for the design of integrated building blocks. Noise and modeling of noise in electrical circuits, and the structures and properties of DA/AD converters are covered.
Learning outcomes: On completion of the study module students should be able to explain the structures and operating principles of the passive and active (BJT and MOS) components available for use in modern IC technologies, analyse and design integrated structural blocks based on these components, such as operational amplifiers, comparators and sampling circuits, and estimate and minimize the effects of noise on these. They should also be able to explain the terminology connected with DA and AD conversion and converters and to analyse and outline their main structural principles and evaluate their characteristics.

Contents:

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

Learning activities and teaching methods:

Lectures, exercises and a small design work. Final exam.

Recommended optional programme components:

Electronics Design I.

Recommended or required reading:

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

521450S: Optoelectronics, 4 op

Voimassaolo: - 31.07.2014

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kilpelä, Ari Juhani

Opintokohteen kielet: Finnish

Language of instruction:

Finnish.

Timing:

Period 5-6

Learning outcomes:

To give the basic knowledge of the transmitter and receiver electronics used in optoelectronic applications, and basic theory of optical fibers and their usage in various applications.

Learning outcomes: On completion of the study module students should be able to explain the principles of operation of the photoconductors and photochannels (optic fibres), semiconductor light sources and photodetectors used in optoelectronic measurements and telecommunications, paying due attention to factors affecting their performance. They should also be able to outline circuit-level structures for light source control circuits and photodetector preamplifiers and be capable of comparing them in terms of their main performance parameters. They should also be reasonably able to use the main principles of signal processing that are required for the design of optoelectronic measurement applications.

Contents:

Geometrical and physical optics, optical fibers and their properties, sources of radiation (the radiation of black body, LED- and laser structures), photodetectors (photo conductive detector, light multiplier, PIN- and AP-diodes, position sensitive detectors), light source modulation, preamplifiers and their bandwidth/stability/noise analysis, the signal analysis methods used in optoelectonics

Learning activities and teaching methods:

Lectures and exercises. May include a seminar. Final exam.

Recommended optional programme components:

Principles of Semiconductor Devices.

Recommended or required reading:

Lecture notes. S. Kasap: Optoelectronics and Photonics, Principles and Practises, Prentice Hall 2001. J. Wilson, J. Hawkes, "Optoelectronics, an introduction", Prentice Hall, 3ed, ISBN 0-13-103961-X.

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

521348S	Statistical Signal Processing	5.0 op

Ei opintojaksokuvauksia.

521385S: Mobile Telecommunication Systems, 5 op

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

Language of instruction:

In English.

Timing:

Period 4-6.

Learning outcomes:

To get the basic understanding of mobile communication systems dimensioning and performance. To learn some of the current and developing mobile communication system standards and to prepare students to understand the structure, functionality and dimensioning of these systems. Learning outcomes: Upon completing the required coursework, the student is able to determine the values of the main parameters of WCDMA physical layer and power control. The student can also determine 3G channel model and derive the CDMA cellular network capacity. In addition, the student can determine the main component used in the CDMA network planning. The course gives skills to describe mobility management, adaptive recourse control and dynamic recourse allocation in CDMA networks.

Contents:

Concept and structure of mobile communications system. Basics of CDMA radio network planning and capacity, channel modeling, distributed transmission power control, mobility management, adaptive recourse control, cooperative transmission, transmission diversity, dynamic recourse allocation. Examples of digital mobile telecommunication systems in practice.

Learning activities and teaching methods:

Two hours of lectures in a week and exercises. The course is passed with final examination and accepted laboratory exercise. The course is lectured in English.

Recommended optional programme components:

Telecommunication Engineering II

Recommended or required reading:

Parts of the following: S. Glisic: Wireless Networks:4G Technologies; S. Glisic: Adaptive WCDMA: Theory and Practice, S. Glisic: Advanced Wireless Communications: 4G Cognitive and Cooperative Technoloques (2 nd ed.), 2007

Compulsory

521385S-01: Mobile Telecommunications systems, exam, 0 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521385S-02: Mobile Telecommunication Systems, exercisework, 0 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Partial credit
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Juha-Pekka Mäkelä
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521320S: Wireless Communications 2, 8 op

Voimassaolo: 01.08.2007 -
Opiskelumuoto: Advanced Studies
Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S	Wireless Communications I	5.0 op
521323S	Wireless Communications I	5.0 op

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.
Learning outcomes: After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to to make the performance comparison of them.
Student can explain design methods signals for bandlimited channels and can classify different channel equalizers, and perform the performance analysis. In addition, the student can utilize channel capacity evaluation for fading channels, he/she recognizes the basic methods for link adaptation and multiantenna communication.

Contents:

Radio channel models, channel capacity, digital modulation method and their performance in AWGN-channel, carrier and symbol synchronization, performance of digital modulation in fading channel, diversity techniques, adaptive modulation and coding, multiantenna techniques and channel equalizers in wireless communication.

Learning activities and teaching methods:

Lectures and exercises in total 4 hours in a week during periods 1-3. The course is given in English. The course is passed with final examination (during lecture periods possibility to pass with intermediate exams) and accepted design exercise. Grade is based on exam.

Recommended optional programme components:

Telecommunication Engineering II. Also recommended: Statistical Signal Processing, Radio Communication Channels.

Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of J.G. Proakis: Digital Communications, 4th ed, 2001. Also, additional material from other sources.

521369A: Simulations and Tools for Telecommunications, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521328A	Simulations and Tools for Telecommunications	5.0 op

Language of instruction:

Lectures are in Finnish. The course book and lecture notes are in English. If the teacher in English speaking, also the lectures are in English.

Timing:

Periods 5-6.

Learning outcomes:

The goal is to familiarize the students with simulation of communication systems, protocols, algorithms and transceiver RF/IF-blocks. The course gives answers to questions why, when and how to simulate. In addition to simulation principles also communication system simulations especially in the baseband level are considered as well as brief overview to simulations in the network level and RF/IF parts.

Learning outcomes: A student recognizes problems and limitations related to simulations. A student can select a suitable simulation method and knows how to validate the model. Student knows how to generate signals, random numbers and noise as well as fading channels. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results. A student can explain principles of network level simulations. Furthermore, a student recognizes common communications and RF/IF simulation programs.

Contents:

Simulation methods, modelling communication systems with simulations, confidence limits of simulation, noise generation and modelling of fading channel. A simple baseband simulation example. The common simulation packages communication and RF systems are presented.

Learning activities and teaching methods:

Lectures 2 hours per week (including program introductions) and a compulsory design exercise.

Recommended or required reading:

Lecture notes. Selected parts (informed in the notes) of Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems, Modeling Methodology and Techniques, 2nd edition.
Plenum Press, 2000. Additional reading: William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.

Assessment methods and criteria:

The course is passed with final examination and acceptably passed design exercise.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: After passing the course the student is able to work as an active, responsible and initiative member of a project group. The student can apply the theoretical knowledge of his/her area in a creative way to solve a practical research problem, implement the methods needed in the work with a programming language, and document the results of the work in the form of a scientific publication.

Contents:

In this course a small-scale research work on information processing is carried our as a part of the activities of a research group. The topics are chosen according to the needs of current research projects. The main emphasis is in developing and applying information processing methods. Implementation of a method in Matlab, C or Java environment is usually required.

Learning activities and teaching methods:

The work is started by getting a short introduction to the goals and activities of the research group, and by agreeing with the advisor about the contents of the given work. Before starting the work, it should be agreed about its different phases, practical implementation and supervision. Typically the work is divided into: studying the theory, programming, testing, preparing the document, and final presentation of the results.

Recommended optional programme components:

A good general success in studies is required. Good programming skill is a plus. Additional conditions can be set on the basis of the given problem.

Recommended or required reading:

Books and scientific articles related to the given research problem.

Advanced module, embedded systems softare, compulsory courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

812346A: Object Oriented Analysis and Design, 6 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Information Processing Science
Arvostelu: 1 - 5, pass, fail
Opettajat: Iisakka, Juha Veikko
Opintokohteen kielet: Finnish

ECTS Credits:

6 ECTS

Language of instruction:

Finnish

Timing:

Ajoitus: 1. vsk, kevätlukukausi, periodi 4

Learning outcomes:

Objective: The course covers the principles of object orientation as well as object-oriented analysis, design modelling and modelling techniques.

Learning Outcomes: After completing the course the student knows object-oriented analysis, design modelling, modelling techniques and design principles. Moreover, the student is able to analyse and design using these techniques.

Contents:

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.

Learning activities and teaching methods:

Mode of delivery: Lectures 34h, compulsory exercises and assignments 30h, independent work 95h.

Target group:

Target group: Bachelor level students, compulsory

Recommended optional programme components:

Prerequisites: Basic knowledge of programming and information systems analysis and design

Recommended or required reading:

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

Assessment methods and criteria:

Assessment methods: Refer to course web pages

Grading:

1-5

Person responsible:

Juha Iisakka

812347A: Object-Oriented Programming, 6 op

Voimassaolo: - 31.07.2015
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Information Processing Science
Arvostelu: 1 - 5, pass, fail
Opettajat: Ari Vesanen
Opintokohteen kielet: Finnish

ECTS Credits:

6 ECTS

Language of instruction:

Finnish

Timing:

Ajoitus: 2. vsk, syyslukukausi, periodit 1+2

Learning outcomes:

Objective: The course demonstrate the concepts and benefits of object-orientation, such as improved structure, quality and maintainability of software.

Learning Outcomes: After completing the course, a student:

- Can understand the paradigm of the general objectives and techniques, as well as object-oriented programming concepts, the importance of practice and their implementation;
- Is able to apply design patterns with the solutions and understands the creatures, the interface /implementation approach and message passing principles and their importance;
- Is able to apply the inheritance and composition of the diversity, and can remember the Model-View-Controller model of software implementation principles.

Contents:

Contents:

1. Object-orientation
2. C++ language
3. Composition, inheritance and polymorphism
4. Design patterns and Model-View-Controller
5. Generics and object-oriented data structures

Learning activities and teaching methods:

Mode of delivery: Lectures 32h, laboratory exercises 24h, weekly examination and independent work 110h

Target group:

Target group: Bachelor level students, compulsory

Recommended optional programme components:

Prerequisites: Courses **"**Introduction to Programming", "Introduction to Programming Assignment", "Object-oriented Analysis and Design" or similar knowledge

Recommended or required reading:

Study materials:

- Timothy Budd: Introduction to object-oriented programming, 3 rd edition.
- Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides: Design patterns – Elements of reusable object-oriented software.
- Bruce Eckel: Thinking in C++ Volume 1, 2 nd edition.

Assessment methods and criteria:

Assessment methods: Weekly examination (preferred) or final exam + programming assignment

Grading:

1-5

Person responsible:

Ari Vesanen

521260S: Representing Structured Information, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S Programmable Web Project (OPEN UNI) 5.0 op

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

Learning outcomes: Upon completing the required coursework, the student is able to read XML-based descriptions; to identify their elements and relations between them. The student is able to evaluate and compare existing descriptions. Moreover, the student is able to design and document descriptions and to implement programs that use existing and self made descriptions. Finally, the student is able to create Web Services that utilize XML representations.

Contents:

XML and XML Schema, parsing XML, XML & Web Services, tools for writing XML, processing XML in programs, implementing programs processing XML.

Learning activities and teaching methods:

Lectures, programming exercises and project work

Recommended optional programme components:

Programming

Recommended or required reading:

Will be announced later

Advanced module embedded systems software, optional courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses, module size approx. 40 cr

521488S: Multimedia Systems, 6 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: English

Language of instruction:

In Finnish.

Timing:

Period 2-3.

Learning outcomes:

The aim of the course is to provide advanced knowledge of multimedia technologies, and applying them in designing and implementing a multimedia system.
Learning objectives: Student can determine specifics of different multimedia elements and can explain basic techniques for presentation of multimedia. Student can describe novel multimedia communication techniques and recognize different functional domains, and how to apply them in the design and implementation of novel multimedia applications and services.

Contents:

key concepts, multimedia elements: image, voice, video, and animation techniques; resource management, real-time multimedia, quality of service, synchronization, multimedia communication techniques, multimedia databases, reference models, standardization, applications, watermarking, design and implementation of multimedia system.

Learning activities and teaching methods:

Lectures and course exercise related to multimedia systems (emphasis either on implementation, research or design). Course is passed with final examination and accepted course exercise. In addition group exam for additional points to exam. Course materials and group work instructions are available at OPTIMA.
Further information: http://www.ee.oulu.fi/research/tklab/courses/521488S/

Recommended optional programme components:

recommended courses include basic courses in computer science and mathematics, Operating systems (521453A), Digital Image Processing (521467S), Computer networks (521476S), Software Engineering (521457A) and Knowledge Engineering (521468S).
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Recommended or required reading:

Multimedia Communications: Applications, Networks, Protocols and Standards. F. Halsall, Addison-Wesley 2001, chapters 1-5. Lecture slides provide appendices and show the focus areas in more detail.
Supportive reading **:** Multimedia: Computing, Communications and Applications. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995, chapters 1-6, 9.1.-9.4, 10.1, 11,12 and 15. Open Distributed Processing and Multimedia. G. Blair and J. Stefani, Addison-Wesley 1998, chapters 2-4 and 8. Principles of Multimedia Database Systems. V. Subrahmanian, Morgan Kaufman 1998, chapters 1,5, 9 and 15. Multimedia: Computing, Communications and Application. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995. Chapters 1-6, 9.1.-9.3, 10.1, 11-13, 15, 17.

521266S: Distributed Systems, 6 op

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

521290S	Distributed Systems	5.0 op

Language of instruction:

In English.

Timing:

Period 5-6.

Learning outcomes:

The course provides the key principles of distributed systems and the major design paradigms used in implementing distributed

systems.

Learning outcomes:

Upon completing the course the student is able to explain the key

principles of distributed systems, apply them in evaluating the

major design paradigms used in implementing distributed systems, solve distributed systems related problems, and design and

implement a small distributed system

Contents:

Architectures, processes, communication, naming, synchronization, consistency and replication, fault tolerance, security,

distributed object-based systems, distributed file systems, distributed object-based systems, distributed coordination-based systems

Learning activities and teaching methods:

Lectures, exercises and practical work.

The course is passed with a final exam or with a set of intermediate exams, together with an approved practical work.

Recommended optional programme components:

Computer networks, Operating systems, Software Engineering.

Recommended or required reading:

Andrew S. Tanenbaum and Maarten van Steen, Distributed Systems - Principles and Paradigms, Second Edition, Prentice Hall, 2007.

Lecture slides and exercises.

521281S: Application Specific Signal Processors, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

521264S: Human-Computer Interaction Techniques, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: A student is able to explain user-computer interaction principles types, mechanisms on the area of smartphones and interoperable smart environments, and the student is able to apply the methods in a creative and innovative way to the selected application areas. After the course the student is able evaluate critically the applicability of interaction techniques and provide solutions to interaction technique design challenges.

Contents:

D esign processes and guidelines to develop professional quality user interfaces. Techniques for physical selection interaction. Techniques for context aware interaction with multitude of context types. Techniques and principles for multimodal interaction (for example interaction based on mixture of modalities; gesture, graphics, audio, context and touch). Mechanisms for context-based interaction adaptivity.

Learning activities and teaching methods:

Lectures, Seminar presentations , Mandatory design excersice.

Recommended optional programme components:

Required skills: Programming skills, intelligent systems

Recommended or required reading:

Lecture material. Selected scientific publications.

Assessment methods and criteria:

To pass the course accepted written exam and accepted design excersice are required.

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: After passing the course the student is able to work as an active, responsible and initiative member of a project group. The student can apply the theoretical knowledge of his/her area in a creative way to solve a practical research problem, implement the methods needed in the work with a programming language, and document the results of the work in the form of a scientific publication.

Contents:

In this course a small-scale research work on information processing is carried our as a part of the activities of a research group. The topics are chosen according to the needs of current research projects. The main emphasis is in developing and applying information processing methods. Implementation of a method in Matlab, C or Java environment is usually required.

Learning activities and teaching methods:

The work is started by getting a short introduction to the goals and activities of the research group, and by agreeing with the advisor about the contents of the given work. Before starting the work, it should be agreed about its different phases, practical implementation and supervision. Typically the work is divided into: studying the theory, programming, testing, preparing the document, and final presentation of the results.

Recommended optional programme components:

A good general success in studies is required. Good programming skill is a plus. Additional conditions can be set on the basis of the given problem.

Recommended or required reading:

Books and scientific articles related to the given research problem.

521320S: Wireless Communications 2, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S	Wireless Communications I	5.0 op
521323S	Wireless Communications I	5.0 op

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.
Learning outcomes: After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to to make the performance comparison of them.
Student can explain design methods signals for bandlimited channels and can classify different channel equalizers, and perform the performance analysis. In addition, the student can utilize channel capacity evaluation for fading channels, he/she recognizes the basic methods for link adaptation and multiantenna communication.

Contents:

Radio channel models, channel capacity, digital modulation method and their performance in AWGN-channel, carrier and symbol synchronization, performance of digital modulation in fading channel, diversity techniques, adaptive modulation and coding, multiantenna techniques and channel equalizers in wireless communication.

Learning activities and teaching methods:

Lectures and exercises in total 4 hours in a week during periods 1-3. The course is given in English. The course is passed with final examination (during lecture periods possibility to pass with intermediate exams) and accepted design exercise. Grade is based on exam.

Recommended optional programme components:

Telecommunication Engineering II. Also recommended: Statistical Signal Processing, Radio Communication Channels.

Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of J.G. Proakis: Digital Communications, 4th ed, 2001. Also, additional material from other sources.

521369A: Simulations and Tools for Telecommunications, 3 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Risto Vuohtoniemi

Opintokohteen kielet: Finnish

Leikkaavuudet:

521328A Simulations and Tools for Telecommunications 5.0 op

Language of instruction:

Lectures are in Finnish. The course book and lecture notes are in English. If the teacher in English speaking, also the lectures are in English.

Timing:

Periods 5-6.

Learning outcomes:

The goal is to familiarize the students with simulation of communication systems, protocols, algorithms and transceiver RF/IF-blocks. The course gives answers to questions why, when and how to simulate. In addition to simulation principles also communication system simulations especially in the baseband level are considered as well as brief overview to simulations in the network level and RF/IF parts.

Learning outcomes: A student recognizes problems and limitations related to simulations. A student can select a suitable simulation method and knows how to validate the model. Student knows how to generate signals, random numbers and noise as well as fading channels. A student knows how to make Monte-Carlo simulations at the baseband level and can estimate confidence level of simulation results. A student can explain principles of network level simulations. Furthermore, a student recognizes common communications and RF/IF simulation programs.

Contents:

Simulation methods, modelling communication systems with simulations, confidence limits of simulation, noise generation and modelling of fading channel. A simple baseband simulation example. The common simulation packages communication and RF systems are presented.

Learning activities and teaching methods:

Lectures 2 hours per week (including program introductions) and a compulsory design exercise.

Recommended or required reading:

Lecture notes. Selected parts (informed in the notes) of Michel C. Jeruchim, Philip Balaban, and K. Sam Shanmugan, Simulation of Communication Systems, Modeling Methodology and Techniques, 2nd edition.
Plenum Press, 2000. Additional reading: William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation with Wireless Applications, Prentice Hall, 2004.

Assessment methods and criteria:

The course is passed with final examination and acceptably passed design exercise.

H452226: Module of the Option, Information Technology, 60 - 80 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Other Entity
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Module of the option, all compulsory

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module of the Option
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

All compulsory

521279S: Signal Processing Systems, 5 op

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

Ei opintojaksokuvauksia.

521259S: Digital Video Processing, 5 op

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

Ei opintojaksokuvauksia.

521466S: Machine Vision, 5 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Heikkilä, Janne Tapani

Opintokohteen kielet: Finnish

Language of instruction:

In Finnish.

Timing:

Periods 5-6.

Learning outcomes:

To make an introduction to computer vision.
Learning outcomes: Upon completion of the course, the student can utilize common machine vision methods for various image analysis problems. He is able to carry out region segmentation and pattern recognition using color, texture and shape descriptors computed from images. He can use motion information in image analysis and model matching in image registration and object recognition. The student can explain the basics of geometric computer vision and is able to calibrate cameras as well as to obtain 3D coordinate measurements from the scene using for example stereo imaging. After the course the student has the rudimentary skills to use the Matlab environment and its tools for implementing machine vision methods and analyzing the results.

Contents:

1. Introduction, 2. Imaging and image representation, 3. Binary image analysis, 4. Pattern recognition concepts, 5. Color and shading, 6. Texture, 7. Contentbased image retrieval, 8. Motion from 2D image sequences, 9. Image segmentation, 10. Matching in 2D, 11. Perceiving 3D from 2D images, 12. 3D models and matching.

Learning activities and teaching methods:

Lectures, exercises, examination. Laboratory excercises using Matlab environment.

Recommended optional programme components:

Digital image processing

Recommended or required reading:

Shapiro L.G., Stockham G.C.: Computer vision, Prentice Hall, 2001. Lecture notes, exercise material. All course material is in English.

031025A: Introduction to Optimization, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ruotsalainen Keijo

Opintokohteen kielet: English

Language of instruction:

Finnish. English for the students in the International Master program.

Timing:

Period 1-3

Learning outcomes:

The objective of the course is to provide the mathematical foundations of the optimization methods, to analyze their basic theoretical properties and demonstrate their performances on examples.
Learning outcomes **:** The student learns to solve convex optimization problems with the basic optimization algorithms. He/She is able to form the necessary and sufficient conditions for the optimization problem and is able to form the corresponding dual problem.

Contents:

Linear optimization. Simplex-algorithm. KKT-conditions. Dual problem. Gradient algorithms. Conjugate gradient algorithm. Barrier- and penalty function methods. Implementation: Lectures 3h/week, Exercises 2h/week. Two intermediate exams or one final exam.

Recommended optional programme components:

Calculus 1, Calculus 2, Matrix algebra.

Recommended or required reading:

- K. Ruotsalainen, Optimoinnin perusteet (lecture notes in finnish)
- P. Ciarlet; Introductionto numerical linear algebra and optimization
- M. Bazaraa, H. Sherali, C.M. Shetty; Nonlinear programming

521488S: Multimedia Systems, 6 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Language of instruction:

In Finnish.

Timing:

Period 2-3.

Learning outcomes:

The aim of the course is to provide advanced knowledge of multimedia technologies, and applying them in designing and implementing a multimedia system.
Learning objectives: Student can determine specifics of different multimedia elements and can explain basic techniques for presentation of multimedia. Student can describe novel multimedia communication techniques and recognize different functional domains, and how to apply them in the design and implementation of novel multimedia applications and services.

Contents:

key concepts, multimedia elements: image, voice, video, and animation techniques; resource management, real-time multimedia, quality of service, synchronization, multimedia communication techniques, multimedia databases, reference models, standardization, applications, watermarking, design and implementation of multimedia system.

Learning activities and teaching methods:

Lectures and course exercise related to multimedia systems (emphasis either on implementation, research or design). Course is passed with final examination and accepted course exercise. In addition group exam for additional points to exam. Course materials and group work instructions are available at OPTIMA.
Further information: http://www.ee.oulu.fi/research/tklab/courses/521488S/

Recommended optional programme components:

recommended courses include basic courses in computer science and mathematics, Operating systems (521453A), Digital Image Processing (521467S), Computer networks (521476S), Software Engineering (521457A) and Knowledge Engineering (521468S).
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Recommended or required reading:

Multimedia Communications: Applications, Networks, Protocols and Standards. F. Halsall, Addison-Wesley 2001, chapters 1-5. Lecture slides provide appendices and show the focus areas in more detail.
Supportive reading **:** Multimedia: Computing, Communications and Applications. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995, chapters 1-6, 9.1.-9.4, 10.1, 11,12 and 15. Open Distributed

Processing and Multimedia. G. Blair and J. Stefani, Addison-Wesley 1998, chapters 2-4 and 8. Principles of Multimedia Database Systems. V. Subrahmanian, Morgan Kaufman 1998, chapters 1,5, 9 and 15. Multimedia: Computing, Communications and Application. R. Steinmetz and K. Nahrstedt, Prentice Hall 1995. Chapters 1-6, 9.1.-9.3, 10.1, 11-13, 15, 17.

521497S: Pattern Recognition and Neural Networks, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521289S Machine Learning 5.0 op

Learning outcomes:

The course provides knowledge of the basic theory and methods of pattern recognition which is a central area of artificial intelligence. Special emphasis is given to statistical classifiers and neural networks.
Learning outcomes: After passing the course, the student can explain the statistical background of pattern recognition and can apply the knowledge on the design and implementation of practical classifiers. The student will be able to derive simple optimal classifiers from the theory and can perform performance evaluation. The student can explain the basics of the Bayesian decision theory and can apply it to derive minimum error classifiers and minimum cost classifiers. The student can apply gradient search methods for finding linear discriminant functions. In addition, (s)he can explain the principles of selected neural networks.

Contents:

Bayesian decision theory, discriminant functions, parametric ja non-parametric classification, feature selection, classifier design and testing, sample classifiers, neural networks.

Learning activities and teaching methods:

Lectures and excersises. Compulsory programming task assignment. Written exam.

Recommended optional programme components:

The basic engineering math courses, programming skills.

Recommended or required reading:

Duda RO, Hart PE, Stork DG, Pattern classification, John Wiley & Sons Inc., 2nd edition, 2001; Haykin S, Neural networks, MacMillan College Publishing Company, 1994 tai 1999; scientific articles, lecture transparencies.

521260S: Representing Structured Information, 5 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Riekki, Jukka Pekka

Opintokohteen kielet: English

Leikkaavuudet:

ay521260S Programmable Web Project (OPEN UNI) 5.0 op

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

Learning outcomes: Upon completing the required coursework, the student is able to read XML-based descriptions; to identify their elements and relations between them. The student is able to evaluate and compare existing descriptions. Moreover, the student is able to design and document descriptions and to implement programs that use existing and self made descriptions. Finally, the student is able to create Web Services that utilize XML representations.

Contents:

XML and XML Schema, parsing XML, XML & Web Services, tools for writing XML, processing XML in programs, implementing programs processing XML.

Learning activities and teaching methods:

Lectures, programming exercises and project work

Recommended optional programme components:

Programming

Recommended or required reading:

Will be announced later

Advanced module signal processing, compulsory courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521404A: Digital Techniques 2, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannu Heusala
Opintokohteen kielet: Finnish

Language of instruction:

In Finnish.

Timing:

Period 1-2.

Learning outcomes:

The goal of the cource is to familiarize students to the professional design flow, design methodology and implementaion options of digital integrated circuits.
Osaamistavoitteet: After the cource students are able to design high level architectures of digital systems and blocks of the system implemented by special hardware (ASIC and FPGA). Students are able to ably design methodologies and tools. Design verification and implementation analysis are emphasised. Students can simulate and model (VHDL modelling and VHDL simulation) digital systems and critically revalue the design also from the implementation's point of view.

Contents:

1. Implementation technologies of digital circuits, 2. Description levels of digital systems, 3. VHDL modelling of digital circuits and systems, 4. System level specification and design, 5. Design of ASICs and FPGAs, 6. High level VHDL synthesis, 7. RTL-VHDL synthesis, 8. Planning of production test of digital ASICs.

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

Voimassaolo: 14.11.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes, Timo Kokkonen

Opintokohteen kielet: English

Leikkaavuudet:

521323S Wireless Communications I 5.0 op

Language of instruction:

In English.

Timing:

Period 1-2.

Learning outcomes:

To learn the information theory as a discipline and its most important applications in information technology in general and in communications engineering in particular.

Learning

outcomes: Upon completing the required coursework, the student is

able to use the

basic

methodology of information theory to calculate the capacity bounds

of communication and data compression systems. The student can

estimate the realisability of given design tasks before

the

execution of the detailed design. What is more, the student can independently search for information and knowledge related to communication engineering, system design and signal processing.

Contents:

Basic concepts, data compression, basics of source coding, channel capacity, capacity of a Gaussian channel, maximum entropy method, rate distortion theory, introduction to network information theory.

Learning activities and teaching methods:

Lectures and self-calculated exercises. The course is passed with final examination.

Recommended optional programme components:

Random signals, Telecommunication Engineering II.

Recommended or required reading:

Parts from Thomas M. Cover & Joy A. Thomas, Elements of Information Theory, 2nd ed. John Wiley & Sons, 1991 ISBN: 0-471-06259-6. Lecture notes.

521280S: DSP Laboratory Work, 5 op

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

Ei opintojaksokuvauksia.

Advanced module signal processing, optional courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses, dodule size approx. 35 cr

521273S: Biosignal Processing, 5 op

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

Language of instruction:

In Finnish.

Timing:

Period 2-3.

Learning outcomes:

The course provides knowledge of most common biomedical signals and signal processing methods that can be used for computerized biomedical signal analysis.

Learning outcomes: After passing the course, the student can explain the importance of artifact filtering, time- and frequency-domains, and nonstationarity for biomedical signal analysis and select a proper solution for most common application situations. In addition, (s)he can explain the central feature detection methods to analyze the contents of biosignals.

Contents:

Biomedical signals. Digital filtering. Time- and frequency-domain analysis, Nonstationarity of biomedical signals. Feature detection and classification. Diagnostic decision.

Learning activities and teaching methods:

Lectures 10 hours + Laboratory exercises 20-30 hours + Written exam

Recommended optional programme components:

The basic engineering math courses, digital filtering, programming skills

Recommended or required reading:

The course is based on the book "Biomedical Signal Analysis, A Case-Study Approach", R.M Rangayyan. 516 pages. +Lecture transparencies
+ Task assignment specific material.

521281S: Application Specific Signal Processors, 5 op

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

Ei opintojaksokuvauksia.

521445S: Digital Techniques 3, 6 op

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

Language of instruction:

In Finnish.

Timing:

Period 3-4.

Learning outcomes:

The goal of the cource is to familiarize students to the professional design flow, design methodology and implementaion options of digital integrated circuits.

Learning outcomes **:** After the cource students are able to design high level architectures of digital systems and blocks of the system implemented by special hardware (ASIC and FPGA). Students are able to ably design methodologies and tools. Design verification and implementation analysis are emphasised. Students can simulate and model (VHDL modelling and VHDL simulation) digital systems and critically revalue the design also from the implementation's point of view.

Contents:

1. Implementation technologies of digital circuits, 2. Description levels of digital systems, 3. VHDL modelling of digital circuits and systems, 4. System level specification and design, 5. Design of ASICs and FPGAs, 6. High level VHDL synthesis, 7. RTL-VHDL synthesis, 8. Planning of production test of digital ASICs.

521320S: Wireless Communications 2, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521395S	Wireless Communications I	5.0 op
521323S	Wireless Communications I	5.0 op

Language of instruction:

In English.

Timing:

Period 1-3.

Learning outcomes:

Understanding of the basic theory and the knowledge of different fields required in digital communication are deepened. Also, communication techniques in fading channels are discussed. An overview of wireless communication systems is given, and ability to design simple communication receivers is created.
Learning outcomes: After completing the course the student can analyze the performance of multilevel digital modulation methods in AWGN channel. She/he can explain the effect of fading channel on the performance of the modulation method and can analyze the performance. She/he recognizes the suitable diversity methods for fading channel and related combining methods. Student can define the basic carrier and symbol synchronization methods and is able to to make the performance comparison of them.
Student can explain design methods signals for bandlimited channels and can classify different channel equalizers, and perform the performance analysis. In addition, the student can utilize channel capacity evaluation for fading channels, he/she recognizes the basic methods for link adaptation and multiantenna communication.

Contents:

Radio channel models, channel capacity, digital modulation method and their performance in AWGN-channel, carrier and symbol synchronization, performance of digital modulation in fading channel, diversity techniques, adaptive modulation and coding, multiantenna techniques and channel equalizers in wireless communication.

Learning activities and teaching methods:

Lectures and exercises in total 4 hours in a week during periods 1-3. The course is given in English. The course is passed with final examination (during lecture periods possibility to pass with intermediate exams) and accepted design exercise. Grade is based on exam.

Recommended optional programme components:

Telecommunication Engineering II. Also recommended: Statistical Signal Processing, Radio Communication Channels.

Recommended or required reading:

Parts of book: Andrea Goldsmith: Wireless Communications, Cambridge University Press, 2005. Parts of J.G. Proakis: Digital Communications, 4th ed, 2001. Also, additional material from other sources.

521373S: Communication Signal Processing I, 6 op

Voimassaolo: 01.08.2004 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juntti, Markku Johannes

Opintokohteen kielet: English

Leikkaavuudet:

521324S	Statistical Signal Processing 2	5.0 op

Language of instruction:

In English.

Timing:

Period 3-4.

Learning outcomes:

Statistical signal processing knowledge is deepened to adaptive signal processing and spectrum estimation.

Learning outcomes: Upon completing the required coursework, the student is able to use the basic methodology of signal processing to design communication systems and their receivers. He or she will be able to design and implement various equaliser algorithms. The student can design linear filters for statistical signal processing applications.

Contents:

Optimal linear filters, spectrum estimation, iterative matrix algorithms, stochastic gradient algorithms, recursive least squares methods

Learning activities and teaching methods:

Lectures and exercises in total 6 hours in two weeks. The course is passed with final examination.

Recommended optional programme components:

Statistical signal processing, Telecommunication Engineering II.

Recommended or required reading:

Parts from: Simon Haykin: Adaptive Filter Theory, 3rd ed. Prentice Hall, 1996. (989 pages) ISBN: 0-13-322760-X. and P. Stoica & R. Moses: Introduction to Spectral Analysis. Prentice-Hall, 1997 (319 pages) ISBN 0-13-258419-0. H. Meyr, M. Moeneclaey & S. A. Fechtel: Digital Communi-cation Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998.

521360S: Communication Signal Processing II, 4 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Jari Iinatti

Opintokohteen kielet: English

Leikkaavuudet:

521325S Synchronisation for Digital Receivers 5.0 op

Language of instruction:

In English.

Timing:

Period 5-6.

Learning outcomes:

Digital communication knowledge is deepened by applying the statistical signal processing techniques to the design of receiver baseband algorithms. The main goal is to learn the principles which are used to optimise the receiver synchronisation and channel estimation methods based on detection and estimation theory.
Learning outcomes: After completing the course the student recognizes the blocks of all-digital receiver and can explain the basis for them. She/he can derive synchronization algorithms for timing, phase and frequency and for joint estimation. He can derive the performance of the algorithms and comparison methods of them. Student can utilize proper interpolation methods for timing estimation. In addition, she/he can utilize and develope algorithms for fading channels.

Contents:

Synthesis and performance of synchronisation algorithms in AWGN channels, frequency estimation, interpolation in synchronisation, synchronisation and channel estimation in fading channels.

Learning activities and teaching methods:

Lectures and exercises in total 6 hours in two weeks during periods 5-6. The course is given in English. A design exercise by Matlab software. The course is passed with final examination and accepted design exercise. Grade is based on exam. Course will be given every second year in uneven year.

Recommended optional programme components:

Statistical Signal Processing, Wireless Communications II. Recommended: Communication Signal Processing I.

Recommended or required reading:

H. Meyr, M. Moeneclaey & S. A. Fechtel, Digital Communication Receivers: Synchronization, Channel, Estimation and Signal Processing. John Wiley, 1998. (Partly).

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: After passing the course the student is able to work as an active, responsible and initiative member of a project group. The student can apply the theoretical knowledge of his/her area in a creative way to solve a practical research problem, implement the methods needed in the work with a programming language, and document the results of the work in the form of a scientific publication.

Contents:

In this course a small-scale research work on information processing is carried our as a part of the activities of a research group. The topics are chosen according to the needs of current research projects. The main emphasis is in developing and applying information processing methods. Implementation of a method in Matlab, C or Java environment is usually required.

Learning activities and teaching methods:

The work is started by getting a short introduction to the goals and activities of the research group, and by agreeing with the advisor about the contents of the given work. Before starting the work, it should be agreed about its different phases, practical implementation and supervision. Typically the work is divided into: studying the theory, programming, testing, preparing the document, and final presentation of the results.

Recommended optional programme components:

A good general success in studies is required. Good programming skill is a plus. Additional conditions can be set on the basis of the given problem.

Recommended or required reading:

Books and scientific articles related to the given research problem.

470444S: Advanced Control Methods, 6 op

Voimassaolo: - 31.07.2010

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Ikonen, Mika Enso-Veitikka, Manne Tervaskanto

Opintokohteen kielet: Finnish

Leikkaavuudet:

477607S Advanced Control and Systems Engineering 5.0 op

Ei opintojaksokuvauksia.

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Guoying Zhao

Opintokohteen kielet: English

Leikkaavuudet:

521140S Computer Graphics 5.0 op

Language of instruction:

In English.

Learning outcomes:

The objective of the course is to supply the student with basic understanding of computer graphics, algorithms and applications.

Learning outcomes: Upon completing the required coursework, the student is able to specify and design 2D graphics algorithms including: line drawing, polygon filling, clipping, and transformations, and 3D computer graphics algorithms including viewing transformations, hierarchical modeling, color, lighting and texture mapping. Moreover, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line drawing, polygon filling, clipping, and transformations, and 3D computer graphics algorithms including viewing transformations, hierarchical modeling, color, lighting and texture mapping; image processing, animation and virtual reality; graphics API (OpenGL) and Virtual Reality Modeling Language (VRML) for implementation.

Learning activities and teaching methods:

The course consists of lectures and several design exercises. The final grade is based on the combined points from exercises and final exam.

Recommended optional programme components:

computer engineering, programming skills using C++

Recommended or required reading:

Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
Edward Angel: Interactive Computer Graphics, 4th, Addison-Wesley 2006
Lecture notes (in English);
Materials in the internet (e.g. OpenGL redbook).

Advanced module intelligent systems, compulsory courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521493S: Computer Graphics, 7 op

Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Guoying Zhao
Opintokohteen kielet: English
Leikkaavuudet:

521140S Computer Graphics 5.0 op

Language of instruction:

In English.

Learning outcomes:

The objective of the course is to supply the student with basic understanding of computer graphics, algorithms and applications.

Learning outcomes: Upon completing the required coursework, the student is able to specify and design 2D graphics algorithms including: line drawing, polygon filling, clipping, and transformations, and 3D computer graphics algorithms including viewing transformations, hierarchical modeling, color, lighting and texture mapping. Moreover, he is able to explain the relationship between the 2D and 3D versions of such algorithms. He also has the necessary basic skills to use these basic algorithms available in OpenGL.

Contents:

The history and evolution of computer graphics; 2D graphics including: line drawing, polygon filling, clipping, and transformations, and 3D computer graphics algorithms including viewing transformations, hierarchical modeling, color, lighting and texture mapping; image processing, animation and virtual reality; graphics API (OpenGL) and Virtual Reality Modeling Language (VRML) for implementation.

Learning activities and teaching methods:

The course consists of lectures and several design exercises. The final grade is based on the combined points from exercises and final exam.

Recommended optional programme components:

computer engineering, programming skills using C++

Recommended or required reading:

Peter Shirley, Michael Ashikhmin, Michael Gleicher, et al. : Fundamentals of Computer Graphics, second edition, AK Peters, Ltd. 2005
Edward Angel: Interactive Computer Graphics, 4th, Addison-Wesley 2006
Lecture notes (in English);
Materials in the internet (e.g. OpenGL redbook).

477505S: Fuzzy-neuromethods in Process Automation, 4 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Process and Environmental Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Esko Juuso

Opintokohteen kielet: Finnish

Leikkaavuudet:

477525S	Computational intelligence in automation	5.0 op
470438S	Fuzzy Sets and Neural Networks in Process Automation	3.5 op

ECTS Credits:

4,0 cr

Language of instruction:

Finnish and English

Timing:

Implementation in 5th period.

Learning outcomes:

Objective: The objective of the course is to provide advanced understanding on the methodologies and applications of intelligent systems, especially in process automation.
Learning outcomes : After the course the student is capable of explaining the concepts of intelligent systems and operation principles of fuzzy set systems, neural networks, neuro-fuzzy systems and genetic algorithms. The student has skills to construct and tune fuzzy models in Matlab-Simulink environment and to explain the operation of these models. The student is able to explain in an integrating way the principle concepts of neural computing and construct neural network models

in Matlab-Simulink environment. The student recognizes the key problems of the data-driven modelling and is able to choose suitable solutions which ensure generalization. The student is able to explain the operation principles of genetic algorithms and to use them in optimization. Moreover, the student is able to describe alternative solutions for dynamic models, hyper plane methods and hybrid solutions. The student can explain the key concepts of cellular automata and evolutionary computation. After the course the student is able to search other relevant programming tools.

Contents:

Modelling, modular and equation based simulation, dynamic simulation, intelligent methods in simulation, simulation in automation, event handling in continuous simulation, simulation of production processes, distributed simulation, integration with other systems, simulation languages and programming tools.

Learning activities and teaching methods:

The course consists of lectures, several exercises, a case study, two seminars and a final report. The case study covers several topics applied in a chosen problem. Each seminar presentation concentrates on a single topic. The final grade is based on the combined points from exercises, case study, seminar and the final report. Final exam is an alternative for the final report. Reports and exams can be done also in English.

Recommended or required reading:

Lecture notes and exercise materials. Material is in Finnish and in English.

Person responsible:

University teacher Esko Juuso

Advanced module intelligent systems, optional courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses, module size apporx. 35 cr

477605S: Digital Control Theory, 4 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Seppo Honkanen
Opintokohteen kielet: Finnish
Leikkaavuudet:

477624S	Control System Methods	5.0 op
470453S	Digital Control Theory	5.0 op

ECTS Credits:

4,0 cr

Language of instruction:

Finnish

Timing:

Implementation in 2nd-3rd periods.

Learning outcomes:

Introducing the computer controlled, sampled data systems. Acquiring the knowledge of designing and tuning discrete-time control systems.
Learning outcomes: After completing the course students can identify the problems of the sampled data systems, and know how to apply discrete time methods for systems analysis and control design.

Contents:

1. Sampled data systems: sampling, Z transformation of signals. 2. Discrete-time modelling: difference equation, shift operator, pulse transfer function, polynomial and state-space description. 3. Analysis of discrete-time systems: z-plane, stability. 4. Discrete-time control design strategies: general RST structure, various pole-zero placement control algorithms, minimum-variance control, model-based control, state-space design methods.

Learning activities and teaching methods:

Lectures and exercises

Recommended optional programme components:

Courses 470602A and 470603A are recommended beforehand.

Recommended or required reading:

Lecturer's note. Landau, I. & Zito, G. (2005) Digital Control Systems, Springer. 485 pp. Åström, K.J. & Wittenmark, B. (1984, 1997) Computer Controlled Systems: Theory and Design. Prentice-Hall International.544 pp.

Assessment methods and criteria:

The course concludes in a written exam; to request an exam in English, contact the lecturer via email beforehand.

Person responsible:

University teacher Seppo Honkanen

521489S: Research Work on Information Processing, 8 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: After passing the course the student is able to work as an active, responsible and initiative member of a project group. The student can apply the theoretical knowledge of his/her area in a creative way to solve a practical research problem, implement the methods needed in the work with a programming language, and document the results of the work in the form of a scientific publication.

Contents:

In this course a small-scale research work on information processing is carried our as a part of the activities of a research group. The topics are chosen according to the needs of current research projects. The main emphasis is in developing and applying information processing methods. Implementation of a method in Matlab, C or Java environment is usually required.

Learning activities and teaching methods:

The work is started by getting a short introduction to the goals and activities of the research group, and by agreeing with the advisor about the contents of the given work. Before starting the work, it should be agreed about its different phases, practical implementation and supervision. Typically the work is divided into: studying the theory, programming, testing, preparing the document, and final presentation of the results.

Recommended optional programme components:

A good general success in studies is required. Good programming skill is a plus. Additional conditions can be set on the basis of the given problem.

Recommended or required reading:

Books and scientific articles related to the given research problem.

802633S: Statistical Pattern Recognition, 10 op

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Mathematical Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Lasse Holmström

Opintokohteen oppimateriaali:

Duda, Richard O. , , 2001
Theodoridis, Sergios , , 2002
Webb, A. R , , 2002

Opintokohteen kielet: Finnish

ECTS Credits:

10 cr

Learning outcomes:

On successful completion of this course, the student will be able to
- describe the most important classical classification and feature extraction methods that are based on continous distributions.
- apply these methods to practical problems.
- derive the mathematical results that motivate some of the classification and feature extraction methods.

Contents:

Pattern recognition consists of measuring and observing natural objects, analysis of these measurements and recognition of objects on the basis this analysis. The course is an introduction to the concepts and theory of statistical pattern recognition which focuses on the automatic, probability theory based classification of objects based on features derived from the measurements.

Person responsible:

Lasse Holmström

521273S: Biosignal Processing, 5 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Advanced Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Tapio Seppänen

Opintokohteen kielet: Finnish

Language of instruction:

In Finnish.

Timing:

Period 2-3.

Learning outcomes:

The course provides knowledge of most common biomedical signals and signal processing methods that can be used for computerized biomedical signal analysis.

Learning outcomes: After passing the course, the student can explain the importance of artifact filtering, time- and frequency-domains, and nonstationarity for biomedical signal analysis and select a proper solution for most common application situations. In addition, (s)he can explain the central feature detection methods to analyze the contents of biosignals.

Contents:

Biomedical signals. Digital filtering. Time- and frequency-domain analysis, Nonstationarity of biomedical signals. Feature detection and classification. Diagnostic decision.

Learning activities and teaching methods:

Lectures 10 hours + Laboratory exercises 20-30 hours + Written exam

Recommended optional programme components:

The basic engineering math courses, digital filtering, programming skills

Recommended or required reading:

The course is based on the book "Biomedical Signal Analysis, A Case-Study Approach", R.M Rangayyan. 516 pages. +Lecture transparencies
+ Task assignment specific material.

470444S: Advanced Control Methods, 6 op

Voimassaolo: - 31.07.2010
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Process and Environmental Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Ikonen, Mika Enso-Veitikka, Manne Tervaskanto
Opintokohteen kielet: Finnish
Leikkaavuudet:

477607S Advanced Control and Systems Engineering 5.0 op

Ei opintojaksokuvauksia.

521264S: Human-Computer Interaction Techniques, 5 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Learning outcomes:

Learning outcomes: A student is able to explain user-computer interaction principles types, mechanisms on the area of smartphones and interoperable smart environments, and the student is able to apply the methods in a creative and innovative way to the selected application areas. After the course the student is able evaluate critically the applicability of interaction techniques and provide solutions to interaction technique design challenges.

Contents:

D esign processes and guidelines to develop professional quality user interfaces. Techniques for physical selection interaction. Techniques for context aware interaction with multitude of context types. Techniques and principles for multimodal interaction (for

example interaction based on mixture of modalities; gesture, graphics, audio, context and touch). Mechanisms for context-based interaction adaptivity.

Learning activities and teaching methods:

Lectures, Seminar presentations , Mandatory design excersice.

Recommended optional programme components:

Required skills: Programming skills, intelligent systems

Recommended or required reading:

Lecture material. Selected scientific publications.

Assessment methods and criteria:

To pass the course accepted written exam and accepted design excersice are required.

Advanced module biomedical information engineering, compulsory courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Obligatory courses

521273S: Biosignal Processing, 5 op

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

Language of instruction:

In Finnish.

Timing:

Period 2-3.

Learning outcomes:

The course provides knowledge of most common biomedical signals and signal processing methods that can be used for computerized biomedical signal analysis.

Learning outcomes: After passing the course, the student can explain the importance of artifact filtering, time- and frequency-domains, and nonstationarity for biomedical signal analysis and select a proper solution for most common application situations. In addition, (s)he can explain the central feature detection methods to analyze the contents of biosignals.

Contents:

Biomedical signals. Digital filtering. Time- and frequency-domain analysis, Nonstationarity of biomedical signals. Feature detection and classification. Diagnostic decision.

Learning activities and teaching methods:

Lectures 10 hours + Laboratory exercises 20-30 hours + Written exam

Recommended optional programme components:

The basic engineering math courses, digital filtering, programming skills

Recommended or required reading:

The course is based on the book "Biomedical Signal Analysis, A Case-Study Approach", R.M Rangayyan. 516 pages. +Lecture transparencies
+ Task assignment specific material.

521107S: Biomedical Instrumentation, 6 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

521093S Biomedical Instrumentation 5.0 op

Ei opintojaksokuvauksia.

Advanced module biomedical information engineering, optional courses

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Advanced Module
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Optional courses, module size approx. 35 cr

521489S: Research Work on Information Processing, 8 op

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

Learning outcomes:

Learning outcomes: After passing the course the student is able to work as an active, responsible and initiative member of a project group. The student can apply the theoretical knowledge of his/her area in a creative way to solve a practical research problem, implement the methods needed in the work with a programming language, and document the results of the work in the form of a scientific publication.

Contents:

In this course a small-scale research work on information processing is carried our as a part of the activities of a research group. The topics are chosen according to the needs of current research projects. The main emphasis is in developing and applying information processing methods. Implementation of a method in Matlab, C or Java environment is usually required.

Learning activities and teaching methods:

The work is started by getting a short introduction to the goals and activities of the research group, and by agreeing with the advisor about the contents of the given work. Before starting the work, it should be agreed about its different phases, practical implementation and supervision. Typically the work is divided into: studying the theory, programming, testing, preparing the document, and final presentation of the results.

Recommended optional programme components:

A good general success in studies is required. Good programming skill is a plus. Additional conditions can be set on the basis of the given problem.

Recommended or required reading:

Books and scientific articles related to the given research problem.

764638S: Basic Neuroscience, 5 op

Voimassaolo: 01.01.2009 -
Opiskelumuoto: Advanced Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

764338A Basic Neuroscience 5.0 op

ECTS Credits:

5 credits

Timing:

3. - 4. spring

Learning outcomes:

Learning outcomes: Student will be able to explain basic oganization and functions of the nervous system.

Contents:

See 764338A Basic Neuroscience

Person responsible:

Mikko Vähäsöyrinki

750340A: Basics of bioinformatics, 3 op

Voimassaolo: - 31.07.2016
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Biology
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruokonen, Minna Johanna

Opintokohteen kielet: English

Leikkaavuudet:

757314A Basics of bioinformatics 5.0 op

ECTS Credits:

3 cr.

Language of instruction:

Finnish / (English).

Timing:

B.Sc. studies, 2 nd spring.

Learning outcomes:

After the course the student knows and is able to use the basic methods for handling the nucleotide and protein sequences. The aim is that the student learns how to use the databases, understands the background and principles of the analytic methods, is able to take up a critical attitude towards the used methods and gets a good background for applying new methods that are developed continuously.

Contents:

Searching of material from the databases, inferring the function of a gene and structure of a protein based on sequence data, comparing the sequences and evaluating the differences between them as well as examining the evolution history of the genes.

Learning activities and teaching methods:

12 h lectures, 2 h seminar, 20 h exercises, independent work.

Target group:

BT: compulsory, recommended for all biologists. Suitable also for biochemists.

Recommended optional programme components:

Course Concepts of genetics (753124P) compulsory, also Molecular evolution (753327A) is recommended.

Recommended or required reading:

Mount, D.W. 2000: Bioinformatics, sequence and genome analysis. Cold Spring Harbor Laboratory Press, 564 p.

Assessment methods and criteria:

Reports, seminar presentation.

Grading:

1-5 / Fail

Person responsible:

Dr. Minna Ruokonen.

080910A: Applied Diagnostic Radiology, 4 op

Voimassaolo: - 31.07.2016

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Institute of Health Sciences

Arvostelu: 1 - 5, pass, fail

Opettajat: Koivula, Kalle Antero

Opintokohteen kielet: Finnish

ECTS Credits:

4 credits

Language of instruction:

Finnish

Timing:

Master studies, autumn-spring

Learning outcomes:

Learning outcomes: The student can explain the basic principles of medical imaging technoqies, possibilities of use and limitations. The student can define how and by what conditions are required to produce an image with acceptable diagnostic quality and what features are essential for interpreting images.

Contents:

Course gives insight to radiological work (conventional X-rays, computed tomography, ultrasound examinations, magnetic resonance imaging and radiological operations). Seminars include radiological examinations from the technical point of view combining technical and medical knowledge.

Learning activities and teaching methods:

Lectures 20 hrs. Seminars and demonstrations 20 hrs. Selected lectures from the course 080602A (see the ECTS guide for the Faculty of Medicine). Final exam.

Recommended or required reading:

S Soimakallio (ed), L Kivisaari, H Manninen, E Svedström, O Tervonen. Radiologia, WSOY, 2005.

Assessment methods and criteria:

Seminar presentation and final exam are graded 1–5 or fail. Seminar grade is weighted as 2/3 and final exam grade as 1/3 in the final grade.

Grading:

1-5 or fail.

Person responsible:

Doc Antero Koivula

Other information:

This course is a part of specialization Medical Engineering. For more information, please contact Dr Pasi Pulkkinen.

080901A: Introduction to Technology in Clinical Medicine, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Institute of Health Sciences

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

ECTS Credits:

6 credits

Language of instruction:

Finnish

Timing:

2nd year, autumn-spring

Learning outcomes:

Learning outcomes: The student can list technologies in different fields of medical technology, can describe the working principle of these technologies and evaluate the advantages and limitationc of the technologies.

Contents:

Course introduction lectures. Specialists from different clinical areas give lectures and demonstrations, in which main themes and terms of the field are introduced and technical equipment and methods are presented.

Learning activities and teaching methods:

Initial exam. Lectures 35 hours, demonstrations 30 hours, written work. Final exam.

Assessment methods and criteria:

Initial exam and written work. Taking part in the lectures and demos. Written final exam.

Grading:

1-5 or fail.

Person responsible:

Professor Miika Nieminen

764103P: Introduction to biophysics, 2 op

Voimassaolo: 01.08.2009 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

764163P-02 Basic biophysics (part 2) 0.0 op

764163P Basic biophysics 5.0 op

764163P-01 Introduction to Biomedical Physics (part 1) 0.0 op

ECTS Credits:

3 credits

Language of instruction:

Finnish

Timing:

1st spring

Learning outcomes:

Learning outcomes: Acquiring basic knowledge of biophysics useful in more advanced courses.

Contents:

The course gives knowledge of basic biological processes from biophysics point of view. The focus is on cellular and molecular mechanisms but also includes introduction to the biophysics of movement and fluid flow phenomena and some other more specialized topics.

Learning activities and teaching methods:

Lectures 21 h.

Target group:

Students in Physics B.Sc. program (obligatory) and students aiming for Biophysics minor.

Recommended optional programme components:

None. This course is a good starting point for other studies in the field of Biophysics.

Recommended or required reading:

Lectures and lecture notes.

Assessment methods and criteria:

Written examination.

Person responsible:

Kyösti Heimonen, Marja Hyvönen and Matti Weckström

Other information:

https://wiki.oulu.fi/display/764103P/

521013A: Advanced Practical Training, 3 op

Opiskelumuoto: Intermediate Studies
Laji: Practical training
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

521027S Advanced practical training 5.0 op

Voidaan suorittaa useasti: Kyllä

Ei opintojaksokuvauksia.

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

Opiskelumuoto: Advanced Studies
Laji: Diploma thesis
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Basic and Intermediate Studies
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Second domestic language

901008P: Second Official Language (Swedish), 2 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Language Centre
Opintokohteen kielet: Swedish
Leikkaavuudet:

ay901008P Second Official Language (Swedish) (OPEN UNI) 2.0 op

Ei opintojaksokuvauksia.

900009P: Second Official Language (Finnish), 2 op

Voimassaolo: 01.08.1995 -
Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Language Centre
Opintokohteen kielet: Finnish

Compulsory studies

030001P: Orientation Course for New Students, 1 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Faculty of Technology
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

477000P Planning of Studies and Career 1.0 op

ECTS Credits:

1 crecit.

Language of instruction:

Finnish.

Timing:

1-3 period.

Learning outcomes:

Upon completion of the course, students will be familiar with the university and the structure of the degree programme. They will be able to gain the tools they need for their studies and the planning of them. Learning outcome: After the course the student is able to recognize his/her own study environment and can make use of the student services of the university. The course provides with skills to draft individual study plan and gives information about different methods of studying. The student can describe some specific professional aspects in the field of architecture or engineering and he/she is also able to use the facilities of academic libraries.

Contents:

Introduction to studies. Overview of the services offered by the university, student organizations and the Finnish social system (f.eg. student financial aid, academic sports services, student health services). Introduction to the University and the Faculty and their administration, degrees and studies at the Faculty of Technology. Overview of the professional aspects in the fields of engineering and architecture and job prospects. Introduction to the methods of studying and to the skills in gaining the tools needed for planning of the studies. Overview of library services, Oula - library catalogue and Nelli - e-resources.

Learning activities and teaching methods:

1. Orientation day for all new students organized by the Faculty of Technology. 2. Orientation to the degree programmes organized by the departments. 3. Student tutoring during the autumn term. Groups are formed during the degree programme orientation. 4. Information on areas of specialization within the degree programmes (during the 2 nd or 3 rd year). 5. Orientation (2 hours) to the library and Oula - library catalogue and Nelli - e-resources at the Science and Technology Library Tellus. Participation in orientations 1, 2 and 5 and min. 5 student tutorials are required for completion of the course.

Grading:

Pass/fail.

Person responsible:

Chief academic officer of the faculty, study advisors of the departments, library.

030005P: Information Skills, 1 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Faculty of Technology
Arvostelu: 1 - 5, pass, fail

Opettajat: Sassali, Jani Henrik, Koivuniemi, Mirja-Liisa

Opintokohteen kielet: Finnish

Leikkaavuudet:

030004P Introduction to Information Retrieval 0.0 op

ECTS Credits:

1 credit.

Language of instruction:

Finnish/English

Timing:

2nd or 3rd year.

Learning outcomes:

Students know the different phases of information retrieval process and basic techniques of scientific information retrieval. They will find the most important reference databases of their discipline and know how to evaluate information sources and retrieval results.

Contents:

Retrieval of scientific information, the retrieval process, key databases of the discipline, and evaluation of information retrieval and information sources.

Learning activities and teaching methods:

The course involves training sessions (8h), web-based learning materials, exercises in the Optima learning environment and a final assignment on a topic of the student's own choice.

Recommended or required reading:

Web-based learning material from Toolbox of Reseach (https://wiki.oulu.fi/display/tor/1.1+Finding+scientific+information)

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:

Science and Technology Library Tellus, tellustieto (at) oulu.fi http://www.kirjasto.oulu.fi/index.php?id=738

Other information:

http://www.kirjasto.oulu.fi/index.php?id=738

902011P: Technical English 3, 6 op

Voimassaolo: 01.08.1995 -

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Language Centre

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Proficiency level:

CEFR B2 - C1

Language of instruction:

English

Target group:

Students of all Engineering Departments (902011P Tekniikan englanti 3)
Students of the Department of Architecture (902011P Tekniikan englanti 3)

Person responsible:

Each department in the Technical Faculty has its own Language Centre contact teacher for questions about English studies.

Other information:

See the Language Centre Study Guide, English, TTK

031010P: Calculus I, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay031010P Calculus I (OPEN UNI) 5.0 op

ECTS Credits:

5 cp

Language of instruction:

Finnish

Timing:

Period 1-3

Learning outcomes:

The course gives the basics of vector algebra, analytic geometry, elementary functions and differential and integral calculus of real valued functions of one variable. Learning outcomes : After completing the course the student identifies concepts of vector algebra and can use vector algebra for solving problems of analytic geometry. The student can also explain basic characteristics of elementary functions and is able to analyse the limit and the continuity of real valued functions of one variable. Furthermore, the student can solve problems associated with differential and integral calculus of real valued functions of one variable.

Contents:

Vector algebra and analytic geometry. Limit, continuity, differential and integral calculus and applications of real valued functions of one variable. Complex numbers.

Learning activities and teaching methods:

Term course. Lectures 5 h/week.

Recommended or required reading:

Grossmann, S.I.: Calculus of One Variable; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations (partly); Adams, R.A.: A Complete Course Calculus (partly).

031011P: Calculus II, 6 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Ilkka Lusikka

Opintokohteen kielet: Finnish

Leikkaavuudet:

031075P Calculus II 5.0 op

ay031011P Calculus II (OPEN UNI) 6.0 op

Language of instruction:

Finnish

Timing:

Period 4-6

Learning outcomes:

The course gives the basics of theory of series and differential and integral calculus of real and vector valued functions of several variables.
Learning outcomes **:** After completing the course the student is able to examine the convergence of series and power series of real terms and estimate the truncation error. Furthermore, the student can explain the use of power series e.g. in calculating limits and approximations for definite integrals and is able to solve problems related to differential and integral calculus of real and vector valued functions of several variables.

Contents:

Sequences, series and power series of real terms. Differential and integral calculus of real and vector valued functions of several variables.

Learning activities and teaching methods:

Term course. Lectures 5 h/week.

Recommended optional programme components:

Calculus I.

Recommended or required reading:

Kreyszig, E.: Advanced Engineering Mathematics; Grossmann, S.I.: Multivariable Calculus, Linear Algebra and Differential Equations.

031019P: Matrix Algebra, 3,5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Matti Peltola
Opintokohteen kielet: Finnish
Leikkaavuudet:

031078P	Matrix Algebra	5.0 op

Language of instruction:

Finnish

Timing:

Period 1-3

Learning outcomes:

The course gives the elementary theory of linear equations, matrices and vector spaces. The eigenvalues and eigenvectors with applications are introduced.
Learning outcomes **:** After completing the course the student is able to apply arithmetic operations of matrices. He can solve system of linear equations by matrix methods and can apply iterative methods to _nd the solution of the system of linear equations. The student is able to recognise the vector space and can relate the consepts of linear transform and matrix. He can analyse matrices by the parameters, vectors and vector spaces of matrices. The student is able to diagonalize matrices and apply diagonalization to the simple applications.

Contents:

Vectors and matrices. Systems of linaer equations. Vector spaces and linear transformations. The rank, nullity, row space and the column space of a matrix. The determinant of a matrix. Eigenvalues and eigenvectors of a matrix. The diagonalization with applications. The iterative methods of solving linear system of equations. The theorems of Gershgorin and Cayley- Hamilton.

Learning activities and teaching methods:

Term course. Lectures 4 h/week. Two examinations or final examination.

Recommended or required reading:

Grossman, S.I. : Elementary Linear Algebra.

031021P: Probability and Mathematical Statistics, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Jukka Kemppainen
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay031021P Probability and Mathematical Statistics (OPEN UNI) 5.0 op

Language of instruction:

Finnish

Timing:

Period 4-6

Learning outcomes:

The course provides the student the fundamental knowledge of the basic concepts of probability, random variables, management of statistical material, hypothesis testing and estimation methods. Learning outcomes **:** After completing the course the student is able to use the basic concepts of probability and most important random variables and is also able to apply these to calculate probabilities and expected values. The student is also able to analyze statistical material by calculating confidence intervals, formulating and testing hypotheses and by performing maximum likelihood estimations.

Contents:

Basic concepts of probability, conditional probability, discrete and continuous random variables and their distributions, expectation and variance, joint distributions, central limit theorem, elements of statistics, interval of confidence, hypothesis testing, maximum likelihood estimation.

Learning activities and teaching methods:

Term course. Lectures 4 h/week. Two examinations or a final examination.

Recommended optional programme components:

Calculus I and Calculus II.

Recommended or required reading:

Milton J.S. and Arnold J.C.: Introduction to Probability and Statistics, McGraw-Hill (1992).

031018P: Complex Analysis, 4 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruotsalainen Keijo
Opintokohteen kielet: Finnish
Leikkaavuudet:

031077P Complex analysis 5.0 op

Language of instruction:

Finnish

Timing:

Period 1-2

Learning outcomes:

The objective of the course is to supply the student with basic understanding of the use of complex numbers and complex functions in various applications of technics, especially in signal processing.
Learning outcomes **:** Upon completing the required coursework, the student is able to apply complex numbers and functions to modeling, solving and analysing of problems arising in technics, especially in signal processing. The student also knows how to use mapping properties and differential and integral calculus of complex functions in applications of technics .

Contents:

Complex numbers, complex exponential function and discrete linear system, mapping properties of complex functions, differential calculus, conformal mapping, integral calculus, Cauchy formula, residue, residue calculus, Möbius transformation, applications to signal processing.

Learning activities and teaching methods:

Term course. Lectures 4 h/week. Two intermediate exams or a final examination.

Recommended optional programme components:

Calculus I.

Recommended or required reading:

Lecture notes and exercise materials. Kreyszig, E.: Advanced Engineering Mathematics; Spiegel **:** Complex Variables; Lang: Complex Analysis.

031023P: Mathematical Structures for Computer Science, 5 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Mathematics Division

Arvostelu: 1 - 5, pass, fail

Opettajat: Matti Peltola

Opintokohteen kielet: Finnish

Leikkaavuudet:

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

Language of instruction:

Finnish

Timing:

Period 1-2

Learning outcomes:

The course gives the elementary theory of logic, predicate logic and multi-valued logic as well as basic theory of set theory and number theory. The automata theory and the theory of formal languages is introduced.
Learning outcomes **:** After completing the course the student is able to apply result of logic to _nd the truth value of logical statement. He can express sentences of natural language by symbols of logic. He can use arithmetic operations on different number bases. The student is able to apply formal methods of discrete mathematics to model simple information processing problems.

Contents:

Elementary logic. Mathematical induction. Boolean algebra and set theory. Theory of automata and formal languages. Some graph theory.

Learning activities and teaching methods:

course. Lectures 4 h/week. Two examinations or a _nal examination.

Recommended or required reading:

Rosen K.H.: Discrete Mathematics and Its Applications. Gersting J.L.: Mathematical Structures for Computer Science.

031050A: Signal Analysis, 4 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

031080A	Signal Analysis	5.0 op

Ei opintojaksokuvauksia.

031017P: Differential Equations, 4 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Hamina, Martti Aulis
Opintokohteen kielet: Finnish
Leikkaavuudet:

800320A	Differential equations	5.0 op
031076P	Differential Equations	5.0 op

Language of instruction:

Finnish

Timing:

Period 4-6

Learning outcomes:

The students learn the concepts concerning differential equations and get the ability to read associated literature. The students will achieve adequate mathematical skills for treating differential equations. They can identify simple analytically solvable differential equations and they can solve these by using various methods.
Learning outcomes: The students can apply differential equations as a mathematical model. They can identify and solve various differential equations and they have knowledge on basic solvability of differential equations. The student can use the Laplace transform as a solution method.

Contents:

Principles of mathematical modelling. Ordinary differential equations of first and higher order. Laplace transform with applications to differential equations.

Learning activities and teaching methods:

Lectures 3h/week. Two intermediate exams or one final exam.

Recommended optional programme components:

Calculus I.

Recommended or required reading:

Lecture notes in Finnish. Kreyszig. E., Advanced Engineering Mathematics

761101P: Basic Mechanics, 4 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Leikkaavuudet:

761118P Mechanics 1 5.0 op
761118P-01 Mechanics 1, lectures and exam 0.0 op
761118P-02 Mechanics 1, lab. exercises 0.0 op
761111P-01 Basic mechanics, lectures and exam 0.0 op
761111P-02 Basic mechanics, lab. exercises 0.0 op
761111P Basic mechanics 5.0 op
761101P2 Basic Mechanics 4.0 op

ECTS Credits:

4 credits

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Autumn

Learning outcomes:

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

Contents:

We encounter many phenomena related to mechanics in our everyday life. Most engineering sciences are based on mechanics and mechanics forms the basis of many other fields of physics, also the modern physics.
Contents in brief: Short summary of vector calculus. Kinematics, projectile motion and circular motion. Newton's laws of motion. Work and different forms of energy. Momentum, impulse and collisions. Rotational motion and moment of inertia. Torque and angular momentum. Rigid body equilibrium problems. Gravitation. Periodic motion. Fluid mechanics.

Learning activities and teaching methods:

Lectures 32 h, 8 exercises (16 h).

Target group:

Secondary subject students.

Recommended optional programme components:

Knowledge of vector calculus and basics of differential and integral calculus would be desirable.

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12th edition, 2008, chapters 1-14. Also 11th and 10th editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.
Course material availability can be checked here.

Assessment methods and criteria:

Four mini examinations and end examination or final examination.

Grading:

Scale 1-5 / fail

Person responsible:

Anita Aikio

Other information:

https://wiki.oulu.fi/display/761101P/

761102P: Basic Thermodynamics, 2 op

Opiskelumuoto: Basic Studies
Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

766348A	Thermophysics	7.0 op
766328A	Thermophysics	6.0 op

ECTS Credits:

2 credits

Language of instruction:

Finnish

Timing:

Every Fall term

Learning outcomes:

The student will learn to recognize and understand ordinary thermodynamic phenomena taking place around us as well as to take them into account and utilize them, for instance, in designing devices and buildings.

Contents:

We cover the basics of temperature, heat and thermal properties of matter both in macroscopic and microscopic levels. Topics in detail: Temperature, thermometers, heat, thermal properties of matter (e.g. thermal expansion, specific heat, phase changes), equations of state, the laws of thermodynamics, heat engines (e.g. internal-combustion engine), refrigerators, the Carnot cycle, entropy.

Learning activities and teaching methods:

Lectures 16 h, 4 exercises (8 h).

Target group:

For students with physics as a minor subject.

Recommended or required reading:

Young and Freedman; University Physics, Addison Wesley (Edition 10, Chapters 15-18, or Editions 11-12, Chapters 17-20). Similar material can also be found in H. Benson: University physics, Wiley & Sons, New York (Chapters 18-21).
Lecture notes: Basic thermodynamics (in Finnish) by K. Mursula.
Course material availability can be checked here.

Assessment methods and criteria:

2 intermediate examinations (in Fall) or final examination.

Grading:

Scale 1-5 / fail

Person responsible:

Ville-Veikko Telkki

Other information:

https://wiki.oulu.fi/display/761102P/

761103P: Electricity and Magnetism, 4 op

Opiskelumuoto: Basic Studies

Laji: Course

Vastuuyksikkö: Department of Physics

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

761119P	Electromagnetism 1	5.0 op
761119P-01	Electromagnetism 1, lectures and exam	0.0 op

761119P-02 Electromagnetism 1, lab. exercises 0.0 op
761113P-01 Electricity and magnetism, lectures and exam 0.0 op
761113P-02 Electricity and magnetism, lab. exercises 0.0 op
761113P Electricity and magnetism 5.0 op
766319A Electromagnetism 7.0 op

ECTS Credits:

4 credits

Language of instruction:

The lectures will be in Finnish. The textbook is in English and exercises are selected from the textbook. For further information, contact the responsible person of the course.

Timing:

Spring

Learning outcomes:

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

Contents:

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

Learning activities and teaching methods:

Lectures 32 h, 6 exercises (12 h).

Target group:

Secondary subject students.

Recommended optional programme components:

Knowledge of vector calculus and basics of differential and integral calculus are needed.

Recommended or required reading:

Text book: H.D. Young and R.A. Freedman: University physics, Addison-Wesley, 12th edition, 2008, chapters 21-31. Also 11th and 10th editions can be used.
Lecture material: Finnish lecture material will be available on the web page of the course.

Assessment methods and criteria:

Four mini examinations and end examination or final examination.

Person responsible:

Anita Aikio

Other information:

https://wiki.oulu.fi/display/761103P/

761104P: Wave Motion, 3 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Physics
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

761310A Wave motion and optics 5.0 op
761310A-01 Wave motion and optics, lectures and exam 0.0 op

761310A-02 Wave motion and optics, lab. exercises 0.0 op
761114P-01 Wave motion and optics, lectures and exam 0.0 op
761114P-02 Wave motion and optics, lab. exercises 0.0 op
761114P Wave motion and optics 5.0 op

ECTS Credits:

3 credits

Language of instruction:

Lectures and exercises in Finnish. Material in English.

Timing:

Spring

Learning outcomes:

Learning outcomes: The student can classify different types of wave motions and can name the characterizing quantities (wavelength, period, wave speed), can apply geometrical optics to simple mirror and lens systems, can explain the meaning of interference and diffraction and their applications, like using interference to determine wavelength of radiation.

Contents:

Basic course on wave motion, and geometric and wave optics.
Wave motion and propagation. Acoustics. Geometric optics: basic principles, mirrors and lenses. Electromagnetic waves. Wave optics: interference, diffraction, and polarization. Optical instruments. Photometry. Laser.

Learning activities and teaching methods:

Lectures 32 h, exercises 10 h.

Target group:

For students of minor subject.

Recommended optional programme components:

Upper secondary school physics and mathematics.

Assessment methods and criteria:

Four mini examinations and one end examination or a final examination.

Person responsible:

Sami Heinäsmäki

Other information:

https://wiki.oulu.fi/display/761104P/

521412A: Digital Techniques 1, 6 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical and Information Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Antti Mäntyniemi
Opintokohteen kielet: Finnish
Leikkaavuudet:

521301A Digital Techniques 1 8.0 op

Language of instruction:

In Finnish.

Timing:

Period 5-6.

Learning outcomes:

After having completed the coursest student are expected to understand functional principles, implementation options, and logic design principles of the most usual digital equipmet.
Learning outcomes: After the course, students are able to ably binary number system and Boolean algebra in the form of switching algebra to the design and functional analyze of simple digital circuits. In addition, they are also able to use in their designs graphical symbols specified in the dependency notation standard (SFS4612 ja IEEE/ANSI Std.91-1991) and different descriptions of function and structure of state machines. Based on this knowledge, students are able to implement and analyze digital devices consisting of ordinary simple digital components, especially FPGA circuits. After having assimilated the basic knowledge of digital technique, students are able to understand also the function and structure of micro controllers and micro processors.

Contents:

Boolean algebra, number notations, analyze and synthesis of combinatorial circuits, flip-flops, principles of state machine behavior, CPLD- and FPGA-circuits, physical characteristics of CMOS technology.

Learning activities and teaching methods:

Kurssissa tutustutaan luennoilla ja harjoituksissa konkreettisten esimerkkien kautta nykyaikaisten digitaalieteknisten laitteiden toimintaan ja rakenteeseen. Kurssiin sisältyy luennot ja laskuharjoitukset. Opintojakso suoritetaan loppukokeella. Kurssiin liittyy Ohjelmoitava elektroniikka -kurssi, jolle osallistuminen edellyttää Digitaalitekniikka I -kurssin sisällön hallintaa.

Recommended or required reading:

Brown, S., Vranesic, Z. Fundamentals of Digital Logic with VHDL Design, McGraw Hill, 2005

521109A: Electrical Measurement Principles, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Saarela

Opintokohteen kielet: Finnish

Language of instruction:

Lectures are in Finnish. Laboratory exercises can be done in English.

Timing:

Periods 4-6.

Learning outcomes:

The goal of this course is to give the theoretical and practical basis on electrical measuring techniques and to give basic knowledge to later studies. The course will also provide knowledge to use of general electrical measurement equipment.
Learning outcomes: Upon completion of the course, students are be able to measure basic measurements with a ammeter, voltmeter and oscilloscope. They can estimate the validity of their measurements.

Contents:

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

Learning activities and teaching methods:

Lectures and laboratory exercises. One or two exams and passed lab exercises.

Recommended optional programme components:

Calculus I and II, Physics S.

Recommended or required reading:

A.D. Helfrich, W.D. Cooper: Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1990., material from Optima.

521141P: Elementary Programming, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Riekki, Jukka Pekka
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521141P Elementary Programming (OPEN UNI) 5.0 op

Voidaan suorittaa useasti: Kyllä

Language of instruction:

Finnish.

Timing:

Period 1-3.

Learning outcomes:

Learning outcomes: Upon completing the required coursework, the student is able to recognize the basic programming concepts and structures. Moreover, the student is able to implement small programs.

Contents:

History of programming, basic concepts of programming, basic structures of programming languages, solving problems by programming

Learning activities and teaching methods:

Lectures, many programming exercises

Recommended or required reading:

Will be announced later

521267A: Computer Engineering, 4 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Janne Haverinen
Opintokohteen kielet: Finnish
Leikkaavuudet:

810122P Computer Architecture 5.0 op

Learning outcomes:

The aim of the course is to provide basic understanding to the operation of a digital computer, and to provide basic knowledge for programming using a symbolic programming language. Learning objectives: After passing the course, student can explain the basic operation principle of a computer, the phases of an instruction execution, and an interrupt mechanism. The student can explain the basic organization of a computer including CPU, ALU, memory, I/O device, bus, and a register. The student can describe some basic operations of a computer using a register transfer language, and explain the role of instruction format as a part of the control logic. The student can perform conversions between number systems such as decimal, binary and hexadecimal systems. The student can use and interpret the basic data representations used in a digital computer such as integers, fixed point numbers, floating point numbers, and ASCII symbols. The

student can explain the arithmetic operations performed using two's complement, the basic principles of a RISC architecture, and the connection of these principles to the performance of the computer. The student can explain a typical memory organization and terms like address space, cache memory, and virtual memory. The student can explain the principles of asynchronous communication, and the operation of the assembler. The student can create small programs using an assembly language.

Contents:

Computer organization and architecture, the operation principle of a computer, register transfer language, data types, interrupt, I/O devices, and memory organization. Assembly language and the operation of an assembler.

Learning activities and teaching methods:

Lectures, programming exercise, and exam.

Recommended optional programme components:

Digital Techniques I

Recommended or required reading:

Mano M., Computer System Architecture. Prentice Hall, Englewood Cliffs, New Jersey 1993; Patterson D., Hennessy J., Computer Organization and Design. Morgan Kauffman, San Fracisco, CA, 2005.

521150A: Introduction to Internet, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

521142A: Embedded Systems Programming, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Riekki, Jukka Pekka
Opintokohteen kielet: Finnish
Voidaan suorittaa useasti: Kyllä

Language of instruction:

Finnish.

Timing:

Period 4-6.

Learning outcomes:

Learning outcomes: Upon completing the required coursework, the student is able to implement small C programs both in PC environment and for embedded systems with memory-mapped I/O. Moreover, the student is able to recognize how embedded systems programming differs from programming general-purpose computers.

Contents:

Basics of C, bitwise operations, memory management, memory-mapped I/O devices, hardware registers, interrupts

Learning activities and teaching methods:

Lectures, many programming exercises

Recommended optional programme components:

Elementary programming

Recommended or required reading:

Will be announced later

521457A: Software Engineering, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Leikkaavuudet:

ay521457A Software Engineering (OPEN UNI) 5.0 op

Learning outcomes:

The purpose of this course is to give an overview of software development related to real-time systems.

Learning outcomes: After finishing the course, the student knows the basic concepts of software and real-time systems, the different areas of project management, the phases of software development and the goals and tasks of them, is able to use structural methods for defining systems and knows the principles of object-oriented design and analysis. After the course, the student has basic knowledge of utilizing software tools for structural analysis and design.

Contents:

Problematics of software development and the special features of real-time systems in this regard. Software development is viewed in regard to project management and actual implementation: 1. process models, 2. requirements specification, 3. project management basics:
design, metrics, risk management, resource management, followup, quality control, product control, 5. structural analysis and design, 5. software testing methods and strategies, 6. introduction to object-oriented analysis and design.

Learning activities and teaching methods:

The course consists of lectures and a laboratory design exercise.
The course is completed by a final exam and a successfully completed exercise.

Recommended optional programme components:

Introduction to Programming

Recommended or required reading:

R.S. Pressman: Software Engineering - A Practitioner's Approach. Sixth Edition. McGraw-Hill 2005, chapters 1-11, 13-14 and 21-27. Older editions (4th and 5th) can also be used as a reference. In this case the lectures are based on chapters 1-20.

521277A: Embedded Systems, 4 op

Voimassaolo: 01.08.2011 - 31.07.2013

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Janne Haverinen

Opintokohteen kielet: English

Ei opintojaksokuvauksia.

521144A: Algorithms and Data Structures, 6 op

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Riekki, Jukka Pekka
Opintokohteen kielet: Finnish
Leikkaavuudet:

811312A Data Structures and Algorithms 5.0 op

Language of instruction:

Finnish.

Learning outcomes:

Upon completing the required coursework, the student is able to evaluate algorithms and data structures and alternatives for implementing them. Moreover, the student is able to design and implement algorithms and data structures.

Contents:

Data structures, algorithms, complexity.

Learning activities and teaching methods:

Lectures, laboratory exercises, final exercise.

Recommended optional programme components:

Elementary programming, Mathematical Structures for Computer Science.

Recommended or required reading:

Will be announced later.

521453A: Operating Systems, 5 op

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

ay521453A Operating Systems (OPEN UNI) 5.0 op

Language of instruction:

In Finnish.

Learning outcomes:

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

Contents:

Operating system structure and services, process management, process synchronization, deadlocks, memory management, virtual memory, file-systems.

Learning activities and teaching methods:

The course consists of lectures and laboratory work, which includes pre-exercise and guided exercise performed in a group of one or two students in the unix environment. The final grade is based on the final examination and accepted laboratory work.

Recommended optional programme components:

Elementary Programming, Embedded Systems Programming, Computer Engineering

Recommended or required reading:

Lecture notes (in Finnish) and exercise material. Silberschatz A., Galvin P., and Gagne G.: Operating System Concepts, 6th edition (or newer), John Wiley & Sons, Inc., 2003. Chapters 1-12.

521275A: Embedded Software Project, 8 op

Voimassaolo: 01.08.2007 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Röning

Opintokohteen kielet: English

Learning outcomes:

To familiarize students with modern embedded system development with modern methods and tools.
Learning Outcomes: Embedded software project is the final course in the Bachelor's degree. The skills to pass this course have been acquired in precious courses. During the course, students work in groups to implement a program into an embedded system and write a Bachelor's thesis on the work. The subject of the program is not necessarily covered in previous courses.
After completing the course work, students have demonstrated that they can employ their skills in acquiring information to find a feasible solution to a given problem while still addressing the constraints imposed by a given embedded system. The student has shown that they are capable of designing and then implementing the non-trivial solution as a program to the given embedded system. Furthermore, they have demonstrated that they are capable of writing good-quality scientific text, including a literature survey, theory, technical documentation, testing documentation and other necessary chapters to form an acceptable Bachelor's thesis.

Contents:

Development tools, practical application programme for an embedded system.

Learning activities and teaching methods:

Pair project with monitoring meetings and a compulsory exercise.

Recommended optional programme components:

Software Engineering, Embedded Systems, Operating Systems.

Recommended or required reading:

Data periodicals, handouts, handbooks.

521361A: Telecommunication Engineering II, 3 op

Voimassaolo: 01.08.1950 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Kari Heikki Antero Kärkkäinen

Opintokohteen kielet: Finnish

Leikkaavuudet:

521330A Telecommunication Engineering 5.0 op

Language of instruction:

In Finnish.

Timing:

Period 3-4.

Learning outcomes:

To learn the basics of digital transmission systems that are based on amplitude, phase and frequency modulation of a discrete-valued symbol sequence, the influence of transmission channel on system performance, the basics of information and coding theory.
Learning outcomes:
After completing the course student can tell and analyze the essential and optional blocks of a digital communication system both in time and in frequency domain. Student can tell the limitations resulting from transmission channel and can tell various methods to combat such effects. Using simple assumptions, student can analyze system performance mathematically and compare various modulation methods from the viewpoint of system resources. Student can evaluate standards and specifications of communication systems. Student can also apply obtained knowledge for practical system and sub-system design.

Contents:

Basic blocks of a digital transmission system, baseband digital transmission, digital continuous-wave modulations (ASK, MPSK, MFSK), correlation and matched filter receivers, receiver structures and their bit error probability performance with AWGN channel, effect of band-limiting and multipath propagation, basics of information theory, discrete channel models, entropies, source coding, channel capacity, basics of error-correction coding methods.

Learning activities and teaching methods:

Lectures and exercises. A final exam concludes the course.

Recommended optional programme components:

Stochastic Processes

Recommended or required reading:

R.E. Ziemer & W. H. Tranter: Principles of Communications - Systems, Modulation and Noise, 5th edition, 2002, John Wiley & Sons, chapter 7, partially chapters 8 and 10

A452122: Module Preparing for the Option, Information Networks, 10 - 30 op

Voimassaolo: 01.08.2005 -

Opiskelumuoto: Module Preparing for the Option

Laji: Study module

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

812346A: Object Oriented Analysis and Design, 6 op

Voimassaolo: 01.08.2011 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Information Processing Science
Arvostelu: 1 - 5, pass, fail
Opettajat: Iisakka, Juha Veikko
Opintokohteen kielet: Finnish

ECTS Credits:

6 ECTS

Language of instruction:

Finnish

Timing:

Ajoitus: 1. vsk, kevätlukukausi, periodi 4

Learning outcomes:

Objective: The course covers the principles of object orientation as well as object-oriented analysis, design modelling and modelling techniques.

Learning Outcomes: After completing the course the student knows object-oriented analysis, design modelling, modelling techniques and design principles. Moreover, the student is able to analyse and design using these techniques.

Contents:

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.

Learning activities and teaching methods:

Mode of delivery: Lectures 34h, compulsory exercises and assignments 30h, independent work 95h.

Target group:

Target group: Bachelor level students, compulsory

Recommended optional programme components:

Prerequisites: Basic knowledge of programming and information systems analysis and design

Recommended or required reading:

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

Assessment methods and criteria:

Assessment methods: Refer to course web pages

Grading:

1-5

Person responsible:

Juha Iisakka

812347A: Object-Oriented Programming, 6 op

Voimassaolo: - 31.07.2015
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Information Processing Science
Arvostelu: 1 - 5, pass, fail

Opettajat: Ari Vesanen

Opintokohteen kielet: Finnish

ECTS Credits:

6 ECTS

Language of instruction:

Finnish

Timing:

Ajoitus: 2. vsk, syyslukukausi, periodit 1+2

Learning outcomes:

Objective: The course demonstrate the concepts and benefits of object-orientation, such as improved structure, quality and maintainability of software.

Learning Outcomes: After completing the course, a student:

- Can understand the paradigm of the general objectives and techniques, as well as object-oriented programming concepts, the importance of practice and their implementation;
- Is able to apply design patterns with the solutions and understands the creatures, the interface /implementation approach and message passing principles and their importance;
- Is able to apply the inheritance and composition of the diversity, and can remember the Model-View-Controller model of software implementation principles.

Contents:

Contents:

1. Object-orientation
2. C++ language
3. Composition, inheritance and polymorphism
4. Design patterns and Model-View-Controller
5. Generics and object-oriented data structures

Learning activities and teaching methods:

Mode of delivery: Lectures 32h, laboratory exercises 24h, weekly examination and independent work 110h

Target group:

Target group: Bachelor level students, compulsory

Recommended optional programme components:

Prerequisites: Courses **"**Introduction to Programming", "Introduction to Programming Assignment", "Object-oriented Analysis and Design" or similar knowledge

Recommended or required reading:

Study materials:

- Timothy Budd: Introduction to object-oriented programming, 3 rd edition.
- Erich Gamma, Richard Helm, Ralph Johnson & John Vlissides: Design patterns – Elements of reusable object-oriented software.
- Bruce Eckel: Thinking in C++ Volume 1, 2 nd edition.

Assessment methods and criteria:

Assessment methods: Weekly examination (preferred) or final exam + programming assignment

Grading:

1-5

Person responsible:

Ari Vesanen

521316A: Wireless Communications 1, 4 op

Voimassaolo: 01.08.2006 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Opettajat: Matti Latva-aho

Opintokohteen kielet: Finnish

Leikkaavuudet:

521329A	Hands-on Course in Wireless Communication	5.0 op
521307A	Laboratory Exercises on Analogue Electronics	5.0 op
521316S	Broadband Communications Systems	5.0 op

Language of instruction:

English

Timing:

Periods 1-3

Learning outcomes:

The target is to introduce the key transmission technologies used in modern broadband wireless systems and to introduce the most common wireless standards.

Learning outcomes: Upon completing the required coursework, student can distinguish the basic transmission technologies used in the most important commercial wireless communication systems. Furthermore, the student can differentiate and compare the key points behind these technologies, why they are used and what are their advantages and disadvantages. Student can explain how the wireless channel impacts the design of the overall system. The most relevant standards are introduced and explained, so that student can attain information from past and especially the forthcoming wireless standards. Student can also observe and explain the performance of these technologies with variable system and channel parameters through the course laboratory exercise.

Contents:

Wideband radio channels, multiple access techniques, spread spectrum and DS-CDMA techniques, OFDM techniques,UWB techniques, positioning, applications and most common standards.

Learning activities and teaching methods:

Lecturers, lab exercise, final exam

Recommended or required reading:

Defined during the lectures

521495A: Artificial Intelligence, 5 op

Voimassaolo: 01.08.2012 -

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: English

Leikkaavuudet:

ay521495A	Artificial Intellig (OPEN UNI)	5.0 op

Learning outcomes:

The course makes an introduction to basic principles and methods of artificial intelligence.
Learning outcomes: After passing the course the student identifies those problems which can be solved with artificial intelligence methods. The student knows the basic principles of intelligent agents, and how to apply most commonly used search, logic inference and planning methods to solve artificial intelligence problems. The student can also apply some uncertainty based inference methods and simple learning methods based on machine's observations. In addition, the student is able to implement most common

search methods with a programming language.

Contents:

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

Learning activities and teaching methods:

Lectures, programming exercise, and examination.

Recommended optional programme components:

Knowledge of some programming language.

Recommended or required reading:

Russell, S., Norvig, P.: Artificial Intelligence, A Modern Approach, Second Edition, Prentice-Hall, 2003. Syrjänen, M.: Tietämystekniikan peruskurssin luentomoniste (in Finnish). Original lecture slides at: http://aima.eecs.berkeley.edu/slides-pdf/

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Hannuksela, Jari Samuli
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

Language of instruction:

In Finnish.

Timing:

Period 5-6.

Learning outcomes:

The objective of the course is to supply the student with basic understanding of digital signal processing and applications.
Learning outcomes: Upon completing the required coursework, the student is able to specify and design respective frequency selective FIR and IIR filters using the most common methods. He is also able to solve for the impulse and frequency responses of FIR and IIR filters given as difference equations, transfer functions, or realization diagrams, and can present analyses of the aliasing and imaging effects based on

the responses of the filters. Moreover, the student is able to explain the impacts of finite word length in filter design. After the course the student has the necessary basic skills to use signal processing tools available in Matlab environment and to judge the results.

Contents:

1. Introduction, 2. Discrete transforms, 3. Correlation and convolution, 4. Digital filter design, 5. FIR filter design, 6. IIR filter design, 7. Finite word length effects, 8. Multi-rate signal processing, 9. Adaptive filtering.

Learning activities and teaching methods:

The course is based on lectures and design exercises. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.

Recommended optional programme components:

Signals and systems, complex analysis.

Recommended or required reading:

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

031022P: Numerical Analysis, 5 op

Opiskelumuoto: Basic Studies
Laji: Course
Vastuuyksikkö: Mathematics Division
Arvostelu: 1 - 5, pass, fail
Opettajat: Ruotsalainen Keijo
Opintokohteen kielet: Finnish

Language of instruction:

Finnish.

Timing:

Period 4-6

Learning outcomes:

The objective of the course is to provide the mathematical foundations of numerical methods, to analyze their basic theoretical properties (stability, accuracy and computational complexity), and demonstrate their performances on examples.
Learning outcomes **:** The student recognizes what numerical solution methods can be used to solve some spesific mathematical problems, can perform the required steps in the numerical algorithm and is able to perform the error analysis.

Contents:

Numerical linearalgebra. Basics of the approximation theory. Numerical quadratures.Numerical methods for ordinary and partial differential equations.

Learning activities and teaching methods:

Lectures 4h/week. Two intermediate exams or one final exam.

Recommended or required reading:

- K. Ruotsalainen, Numeeriset menetelmät (lecture notes in finnish)
- Faires and Burden; Numerical methods
- A. Quarteroni, R. Sacco and F Salieri; Numerical mathematics

Prequisites: Calculus 1, Calculus 2, Matrix algebra and Differential Equations.

521495A: Artificial Intelligence, 5 op

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

ay521495A Artificial Intellig (OPEN UNI) 5.0 op

Learning outcomes:

The course makes an introduction to basic principles and methods of artificial intelligence.
Learning outcomes: After passing the course the student identifies those problems which can be solved with artificial intelligence methods. The student knows the basic principles of intelligent agents, and how to apply most commonly used search, logic inference and planning methods to solve artificial intelligence problems. The student can also apply some uncertainty based inference methods and simple learning methods based on machine's observations. In addition, the student is able to implement most common search methods with a programming language.

Contents:

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

Learning activities and teaching methods:

Lectures, programming exercise, and examination.

Recommended optional programme components:

Knowledge of some programming language.

Recommended or required reading:

Russell, S., Norvig, P.: Artificial Intelligence, A Modern Approach, Second Edition, Prentice-Hall, 2003.
Syrjänen, M.: Tietämystekniikan peruskurssin luentomoniste (in Finnish). Original lecture slides at: http://aima.eecs.berkeley.edu/slides-pdf/

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521467A Digital Image Processing (OPEN UNI) 5.0 op

Ei opintojaksokuvauksia.

521484A: Statistical Signal Processing, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

521348S Statistical Signal Processing 5.0 op

Ei opintojaksokuvauksia.

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

Voimassaolo: 01.08.2005 -
Opiskelumuoto: Module Preparing for the Option
Laji: Study module
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Ei opintojaksokuvauksia.

Compulsory studies

521302A: Circuit Theory 1, 5 op

Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Electrical Engineering
Arvostelu: 1 - 5, pass, fail
Opettajat: Rahkonen, Timo Erkki
Opintokohteen kielet: Finnish

Language of instruction:

The course and exercises are held in Finnish.

Timing:

Period 5-6.

Learning outcomes:

In this course the student learns to analyse simple DC, AC, and transient circuits. The course gives necessary basic knowledge for all analogue electronics courses (Basics of Electronic Design, Electronics Design I - III, Analog Filters).
Learning Outcomes: After completing the course the student can write and solve a system of equations describing the behaviour of electric circuits, use complex phasor arithmetics to solve the response of circuits driven by sinusoidal signals, solve time responses of circuits, simplify circuit by employing equivalent circuits and series and parallel combinations, and run simple circuit simulations and understands the differences and limitations of different types of analyses.

Contents:

Electric quantities, circuit laws, systematic writing and solving of circuit equations using nodal and mesh analysis, time and frequency response, phasor calculation. Basics of circuit simulation.

Learning activities and teaching methods:

6 hours lectures and exercises per week. Basic circuit simulation exercises. The course is passed by a final exam and the simulation exercises (contact the lecturer for exam in English).

Recommended optional programme components:

Matrix Algebra, Differential Equations.

Recommended or required reading:

Handouts. The same topics are covered in Nilsson, Riedel: Electric Circuits (6th ed., Prentice-Hall 1996), chapters 1-11.

521431A: Principles of Electronics Design, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Electrical Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Juha Kostamovaara

Opintokohteen kielet: Finnish

Language of instruction:

Finnish.

Timing:

Period 1-3.

Learning outcomes:

To give the students all the basic information that all electrical engineers needs about circuit techniques of analogue electronics and internal structure of digital circuits.

Contents:

Analogue and digital circuits, basic amplifier related concepts, operational amplifier, diodes and diode circuits, single stage bipolar- and MOS-transistor amplifiers and how to bias them, small signal modeling and analyzing ac-properties of the amplifiers, internal structures of digital circuits (mainly CMOS), the principles of AD/DA -conversion and principles of VLSI-technology.

Learning activities and teaching methods:

Lectures and exercises. Final exam.

Recommended optional programme components:

Basic knowledge in Circuit Theory (Circuit Theory I). Also, understanding the basic operation of semiconductors helps (Principles of Semiconductor Devices).

Recommended or required reading:

Handout. Sedra, Smith: Microelectronic Circuits (4th edition), chapters 1, 3-5, 10.9, 13 and 14. OR Hambley: Electronics (2nd edition), chapters 1, 2, 3, 4, 5; 6 partially and some parts of other chapters.

521337A: Digital Filters, 5 op

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Department of Computer Science and Engineering

Arvostelu: 1 - 5, pass, fail

Opettajat: Hannuksela, Jari Samuli

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay521337A	Digital Filters (OPEN UNI)	5.0 op

Language of instruction:

In Finnish.

Timing:

Period 5-6.

Learning outcomes:

The objective of the course is to supply the student with basic understanding of digital signal processing and applications.

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

Contents:

1. Introduction, 2. Discrete transforms, 3. Correlation and convolution, 4. Digital filter design, 5. FIR filter design, 6. IIR filter design, 7. Finite word length effects, 8. Multi-rate signal processing, 9. Adaptive filtering.

Learning activities and teaching methods:

The course is based on lectures and design exercises. The design exercises familiarize the students with the methods of digital signal processing using the Matlab software package. The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.

Recommended optional programme components:

Signals and systems, complex analysis.

Recommended or required reading:

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

521467A: Digital Image Processing, 5 op

Voimassaolo: 01.08.2012 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish
Leikkaavuudet:

ay521467A Digital Image Processing (OPEN UNI) 5.0 op

Ei opintojaksokuvauksia.

521032A: Information Engineering Study, 3 - 8 op

Voimassaolo: 01.08.2008 -
Opiskelumuoto: Intermediate Studies
Laji: Course
Vastuuyksikkö: Department of Computer Science and Engineering
Arvostelu: 1 - 5, pass, fail
Opintokohteen kielet: Finnish

Language of instruction:
Finnish/English
Learning outcomes:
In this course the student learns basic research skills by writing a thesis that fulfills the principles scientific reporting. Another objective is to provide deeper knowledge on the given subject area.

Learning outcomes: After the course the student has rudimentary skills for doing a literature study and using it to write a short thesis that fulfills the principles of scientific writing. He can explain the most essential related methods, and he can utilize the terminology of the given subject in written and oral communications. The student is able to tell about good research practices and use them when working in research oriented tasks.

Contents:

The student makes himself familiar with the problems, concepts and methods of the subject area using scientific literature. He may also implement the selected methods and produce own experimental data. The material obtained is then analyzed and represented as a written thesis that follows the guidelines of the diploma thesis when applicable. Special attention is paid to coverage, consistency and clarity of the presentation.

Learning activities and teaching methods:

The subject is selected together with the supervisor. The course includes self-studying and meetings with the supervisor. The thesis can be made also in groups of two students provided that the individual part each student is sufficient and the roles have been clearly specified in the thesis submitted for review. Completing the course requires that the thesis has been accepted.

Recommended optional programme components:

Basic mathematics and related intermediate courses.

Recommended or required reading:

The material is determined based on the subject.

900060A: Technical Communication, 2 op

Voimassaolo: 01.08.2005 - 31.07.2021

Opiskelumuoto: Intermediate Studies

Laji: Course

Vastuuyksikkö: Language Centre

Arvostelu: 1 - 5, pass, fail

Opintokohteen kielet: Finnish

Leikkaavuudet:

ay900060A	Technical Communication (OPEN UNI)	2.0 op
470218P	Written and Oral Communication	3.0 op

Ei opintojaksokuvauksia.