

# Opasraportti

## Open University - Information and Communication Technologies (ICTs) (2019 - 2020)

### Tutkintorakenteisiin kuulumattomat opintokokonaisuudet ja -jaksot

ay031010P: Calculus I (OPEN UNI), 5 op  
 ay031075P: Calculus II (OPEN UNI), 5 op  
 ay031077P: Complex analysis (OPEN UNI), 5 op  
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 521337A-02: Digital filters, partial credit, 0 op  
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 ay521287A: Introduction to Computer Systems (OPEN UNI), 5 op  
 ay521077P: Introduction to Electronics (OPEN UNI), 5 op  
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 ay811103P: Introduction to Software Engineering (OPEN UNI), 5 op  
 ay810136P: Introduction to information processing sciences (OPEN UNI), 5 op  
 ay031078P: Matrix Algebra (OPEN UNI), 5 op  
 ay521453A: Operating Systems (OPEN UNI), 5 op  
 521159P: Principles of Digital Fabrication, 5 op  
 ay031021P: Probability and Mathematical Statistics (OPEN UNI), 5 op  
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### Opintojaksojen kuvaukset

### Tutkintorakenteisiin kuulumattomien opintokokonaisuuksien ja -jaksojen kuvaukset

**ay031010P: Calculus I (OPEN UNI), 5 op****Voimassaolo:** 01.08.2012 -**Opiskelumuoto:** Basic Studies**Laji:** Course**Vastuuyksikkö:** University of Oulu, Open University**Arvostelu:** 1 - 5, pass, fail**Opetus suunnattu:** University of Oulu, Open University**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

031010P    Calculus I    5.0 op

**ECTS Credits:**

5

**Language of instruction:**

Finnish

**Timing:**

Autumn semester, periods 1-3.

**Learning outcomes:**

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

Lectures 55 h / Group work 22 h.

**Target group:**

-

**Prerequisites and co-requisites:**

-

**Recommended optional programme components:**

-

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Intermediate exams or a final exam.

**Grading:**

Numerical grading scale 1-5.

**Person responsible:**

Ilkka Lusikka

**Working life cooperation:**

-

**Other information:**

-

**ay031075P: Calculus II (OPEN UNI), 5 op****Voimassaolo:** 01.08.2016 -**Opiskelumuoto:** Basic Studies**Laji:** Course**Vastuuyksikkö:** University of Oulu, Open University**Arvostelu:** 1 - 5, pass, fail

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031075P Calculus II 5.0 op

**ECTS Credits:**

5

**Language of instruction:**

Finnish

**Timing:**

Spring, period 3

**Learning outcomes:**

The course gives the basics of theory of series and differential and integral calculus of real and vector valued functions of several variables. After completing the course the student is able to examine the convergence of series and power series of real terms. Furthermore, the student can explain the use of power series e.g. in calculating limits and is able to solve problems related to differential and integral calculus of real and vector valued functions of several variables.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 28 h / Group work 28 h.

**Target group:**

-

**Prerequisites and co-requisites:**

The recommended prerequisite is the completion of the course Calculus I.

**Recommended optional programme components:**

-

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Intermediate exams or a final exam.

**Grading:**

Numerical grading scale 1-5.

**Person responsible:**

Ilkka Lusikka

**Working life cooperation:**

-

**Other information:**

-

## ay031077P: Complex analysis (OPEN UNI), 5 op

**Voimassaolo:** 01.08.2018 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opettajat:** Jukka Kemppainen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031077P Complex analysis 5.0 op

**ECTS Credits:**

5 ECTS credits / 135 hours of work

**Language of instruction:**

Finnish

**Timing:**

Fall semester, period 1.

**Learning outcomes:**

After completing the course the student

1. is able to calculate the derivative and the integral of functions of complex variable,
2. understands the concept of analyticity
3. is capable of calculating the contour integrals and using the theory of residues for computing the line integrals, will be able to apply the techniques of complex analysis to simple problems in signal processing.

**Contents:**

Complex numbers and functions, complex derivative and analyticity, complex series, Cauchy's integral theorem, Laurent and Taylor expansions, theory of residues, applications to signal analysis.

**Mode of delivery:**

Face-to-face teaching, Stack(web-based too) exercises.

**Learning activities and teaching methods:**

Lectures 28 h/Exercises 14 h/Self study 93 h.

**Target group:**

The students in the engineering sciences. The other students are welcome, too.

**Prerequisites and co-requisites:**

The recommended prerequisite is the completion of the courses Calculus I and II, Differential Equations.

**Recommended optional programme components:**

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

**Recommended or required reading:**

The lecture notes

**Assessment methods and criteria:**

Intermediate exams or a final exam.

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

**Grading:**

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

**Person responsible:**

Jukka Kemppainen

**Working life cooperation:**

-

## ay811102P: Devices and Data Networks (OPEN UNI), 5 op

**Voimassaolo:** 01.01.2019 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opettajat:** Juustila, Antti Juhani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

811102P    Devices and Data Networks    5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

finnish

**Timing:**

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

**Learning outcomes:**

After completing the course, the student is able to:

- explain the basic structure and the development history of a microprocessor

- identify the core features of microprocessors (word size, clock frequency, power consumption, level of integration, RISC/CISC) and based on these, choose a suitable processor regarding the problem at hand
- describe the different representations of data (binary, hexadecimal, octal) as well as data persistence and presentation formats within a computer as well as in data transmission through networks
- describe the most important peripheral devices, data buses and interfaces (memory, I/O, USB, I2C, SPI)
- explain the principles of using stack and heap memories from the programmer's perspective
- explain the central properties and history of internet and important internet protocols (such as TCP, UDP, HTTP, TLS/SSL, XMPP, DHCP) as well as the layered architecture of protocols
- describe the implications of data networks, such as delays, packet loss and capacity, and understand the effects of these on developing services and applications relying on networks.
- explain the particular features of wireless networks
- identify the basic techniques of utilizing networks when developing services and applications, using some programming language

**Contents:**

Basic structure and development history of microprocessors. Core features of microprocessors (word size, clock frequency, power consumption, level of integration, RISC/CISC). Different representations of data (binary, hexadecimal, octal), data persistence and presentation formats in computers and networks. Peripheral devices, data buses and interfaces (memory, I/O, USB, I2C, SPI). Stack and heap memories. Properties and history of internet and internet protocols, layered architecture of protocols. Impact of data network properties on developing services and applications. Wireless networks. Programming networked applications and services.

**Mode of delivery:**

Blended teaching

**Learning activities and teaching methods:**

Lectures, (20 h), independent studying (30 h), exercises (20 h), demonstrations (20 h), essay (20 h), other active teaching methods and group work (20 h).

**Target group:**

BSc students

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

Lecture material, demonstrations, exercise material and other material and literature announced in the course.

**Assessment methods and criteria:**

Exam (in learning environment), personal portfolio, essay, continuous evaluation.

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Antti Juustila

**ay031076P: Differential Equations (OPEN UNI), 5 op**

**Voimassaolo:** 01.06.2018 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031076P Differential Equations 5.0 op

**ECTS Credits:**

5 ECTS credits / 135 hours of work

**Language of instruction:**

Finnish

**Timing:**

The course is held in the spring, during period 4. It is recommended to complete the course at the 1th spring semester.

**Learning outcomes:**

The students can apply differential equations as a mathematical model. They can identify and solve various differential equations and they have knowledge on basic solvability of differential equations. The student can use the Laplace transform as a solution method.

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 28 h / Group work 22 h / Self-study 85 h.

**Target group:**

1. year students of technical sciences, mathematics and physics.

**Prerequisites and co-requisites:**

The recommended prerequisite is the completion of the course Calculus I.

**Recommended optional programme components:**

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**Recommended or required reading:**

Recommended literature: Kreyszig, E: Advanced Engineering Mathematics;

**Assessment methods and criteria:**

The course can be completed by intermediate exams (2 exams) or by a final exam.

Lue lisää [opintosuoritusten arvostelusta](#) yliopiston verkkosivulta.

**Grading:**

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

**Person responsible:**

Keijo Ruotsalainen

**Working life cooperation:**

-

**Other information:**

-

## 521337A: Digital Filters, 5 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Olli Silven

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay521337A Digital Filters (OPEN UNI) 5.0 op

**ECTS Credits:**

5 ECTS cr

**Language of instruction:**

Finnish, English study material available

**Timing:**

Spring, period 3.

**Learning outcomes:**

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

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

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

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching (Lectures), independent work, group work

**Learning activities and teaching methods:**

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

**Target group:**

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

**Prerequisites and co-requisites:**

031077P Complex Analysis, 031080A Signal Analysis

**Recommended optional programme components:**

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

**Recommended or required reading:**

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

**Assessment methods and criteria:**

The course can be passed either with week exams or a final exam. In addition, the exercises need to be returned and accepted.

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

**Grading:**

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

**Person responsible:**

Olli Silven

**Working life cooperation:**

None.

## 521467A: Digital Image Processing, 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Heikkilä, Janne Tapani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

ay521467A Digital Image Processing (OPEN UNI) 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

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

**Timing:**

Spring, period 4.

**Learning outcomes:**

Upon completion of the course the student:

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

**Contents:**

1. Fundamentals of digital images, 2. Image enhancement in spatial and frequency domains, 3. Image restoration, 4. Color image processing, 5. Wavelets, 6. Image compression, 7. Morphological image processing and 8. Image segmentation.

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

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

**Target group:**

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

**Prerequisites and co-requisites:**

Basic Python programming skills.

**Recommended optional programme components:**

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

**Recommended or required reading:**

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

Lecture notes and exercise

**Assessment methods and criteria:**

The course is completed by passing the exam and homework assignments.

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

**Grading:**

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

**Person responsible:**

Janne Heikkilä

**Working life cooperation:**

None.

### 521337A-02: Digital filters, partial credit, 0 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Partial credit

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Olli Silven

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

### 521337A-01: Digital filters, partial credit, 0 op

**Opiskelumuoto:** Intermediate Studies

**Laji:** Partial credit

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Olli Silven

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

### 521467A-02: Digital image processing, Exercise work, 0 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Partial credit

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Heikkilä, Janne Tapani

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.



## 521467A-01: Digital image processing, exam, 0 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Partial credit

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Heikkilä, Janne Tapani

**Opintokohteen kielet:** Finnish

Ei opintojaksokuvauksia.

## ay521141P: Elementary Programming (OPEN UNI), 5 op

**Voimassaolo:** 01.01.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opettajat:** Mika Oja

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521141P Elementary Programming 5.0 op

**Voidaan suorittaa useasti:** Kyllä

### ECTS Credits:

5

### Language of instruction:

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

### Timing:

Fall, period 1.

### Learning outcomes:

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

### Contents:

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

### Mode of delivery:

Web-based teaching + face-to-face teaching

### Learning activities and teaching methods:

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

### Target group:

1<sup>st</sup> year students of computer science and engineering and electrical engineering and other Students of the University of Oulu.

### Prerequisites and co-requisites:

None.

### Recommended optional programme components:

The course provides a basis for subsequent programming courses.

### Recommended or required reading:

Will be announced at the beginning of the course.

### Assessment methods and criteria:

The course is completed by passing all learning assignments, programming exercises and a final exercise project. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:**

pass/fail.

**Person responsible:**

Mika Rautiainen

**Working life cooperation:**

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**ay521006P: Glimpse into ICT (OPEN UNIV), 2 op****Voimassaolo:** 01.01.2020 -**Opiskelumuoto:** Basic Studies**Laji:** Course**Vastuuyksikkö:** University of Oulu, Open University**Arvostelu:** 1 - 5, pass, fail**Opetus suunnattu:** University of Oulu, Open University**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

521006P Glimpse into ICT 2.0 op

Ei opintojaksokuvauksia.

**ay811177P: Humans as Users and Developers of Information Technology (OPEN UNI), 5 op****Voimassaolo:** 01.08.2015 -**Opiskelumuoto:** Basic Studies**Laji:** Course**Vastuuyksikkö:** University of Oulu, Open University**Arvostelu:** 1 - 5, pass, fail**Opetus suunnattu:** University of Oulu, Open University**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

811177P Humans as Users and Developers of Information Technology 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish.

**Timing:**

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

**Learning outcomes:**

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

**Contents:**

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

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

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

**Target group:**

BSc students.

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Home assignments, individual essay, and optional advanced assignment.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Tonja Molin-Juustila

**ayA325901: Information Processing Science, basic studies (OPEN UNI), 25 op**

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Basic Studies

**Laji:** Study module

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

A325901 Information Processing Science, basic studies 27.0 op

Ei opintojaksokuvauksia.

**ay811168P: Information Security (OPEN UNI), 5 op**

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

811168P Information Security 5.0 op

**ECTS Credits:**

5 ECTS credits/134 hours of work

**Language of instruction:**

Finnish

**Timing:**

1st year, spring semester, period 4

**Learning outcomes:**

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

**Contents:**

1. History and basic structures;
2. The need and concepts of information security;
3. Risk management;
4. Planning of security;
5. Cryptography;
6. Access control;
7. Security protocols;
8. Software security;
9. Implementing information security;
10. Information security maintenance.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

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

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

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

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

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

**Assessment methods and criteria:**

lectures by final exam

**Grading:**

1-5

**Person responsible:**

Juha Kortelainen

**Working life cooperation:**

No

**521160P: Introduction to Artificial Intelligence, 5 op**

**Voimassaolo:** 01.08.2017 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** Computer Science and Engineering DP

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

**Opettajat:** Olli Silven

**Opintokohteen kielet:** English

**Leikkaavuudet:**

ay521160P Introduction to Artificial Intelligence (OPEN UNIV) 5.0 op

**ECTS Credits:**

5 ECTS credits /135 hours of work

**Language of instruction:**

The language of instruction is Finnish with part of the material in English. The course is implemented as exercises done by groups of participants.

**Timing:**

The course is held during the period IV in the Spring semester, and it is recommended for the 1st or 2nd year.

**Learning outcomes:**

Upon completion the student the student will have the elementary skills to identify the potentially applicable artificial intelligence techniques for solving problems. He/she is able to recognize search, regression, classification, and clustering problems, and to explain the use of supervised and unsupervised learning, performance measurements and metrics.

**Contents:**

1. Introduction: the role of artificial intelligence
2. Search methods: artificial intelligence in games
3. Regression methods: learning of causalities
4. Classification methods: recognition of categories
5. Clustering methods: identification of category structure
6. Supervised learning
7. Unsupervised learning

**Mode of delivery:**

The course is implemented face-to-face teaching

**Learning activities and teaching methods:**

Lectures 42h / group work 70 h / elf-study 23 h. The exercises are completed as group work in multi-disciplinary teams.

**Target group:**

The course is suitable for all students, but due to the nature of the exercises some elementary programming skills are needed in each student group.

**Prerequisites and co-requisites:**

No prerequisites

**Recommended optional programme components:**

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

**Recommended or required reading:**

The course is modeled loosely based on the University of Washington's Coursera module "Machine learning foundations: a case study approach"

**Assessment methods and criteria:**

The course utilizes continuous assesment. During the course there are 6 intermediate exams of which 5 best ones will be used in final evaluation. The course includes 5 group exercises of which at least 4 need to be passed. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:**

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

**Person responsible:**

Olli Silvén

**Working life cooperation:**

The course includes guest presentations on the artificial intelligence applications

**ay521287A: Introduction to Computer Systems (OPEN UNI), 5 op**

**Voimassaolo:** 01.08.2016 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521287A Introduction to Computer Systems 5.0 op

**ECTS Credits:**

5 ECTS cr

**Language of instruction:**

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

**Timing:**

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

**Learning outcomes:**

Upon completing the course, the student understands the basics of computer architecture and CPU operation. Student knows number systems and data representations in computer. Student is familiar of I/O operation with

peripheral devices in general. Student is able to implement small programs with the C programming language for general-purpose computers and for embedded systems. Student recognizes how embedded systems programming is different from programming general-purpose computers.

**Contents:**

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

**Mode of delivery:**

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

**Learning activities and teaching methods:**

Lectures (20h), course exercises (10-20h), laboratory exercise (3h) and course project in a group.

**Target group:**

3rd year students of electrical engineering.

**Prerequisites and co-requisites:**

Elementary programming 521141P.

**Recommended optional programme components:**

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

**Recommended or required reading:**

Lecture notes. Mano M., Computer System Architecture. Prentice Hall, 1993. Williams, E.: Make: AVR Programming, Learning to Write Software for Hardware, O'Reilly, 2014.

**Assessment methods and criteria:**

Students complete the course exercises after lectures, participate to the laboratory exercise and complete the course project in a group. Assessment is based on the exercises and the course project. More detailed information on assessment can be found from the course Web page, <https://noppa.oulu.fi/noppa/kurssi/521287a/>. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:**

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

**Person responsible:**

Teemu Leppänen, Mika Rautiainen.

**Working life cooperation:**

No.

**Other information:**

521287A Introduction to Computer Systems replaces course 521142A Embedded systems programming for electrical engineering students.

## ay521077P: Introduction to Electronics (OPEN UNI), 5 op

**Voimassaolo:** 01.08.2015 -

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opettajat:** Jari Hannu

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521077P Introduction to Electronics 5.0 op

**ECTS Credits:**

5 ECTS credits / 132,5 hours of work

**Language of instruction:**

Finnish

**Timing:**

The course is held in the 1st period. It is recommended to complete the course at the 1st autumn semester.

**Learning outcomes:**

1. Student understands the block structures of electronic devices and their signal processing paths.
2. Student can identify the interfaces of analog and digital electronics and the software operations.
3. Student is able to identify and classify electronics components and compare their properties.
4. Students can describe electric conductivity and apply the phenomenon on designing and choosing resistors
5. Student is able to estimate the difference between dielectric materials and how they affect the properties of a capacitor.
6. Student can compare properties of magnetic materials and how identify they effect on inductive components.
7. Student can identify semiconductivity and is able to list typical semiconductor components.
8. Student can classify different circuit board techniques and is able to choose proper coupling techniques.
9. Student can identify the future technologies of electronics materials.

**Contents:**

Structures and interfaces of electronic devices. Electromagnetic properties of materials (conductivity, dielectricity, magnetism and semiconductivity). Electronics components (resistors, capacitors, inductive components and semiconductors). Interconnection technologies and circuit board technologies. The future of electronic materials and application areas.

**Mode of delivery:**

Face-to-face teaching and independent work.

**Learning activities and teaching methods:**

The implementation methods of the course vary. The course will be arranged utilizing activating teaching methods agreed on together with the students. There will be 48 hours of guided teaching events and 84.5 hours of teaching without guidance either privately or in a group.

**Target group:**

First year electrical engineering students.

**Prerequisites and co-requisites:**

No prerequisites.

**Recommended optional programme components:**

-

**Recommended or required reading:**

Lecture material; Materials science and engineering: an introduction / William D. Callister, chapters 1, 18 and 20; Electronic components and technology / S. J. Sangwine. Chapters 1,2,3,5 and 7

**Assessment methods and criteria:**

This course utilizes continuous assessment. During the course, there are two intermediate exams. In addition students will make course work which are graded. The assessment of the course is based on the learning outcomes of the course. Read more about [assessment criteria](#) at the University of Oulu webpage.

**Grading:**

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

**Person responsible:**

Jari Hannu

**Working life cooperation:**

No

**Other information:**

-

**ay811174P: Introduction to Software Business (OPEN UNI), 5 op**

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

811174P Introduction to Software Business 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish

**Timing:**

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

**Learning outcomes:**

After completing the course, a student can:

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

**Contents:**

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

**Mode of delivery:**

Face-to-face teaching.

**Learning activities and teaching methods:**

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

**Target group:**

BSc students.

**Recommended optional programme components:**

-

**Recommended or required reading:**

Course material and related literature.

**Assessment methods and criteria:**

Assignments, take home examination.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Marianne Kinnula

## ay811103P: Introduction to Software Engineering (OPEN UNI), 5 op

**Voimassaolo:** 01.08.2019 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opettajat:** Oivo, Markku Tapani

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

811103P Introduction to Software Engineering 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

Finnish

**Timing:**

The course is held in the autumn semester, during period 2. It is recommended to complete the course at the 1st autumn semester of the Bachelor's studies.

**Learning outcomes:**



Upon completion of the course, the student will be able to:

- Describe the principles, define the key concepts and use professional terminology of software engineering
- Demonstrate an understanding of software engineering as a professional practice and a field of industry
- Be aware and able to work following professional practices that are important for software engineers
- Describe contemporary software processes and choose appropriate ones for specific situations
- Know and is able to apply valid problem identification and structuring methods in software engineering
- Know and is able to apply some contemporary software engineering models, methods and tools
- Shows understanding of the necessity of continuing learning and professional development

**Contents:**

- \* Principles of professional software development
- \* Software processes
- \* Agile software development
- \* Requirements engineering
- \* System modelling
- \* Architectural design
- \* Design and implementation
- \* Software testing
- \* Software evolution

**Mode of delivery:**

Blended teaching

**Learning activities and teaching methods:**

Lectures, group exercises, independent work, 133h

**Target group:**

BSc students

**Prerequisites and co-requisites:**

The required prerequisite is that the learning outcomes of the following courses are accomplished: Introduction to Information Processing Science

**Recommended or required reading:**

Sommerville, Ian (2016). Software Engineering, 10th Edition.

**Assessment methods and criteria:**

Exam, group evaluation, presentation

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Markku Oivo

**Working life cooperation:**

Guest lectures and /or company visits

## ay810136P: Introduction to information processing sciences (OPEN UNI), 5 op

**Voimassaolo:** 01.08.2012 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

810136P Introduction to Information Processing Sciences 5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work.

**Language of instruction:**

Finnish

**Timing:**

The course is held in the autumn semester, during period 1. It is recommended to complete the course at the 1st autumn semester. Another implementation, targeted especially for Open University and minor students, is held in the spring semester, during period 3.

**Learning outcomes:**

After passing the course, a student will be able to

- describe the disciplines of Information Processing Science,
- explain the essential Information Processing Science concepts,
- name historically significant and current research topics in Information Processing Science,
- identify the characteristics and requirements of work tasks in the field of Information Processing,
- retrieve, analyse, contest and classify information related to those, as well as
- discuss and report in written form on those.

**Contents:**

The course consists of lectures on disciplines, essential concepts, historically significant and current research as well practical work life in Information Processing Science. In addition, the student will familiarize with scientific work skills by listening, discussing, reading, thinking critically and creatively, retrieving data, classifying and presenting in written form.

**Mode of delivery:**

Blended teaching.

**Learning activities and teaching methods:**

Blended studies 133 h.

**Target group:**

BSc students

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

Digital study material, material searched by students themselves.

**Assessment methods and criteria:**

Exercise tasks.

**Grading:**

Numerical scale 1-5 or fail.

**Person responsible:**

Henrik Hedberg

**ay031078P: Matrix Algebra (OPEN UNI), 5 op**

**Voimassaolo:** 01.08.2016 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031078P Matrix Algebra 5.0 op

**ay521453A: Operating Systems (OPEN UNI), 5 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opettajat:** Juha Röning

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521453A Operating Systems 5.0 op

**ECTS Credits:**

5

**Language of instruction:**

In Finnish, material available in English

**Timing:**

Spring, period 4

**Learning outcomes:**

1. is capable of explaining the basic structure and functioning of operating system

2. is able to point the problems related to process management and synchronization as well as is able to apply learned methods to solve basic problems

3. is capable of explaining the cause and effect related to deadlocks and is able to analyse them related to common circumstances in operating systems

4. is able to explain the basics of memory management, the use of virtual memory in modern operating systems as well as the structure of the most common file-systems.

**Contents:**

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

**Mode of delivery:**

Face-to-face.

**Learning activities and teaching methods:**

Lectures 36 h, laboratory exercise 4 h, the rest as independent work. The laboratory work, including pre-exercise and guided exercise performed in a group of one or two students in the unix environment, covers core topics of the course.

**Target group:**

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

**Prerequisites and co-requisites:**

521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming and 521267A Computer Engineering

**Recommended optional programme components:**

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

**Recommended or required reading:**

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

**Assessment methods and criteria:**

The course is passed the final examination and accepted laboratory working.

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

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

**Person responsible:**

Juha Röning

**Working life cooperation:**

-

**Other information:**

-

**521159P: Principles of Digital Fabrication, 5 op****Voimassaolo:** 01.01.2017 -**Opiskelumuoto:** Basic Studies**Laji:** Course**Vastuuyksikkö:** Computer Science and Engineering DP**Arvostelu:** 1 - 5, pass, fail**Opettajat:** Georgi Georgiev**Opintokohteen kielet:** Finnish**Leikkaavuudet:**

ay521159P Principles of Digital Fabrication (OPEN UNI) 5.0 op

**ECTS Credits:**

5 ECTS credits/ 135 hours of work

**Language of instruction:**

Finnish/English

**Timing:**

The course will be held in the spring semester, during period IV.

**Learning outcomes:**

In this course the students will learn the whole process of digital fabrication in FabLab. They will learn how to create an interactive 3D prototype, design mechanical parts for prototype, create basic electronics, implement a control logic for open hardware embedded board, and work in teams on project.

**Contents:**

The course teaches students to (1) design mechanical components with solid modeling tools, (2) build necessary electronics, and (3) implement software to a microcontroller, to create in FabLab a physical gadget that interacts with the world around it.

**Mode of delivery:**

Face-to-face teaching (Lectures)/ Individual work towards project

**Learning activities and teaching methods:**

Lectures 30h / Individual work 123h. There are sessions each week in FabLab where guidance is available (min total 16 h).

**Target group:**

This course is included in the computer science bachelor degree program. It is also available for all degree programs in the university. The course is offered to high-school students.

**Prerequisites and co-requisites:**

-

**Recommended optional programme components:**

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

**Recommended or required reading:**

There is no recommended or required reading. The tutorials for tools and software (or links to such tutorials) will be provided in the course.

**Assessment methods and criteria:**

The course will be evaluated on the basis of the project delivered by the teams of students. Essential part of this reporting is the documentation of the project.

**Grading:**

pass/fail

**Person responsible:**

Georgi Georgiev

**Working life cooperation:**

-

**Other information:**

The course is also offered to high-school students with special study right and gives 5 ECTS credits that can be included in some bachelor's degrees at University of Oulu.

The exercises are in FabLab:

<https://www oulu fi/fablab/node/32345>

## ay031021P: Probability and Mathematical Statistics (OPEN UNI), 5 op

**Voimassaolo:** 01.08.2016 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

031021P Probability and Mathematical Statistics 5.0 op

**ECTS Credits:**

5

**Language of instruction:**

Finnish

**Timing:**

Spring semester, periods 4-6

**Learning outcomes:**

After completing the course the student knows the key concepts of probability and the most important random variables and is able to use them in calculating probabilities and parameters of probability distributions. In addition, the student is able to analyze statistical data by calculating interval and point estimates for the parameters. The student is also able to formulate statistical hypotheses and test them.

**Contents:**

The key concepts of probability, random variable, parameters of probability distributions, estimation of parameters, hypothesis testing.

**Mode of delivery:**

Face-to-face teaching

**Learning activities and teaching methods:**

Lectures 44 h/Exercises 22 h/Self-study 68 h.

**Target group:**

-

**Prerequisites and co-requisites:**

The recommended prerequisites are the course 031010P Calculus I and some parts of the course 031011P Calculus II.

**Recommended optional programme components:**

-

**Recommended or required reading:**

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

**Assessment methods and criteria:**

Intermediate exams or a final exam.

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

**Grading:**

Numerical grading scale 1-5.

**Person responsible:**

Jukka Kemppainen

**Working life cooperation:**

-

**Other information:**

-

**ay811104P: Programming 1 (OPEN UNI), 5 op**

**Voimassaolo:** 01.08.2019 -

**Opiskelumuoto:** Basic Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opettajat:** Ilkka Räsänen

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

811104P    Programming 1    5.0 op

**ECTS Credits:**

5 ECTS credits / 133 hours of work

**Language of instruction:**

Finnish

**Timing:**

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

**Learning outcomes:**

After completion of this course, the student is able to:

- Create simple working programs
- Identify basic control structures and use them in the program.
- Identify the concepts of modularity, table, storage of information, and use them in the program.
- Find and fix errors in the program.

- Solve a computational problem by using abstraction and stepwise refinement
- Explain the concept of recursion.
- Operate with binary and hexadecimal number systems, as well as knows the presentation of numbers on a computer.
- Document the program.

**Contents:**

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

**Mode of delivery:**

Blended teaching

**Learning activities and teaching methods:**

Lecture (in Finnish) 40 h, exercises 24 h, self-study 70 h

**Target group:**

BSc students

**Recommended or required reading:**

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

**Assessment methods and criteria:**

1. Final exam and exercise points and programming assignment. OR 2. Mid-term exams (2) and exercise points and home programming assignment.

**Grading:**

Numerical scale 1-5 or fail

**Person responsible:**

Ilkka Räsänen

**ay521457A: Software Engineering (OPEN UNI), 5 op**

**Opiskelumuoto:** Intermediate Studies

**Laji:** Course

**Vastuuyksikkö:** University of Oulu, Open University

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

**Opetus suunnattu:** University of Oulu, Open University

**Opettajat:** Juha Röning

**Opintokohteen kielet:** Finnish

**Leikkaavuudet:**

521457A    Software Engineering    5.0 op

**ECTS Credits:**

5

**Language of instruction:**

Finnish. Material available in English.

**Timing:**

Spring, period 3.

**Learning outcomes:**

1. After finishing the course, the student knows the basic concepts of software engineering
2. The student also knows the different areas of project management, the phases of software development
3. The student can defines goals and tasks for each phase of development
4. The student knows the principles of secure software development
5. The student knows the metrics used in software engineering and is able to apply them
6. The student is familiar with tools commonly used in software engineering.

**Contents:**

Problematics of software development and the special features of real-time systems in this regard. Software development is viewed in regard to project management and actual implementation: 1. process models, 2. requirements specification, 3. project management basics: design, metrics, risk management, resource management, follow up, quality control, product control, 4. software testing methods and strategies, 5. introduction to object-oriented analysis and design. 6. Agile software development. 7. Secure software engineering

**Mode of delivery:**

Face-to-face or online course

**Learning activities and teaching methods:**

The course consists of lectures and independent practical exercises. The course is completed by a final exam or learning diaries and successfully completed practical exercises. Lectures 30 h, laboratory design (in period 3) 8 h, the rest of the self-study.

**Target group:**

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

**Prerequisites and co-requisites:**

521141P Elementary Programming, 521286A Computer Systems or 521142A Embedded Systems Programming.

**Recommended optional programme components:**

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

**Recommended or required reading:**

R.S. Pressman: Software Engineering - A Practitioner's Approach. Eight Edition. McGraw-Hill 2010. Older editions (6. and 7.) can also be used with some additional material.

**Assessment methods and criteria:**

Final exam and accepted laboratory exercise.

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

**Grading:**

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

**Person responsible:**

Juha Röning

**Working life cooperation:**

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