Foreword

Welcome to the Master’s Programme in Communications and Systems Engineering, as well as to the University of Vaasa. This handbook is designed to provide assistance and information about your studies. This information can also be found from the website www.uva.fi/en/education/master/comsys/studies.

For timetables, rooms, course descriptions and possible changes, follow WebOodi and Lukkari (the timetable generation system), and ComSyS mailing list. Follow also updates on the Communications and Systems Engineering Group website at cs.uwasa.fi/comsys, and remember to check your university e-mail regularly.

Introduction

MASTER OF SCIENCE (TECHNOLOGY)
120 ECTS credits

The aim of the Communications and Systems Engineering Master’s Programme is to educate qualified Masters of Science (Technology) with a specialization in distributed energy production information systems.

The Master’s Programme in Communications and Systems Engineering is an international Master’s programme focusing on the most popular telecommunication networks of both the present and the future. The emphasis of the programme is on wireless communications and mobility issues. The programme also addresses the areas of telecommunication architecture evolution, digital communication and radio technology. Key subject areas in mobile networks are wireless communication, quality of service, mobility and security. Students have the opportunity to take courses in both general telecommunications and in specific fields of mobile communication.

Wireless communication is the backbone of connecting people as well as machines and devices toward the era of the internet of things (IoT). During the last decade, telecommunications became an essential part of other distributed systems such as smart cities, wireless automation, tactical communication, smart grids, e-health systems, security, and countless other applications. Therefore, the major mission of our program is to provide some of the required scientific and technical information to our students to be able to understand, analyze, and deal with such advanced systems.

Learning outcomes

In the Master’s Programme in Communications and Systems Engineering you will learn to:

- Understand different advanced wireless communication systems, their structures, and theories behind them.
- Understand how the communication systems are integrated with automation and computer systems and how they are utilized in different data transfer situations, e.g. controlling energy production and transfer, in electrical payments systems and e-business etc.
- Evaluate, compare and propose between communication systems or develop new ones when needed for some special application.
- Design communication systems/networks/platforms after some training in industry.
- Work efficiently in groups as well as individually.
- Use high-level computer packages such as Matlab to make simulations for systems.
- Write up-to-date and high-level scientific reports in different related areas such as wireless communication, wireless sensor networks, embedded systems, automation, distributed energy production information systems etc.
- Present your ideas publicly and defend them in a scientific way.
- Understand and be able to analyze new communication systems of the future.
- Have strong scientific research skills; hence, you will be able to continue smoothly into PhD studies in any technical university.
MASTER OF SCIENCE (TECHNOLOGY) 120 ECTS credits

Degree Structure

- Master’s Thesis in Communications and Systems Engineering: 30 ECTS
- Complementary Studies: 30 – 31 ECTS
- Major Studies: 13 - 40 ECTS
- Optional Studies: 5 – 20 ECTS
- Business Studies: 14 ECTS
- Supplementary Studies: 0-60 ECTS

NB! One course can be used only in one entity (one box above).
Supplementary studies

Students who have a B.Sc. degree from a polytechnic / university of applied sciences or from some other major subject than telecommunications, automation engineering or electrical engineering must do supplementary studies. The exact amount of the required supplementary studies (maximum of 60 ECTS) depends on the contents of the degree, and is defined by the Head of the Programme. They are marked in the student’s personal study plan (PSP) which is a compulsory document all students create with the guidance of Coordinator of International Education in the beginning of their studies. The supplementary studies will be added on top of the total of 120 ECTS of the M.Sc. degree.

For example: Supplementary studies (20 ECTS) to students holding a B.Sc. degree from a Finnish polytechnic / university of applied sciences:

- MATH1130 Integral Transforms ................................................................. 5 ECTS
- TLTE2110 C and C++ Programming .......................................................... 5 ECTS
- AUTO2050 Soft Computing ...................................................................... 5 ECTS
- MATH1170 Probability and Statistics ....................................................... 5 ECTS

Master of Science (Technology), Communications and Systems Engineering, 120 ECTS

COMPLEMENTARY STUDIES 30–31 ECTS

Mandatory courses (unless completed in the previous degree)

- OPIS0039 Personal Study Plan .................................................................. 0 ECTS
- KENG9212 Writing Academic English ....................................................... 5 ECTS
- KSUO5111 Finnish for Foreigners I .............................................................. 5 ECTS
  (those who already master the basics of Finnish choose Finnish for Foreigners II or III, native Finnish speakers choose another course)
- OPIS0025 Information Skills I ................................................................. 1 ECTS
- TLTE2090 Wireless Networks ................................................................. 5 ECTS
- TLTE2100 Computer Architectures .......................................................... 5 ECTS
- STAT3120 Probability and Stochastic Processes ....................................... 5 ECTS

Additional courses, enough courses to reach a total of 30 ECTS must be chosen (in case mandatory courses make less than 30)

- TLTE2010 Mobile Communication Services and Systems ......................... 5 ECTS
- TLTE2040 Telecommunication Software .................................................. 5 ECTS
- TLTE2050 Telecommunication Electronics .............................................. 5 ECTS
- MATH2030 Numerical Methods ............................................................... 5 ECTS
- MATH2040 Advanced Optimization .......................................................... 5 ECTS
- TITE2120 Information Security ............................................................... 5 ECTS
AUTO2090 Digital Control .................................................................................. 5 ECTS
or separately agreed courses

MAJOR STUDIES 40 ECTS
You can select your major courses relatively freely, but please note that many of them have prerequisites. Make sure to select your complementary studies, major studies and optional studies so that you have passed the courses needed as prerequisites to your major courses.

Mandatory Courses (13 ECTS)

TLTE3170 Embedded C-Programming ................................................................ 3 ECTS
TLTE3150 Advanced Course in Signals and Systems ....................................... 5 ECTS
TLTE3010 Digital Communication ........................................................................ 5 ECTS

Major courses, enough courses to reach a total of 40 ECTS must be chosen
TLTE3050 Radio Resource Management .......................................................... 5 ECTS
TLTE3160 Telecommunication Architectures .................................................. 5 ECTS
TLTE3030 Broadband Wireless Communication ............................................. 5 ECTS
TLTE3070 Special Topics in Communications and Systems Engineering .......... 1–10 ECTS
TLTE3080 Project Work in Communications and Systems Engineering .......... 3–15 ECTS
TLTE3090 Communications and Systems Engineering Seminar .................... 3–10 ECTS
TLTE3100 Embedded Network Devices ............................................................ 5 ECTS
TLTE3040 Teletraffic Theory ............................................................................ 5 ECTS
TLTE3060 Introduction to Radio Technology .................................................. 5 ECTS
TLTE3120 Computer Simulation in Communication and Systems ................... 5 ECTS
TITE3140 Cryptography .................................................................................... 5 ECTS
TITE3070 Analysis and Design of Human Computer Interaction ..................... 5 ECTS
AUTO3310 Digital Signal Processors ................................................................... 5 ECTS
AUTO3290 Sound Processing ............................................................................ 5 ECTS
AUTO3110 Machine Vision ................................................................................ 5 ECTS

TLTE3990 Master's Thesis, Thesis Presentation and Maturity Exam 30 ECTS
TLTE3990 Master's Thesis ................................................................................. 30 ECTS
TLTE3991 Presentation ....................................................................................... 0 ECTS
KNÄY300x Maturity test ..................................................................................... 0 ECTS
BUSINESS STUDIES (LIKETOIMINTAOSAAMINEN) 14 ECTS
Mandatory for Finnish students, recommended for others.

Choose at least 14 ECTS from the following courses (in Finnish only):
AUTO3350 Tuotekehitys ja IPR .......................................................... 5 ECTS
ENER3070 Energiatekniikan projektiyö 1–3 ........................................ 5 ECTS
ORMS2020 Päättöksenteko epävarmuuden vallitessa .................... 5 ECTS
TITE3300 Ohjelmistiikentoiminta .................................................... 5 ECTS
TITE2220 Johdatus verkkoliiketoimintaan ................................... 5 ECTS
TITE3160 Sähköisen kaupankäynnin erikoiskurssi ....................... 5 ECTS
TITE3060 Informaatioyhteiskunta .................................................. 5 ECTS
TITE3270 Tietojenkäsittelytoiminnan johtaminen ....................... 5 ECTS

For further information, see www.uva.fi/fi/for/student/materials/handbooks/technology.

OPTIONAL STUDIES (5–20 ECTS)
The students may choose these optional courses from any study program of the University of Vaasa (or from other universities if agreed in PSP).

For example:
TLTE3950 Practical Training ......................................................... 1–5 ECTS

The degree may include 1–5 ECTS of practical training / internship improving the student’s professional expertise. A two-week (á 40 hours) training period is equivalent to 1 ECTS credit. The student must also write a report about the training.

Recommended optional courses
KSUO5112 Finnish for Foreigners II .............................................. 5 ECTS
KSUO5113 Finnish for Foreigners III ........................................... 3 ECTS
SATE2020 Energy Production .................................................... 5 ECTS
OPIS0026 Information Skills II .................................................. 1 ECTS
TITE2220 Introduction to e-Business .......................................... 5 ECTS

Other Mathematical, Automation, Energy, and Communications and Systems engineering courses

M.Sc. (Technology) degree: total 120 ECTS
Teaching periods

At the University of Vaasa the Academic year is divided into five periods. These periods begin and end simultaneously in all faculties. During each period, teaching, exams and feedback are organized. One week of each period is reserved for exams and there is no teaching during that week.

During the academic year 2015–2016 the periods are as follows:

**Autumn Semester 2015**
I period 31st August–23rd October (weeks 36–43)
II period 27th October–19th December (weeks 44–51)
Exams are 12:00–15:00 during week 36 (Thu–Sat), week 43 (Mon–Sat), week 50 (Wed–Sat) and week 51 (Mon–Sat), on every Saturday in September, and on every Friday and Saturday in November and December.

**Spring Semester 2016**
III period 11th January–26th February (weeks 2–8)
   - University’s Anniversary 27th January at 14:00
IV period 29th February–8th April (weeks 9–14)
   - Easter holiday 24th–28th April (Thu-Mon)
V period 11th April–27th May (weeks 15–21)
Exams are 12:00–15:00 during week 2 (Thu–Sat), week 8 (Mon–Sat), week 14 (Mon–Sat), week 20 (Wed–Sat), week 21 (Mon–Sat), and on Fridays and Saturdays throughout the Spring Semester.

**Summer Exams**
Sat 11th June and Sat 9th of July, 2016.

Course Registration and Timetables

Students need to register for the courses in advance by using the WebOodi System (weboodi.uwasa.fi/oodi). Timetables for the courses are available in the timetable generator system Lukkari (https://asio.uwasa.fi). Please follow the changes regularly. Note that courses may overlap. In that case register for both and then choose later which one you want to attend.

Information and material about the courses is available on Communications and Systems Engineering Group website (http://cs.uwasa.fi/comsys). Note that it is mandatory to attend to the classes of some courses.

Master’s degree students are expected to complete courses worth approximately 30 ECTS each semester. Please note that extending the student’s residence permit requires that the student can show sufficient progress in her/his studies in terms of credits.

The total number of credits required for a Master's degree is 120 ECTS, including the Master's Thesis (30 ECTS). Contact Communications and Systems Engineering faculty staff to define the topic, supervisor and instructor when you are planning to start writing your Master’s Thesis. After completing your Master’s Thesis, you still need to pass a written maturity exam based on the content of your thesis. Your thesis supervisor will prepare the question(s) for this examination and it will take place on one of the regular examination days or on a separately agreed date.

Detailed course descriptions can be found on the programme website www.uva.fi/en/education/master/comsys and at the end of this handbook.

Exams

Students must register for an exam at least 7 days in advance by using WebOodi (weboodi.uwasa.fi/oodi). The earliest time to register is one month before the exam day.

Students are often able to retake exams; the course lecturer will give you the information on the possible retake exam date(s). Notice that exams may also be held on Saturdays. Check the information on date, time and location in WebOodi.

At the beginning of each semester, the International Office organizes an orientation course for the university studies, during which the information systems like WebOodi are discussed.
Evaluation and Registration of Credits

According to Degree Ordinance 16 § of the University of Vaasa, exam results must be announced within 30 working days of the exam date. In case of delay, the lecturer or other person responsible for announcing the results will have to inform the students about the delay within the 30 days of the exam.

The assessment criteria are public and the student may inquire about these from the examiner. A student may have a look at his/her corrected exam or course work and get information on assessment details by visiting the examiner during his/her office hour.

Exam results are displayed on course website (or on each department’s notice board) and in the WebOodi system. The Academic Affairs Office has copies of the result sheets, which also include the names of students who have failed a course.

Credits for entire courses are registered in the Transcript of Records at the departments. Courses that include mandatory written exercises, programming exercises or other partial credit units will be registered only after all required parts have been completed. For this reason it is important that the student, whenever possible, completes the course and all its required parts simultaneously.

The student either fails or passes a course. Students who pass the course are graded according to the University of Vaasa grading system on scale 1–5 (1 is the lowest and 5 the best grade) or on a pass/fail basis. In the latter case, the mark ‘hyv.’ (from Finnish ‘hyväksytty’ = ‘pass’) appears on the student’s transcript. The transcript of records includes an explanation of the grading system and the ECTS credit system. You can check your credit record in the WebOodi system. Official transcripts of records are available at the International Office upon request.

Transcript of University Records

Official transcripts of university records can be ordered from the International Office on request. The document shows all the courses you have passed, with grades and credits (ECTS credits and a brief explanation of the grading scale at the University of Vaasa). Please be prepared to wait for one whole workday after your request.

Ethical Guidelines

Plagiarism and cheating in exams and other written work is considered a serious offence at Finnish universities. According to the Degree Ordinance 24 § of the University of Vaasa, plagiarism or cheating in examination may lead to cancellation of the course result and dismissal from the University. The cases will be handled according to the Procedures in Case of Academic Fraud guidelines.

Furthermore, the University of Vaasa will inform the immigration officials and police about possible offences when processing the residence permit applications. In addition, if possible employers ask for information (reference) about former students of the university, the above mentioned offences will be informed to the employers – both in Finland and in other countries. In the case of exchange students, the International Office of the University of Vaasa will terminate the student’s exchange period immediately and inform his home university about the offence. Please avoid even the suspicion of plagiarism or cheating in examinations!

Exams: Code of conduct

➤ Do NOT talk in the exam!
➤ Be on time. The doors of the examination venue will be locked 15 minutes past the hour and no one is allowed to enter after that. The invigilator/supervisor of the exam will allocate a seat for each student. When taking seats in the auditorium leave one empty seat on both sides (sometimes two, please follow the invigilators’ instructions).
You are only allowed to have writing equipment and
the instruments specifically allowed for the exam with
you (for example a dictionary or pocket calculator).
Mobile phones and other electronic devices, bags
and jackets have to be left at the side of the exam hall.
Mobile phones must be switched off during the exam.

Any kind of communication with other students is
strictly forbidden after you have received the questi-
on. Ignoring this regulation may result in an allegati-
on of cheating in the examination.

You are not allowed to read the exam questions until
the invigilator gives you permission to do so. Thus
keep your paper turned upside down before you get
permission to start the exam from the invigilator. If ne-
necessary, the invigilator will clarify unclear points in the
examination paper. You can attract the attention of the
invigilator by raising your hand if you need to clarify
something or more paper is required and you wish to
go to the toilet, etc.

You are allowed to enter the exam hall max. 15 minu-
tes after the exam has started.

You are not allowed to leave the exam hall during the
first 45 minutes of the exam.

You are not allowed to leave the exam hall for a ciga-
rette etc. and come back to write your exam.

Before leaving everyone has to hand in the exam
paper to the invigilators. Please check that each exam
paper you submit has your name, your student num-
ber, name of the exam, and name of the examiner. You
have to show your identity card when returning the
exam papers to the invigilator.

If it is found out that a student is cheating in an exam,
s/he will receive a punishment which can lead to a
termination of studies at the University of Vaasa.

Electronic plagiarism detection

Electronic plagiarism detection is a part of the quality
assurance system of education and research. Electronic
plagiarism detection should act as a tool of instruction
while preventing dishonest behavior.

All theses and dissertations (Bachelor, Master, Licentiate
and Doctoral) are checked for originality using the Turnitin
plagiarism detection software. All theses submitted after
August 1st 2014 must be checked with the plagiarism de-
tection software before approval. For detailed instructions,
see the thesis guidelines.

Teachers can use the software to check other assign-
ments, such as essays, exercises, take-home exams, and
reports. It is also the teachers’ responsibility to instruct
students on correct referencing and good scientific prac-
tice during studies.

For additional information on plagiarism detection, refer to
the thesis guidelines and the University portal
port.uwasa.fi/tietohallinto/ohjeet/turnitin.

Personal Study Plan (PSP)

All Master’s degree students must make a Personal Stu-
dy Plan (PSP, also abbreviated HOPS in Finnish) under
the guidance of the Coordinator of International Education
at the beginning of their studies. The PSP is an informal
agreement between the student and the Faculty (student
advisor/teacher) and it can be corrected and updated du-
dring the studies. The general PSP comprises a timetable
of the courses the you are planning to take. It also includes
information about the thesis, estimated graduation time
and some open questions. More information about PSP is
given during the orientation days and in programme meet-
ings arranged in the beginning of the academic year. Per-
sonal Study Plan templates are available at:

Graduation and Thesis

Contact Communications and Systems Engineering
Group staff to define the topic, supervisor and instruc-
tor when you are planning to start writing your Master’s
Thesis. The total number of credits required for a Master’s
degree is 120 ECTS credits including the Master’s Thesis
(30 ECTS).
After completing your Master’s Thesis and before graduation, you need to pass a written examination based on the content of your thesis (maturity exam). Your thesis supervisor will prepare the question(s) for this examination and it will take place on one of the regular examination days or on a separately agreed date.

The Master’s thesis must be handed in for the final review 4–5 weeks before the Faculty Dean’s resolution in which the thesis is to be approved. Also the maturity exam has to be taken well in advance since its evaluation may take up to 4 weeks. Please check with your thesis supervisor the latest date you can submit your thesis and take the maturity test.

Make sure to reserve enough time for the graduation process! For further information, please refer to: www.uva.fi/en/for/student/studies/graduation.

Writing Guidelines

Each faculty of the University has produced writing guidelines for their students. The guidelines contain instructions about the official layout and contents of theses and other written assignments as well as instructions on how to refer to source literature and other material used in the work. Please familiarize yourself with the guidelines from the very beginning of your studies, and apply the instructions to your written work: www.uva.fi/en/for/student/materials/writing_guidelines.

Career Services

For personal discussion and guidance on working life matters (how to apply for a job, job application, CV, etc.) you can make an appointment with the Coordinator of International Education Sami Ilomäki, sami.ilomaki(a)uva.fi, Tervahovi building, room D209. See also the Career Services website: www.uva.fi/en/for/student/guidance/career.

Work Permit

International students holding residence permits issued for studying may work without a work permit 25 hours a week during semester time, and full-time during holidays. These limitations do not concern citizens of the Nordic and EU/EEA countries. However, you should bear in mind that the competition for open positions can be hard. Pay also attention to balance between work and studies: full or part-time working during the semester time should not remarkably delay your studies and graduation.

Please note that the University of Vaasa does not have any scholarship for the programme and cannot offer financial aid for international students. The programme is full-time and thus working is not an option to finance the studies in Finland.

Guidance and Study Counseling

The Coordinator of International Education and the faculty staff will give the guidance concerning the Communications and Systems Engineering programme itself. The International Office gives guidance in general matters, and the Academic Affairs office gives guidance in practical matters concerning studies; exams, graduation etc.

Study counselling is given by teachers, faculty student advisors, student advisors in international relations, and the student advisors in academic affairs. All staff members have office hours during which students may inquire, for example, about teaching arrangements or the contents of a specific course. The responsibility areas are as follows:

Faculty Staff (Fabriikki building, 2nd and 3rd floor)
- Study counseling concerning degrees, programmes and planning studies
- Personal study plan (PSP/HOPS)
- Choosing additional courses/studies
- Questions concerning students’ legal protection
International Office (Luotsi building, 1st floor)
- Registration
- Signing up for two exams simultaneously
- General enquiries (e.g. course timetables, signing up for courses)
- Certificates

Academic Affairs Office and other student services (Luotsi building, 1st floor)
- Change of address (Academic Affairs Office)
- Degree certificates, exam arrangements (Academic Affairs Office)
- Students’ legal protection (Head of Academic Affairs)

WebOodi

The WebOodi system is available at weboodi.uwasa.fi/oodi. Select the language from the bottom of the main menu on the left. This menu shows the functions available for everyone, even without logging in. You may browse information about, for example, teaching events even if you do not have a valid username or password. You will also find instructions on how to use the WebOodi at the bottom of the menu.

In order to register to the WebOodi system, enter your e-mail username and password. After logging in, you will be taken to your personal front page. The courses of the day and the exams you have registered for through WebOodi will appear on your calendar. Your personal student number and your name are visible in the upper left corner of the window. Even if you have several rights to study, you have only one student number in use.

The different functions of WebOodi are shown in the main menu on the left. You can search for information using the “By search terms” or “By organisation” option. These allow you to search for information on, for example, study modules or courses and exams. In “My studies”, you can view your planned studies, valid registrations, credits, and upgraded or rejected studies.

By using the “Transcript of studies” item, you can order an unofficial transcript of records to your e-mail. The “Other functions” option enables you, for example, to update your personal contact information. End your WebOodi session by clicking on “Quit” in the main menu. When you stop using WebOodi, always quit your session properly to prevent the next computer user from accessing and modifying your data.

If you want to write two exams on the same day, you need to fill in the form “Registration for two exams” available at the International Office. Please also remember to register for both exams in WebOodi.

Fees

Master’s degree students do not have any tuition fees. However, they are required to pay the Student Union membership fee of 142 euro per academic year or 76 euro per semester. Membership entitles Master’s degree students for subsidized meals in campus restaurants, student healthcare and various discounts on and off campus.

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COURSE DESCRIPTIONS

Supplementary Studies

INTEGRAL TRANSFORMS

\textit{Integraalimuunnokset}

\textbf{Code:} MATH1130
\textbf{Credits:} 5 ECTS
\textbf{Prerequisites:} Basic studies in mathematics (Calculus and Linear Algebra)

\textbf{Learning Outcomes:} Students learn basic facts on complex functions, their differential and integral calculus, in particular, get familiar with elementary complex functions, are able to differentiate and integrate such functions, as well as solve equations in complex domain involving such functions. Students learn to check whether a function is analytic, calculate line integrals in the complex domain by means of parametric representations, Cauchy formulas, partial fractions and residue methods. Students learn basic facts on Laurent series and their connection to residue calculus. They also learn basic facts on Fourier series, Laplace transforms, and Fourier transforms in particular. Students learn to calculate Fourier series, apply central properties connected with the convergence of Fourier series. They learn to calculate Laplace and Fourier transforms, get familiar with their central properties and are able to apply Laplace and Fourier transforms in solving differential equations, and they learn to apply residue method in calculating integral transforms.

\textbf{Content:} Complex numbers, functions of a complex variable, continuity, differentiability, analytic function, Cauchy-Riemann equations, complex line integral, Cauchy integral formulas, Power series, Taylor and Laurent series in complex domain and their convergence properties, residue calculus, residue theorem, Fourier series (trigonometric and complex versions) with approximation and applications, Laplace transform, inverse Laplace transform, transfer function, applications to differential equations appearing e.g. in modeling electrical circuits, Fourier transform with basic properties and applications, a part of exercises is solved and treated with computers applying mathematical programs.

\textbf{Study Materials:}

\textbf{Teaching Methods:} Lectures 40 h (in Finnish), 10 h (in English), exercises 20 h (in Finnish / English)

\textbf{Modes of Study:} Exams and exercises

\textbf{Language:} Finnish/English

\textbf{Grading:} 1–5 or fail

\textbf{Responsible Person:} Seppo Hassi

\textbf{Teacher(s):} Seppo Hassi, Dmytro Baidiuk and Marko Moisio

\textbf{Responsible Unit:} Department of Mathematics and Statistics

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\textbf{C AND C++ PROGRAMMING}

\textbf{Code:} TLTE2110
\textbf{Credits:} 5 ECTS

\textbf{Learning Outcomes:} This course aims to teach the skills necessary for the development of C/C++ applications. After completing this course the student will be able to develop C and C++ programs containing simple data structures. The student will learn how to implement programs according to given flowcharts or ones developed themselves. Also the use of debuggers will be introduced and applied. The skills learned in the lectures must be applied in the exercises.

\textbf{Content:} In the lectures the theoretical parts required for the exercises are presented. To the course contents belong data types, conditions, loops, functions, arrays and pointers, static and dynamic allocation, structures, time handling, file handling, classes, objects, inheritance, templates, STL Library etc.. The exercises contain the development of C/C++ applications related to the previously mentioned course contents.

\textbf{Study Materials:} Lecture slides and course literature
2. Stroustrup, Bjarne (2013), The C++ Programming Language, Addison-Wesley Longman

\textbf{Teaching Methods:} Lectures, practical exercises and final examination

\textbf{Modes of Study:} Lectures, practical exercises, homework and final examination
Languages: English (lectures and exercises)
Grading: Scale 1–5 or fail, based on final examination
Responsible Person: Mohammed Elmusrati
Teacher(s): Tobias Glocker
Responsible Unit: Department of Computer Science
Additional Information: teg.uwasa.fi/courses/tlte2110

SOFT COMPUTING
Soft Computing
Code: AUTO2050
Credits: 5 ECTS
Prerequisites: Programming, in addition Object Oriented Programming is recommended
Learning Outcomes: After completing this course the student will be able to explain the principles of fuzzy logic; explain the principles of fuzzy reasoning; describe the most important applications and application areas of fuzzy logic; apply the principles of fuzzy sets theory; fuzzy rules and fuzzy control; explain the principles of neural networks; describe the most important neural network types; apply learning of neural networks; describe the most important applications of neural networks; describe the principles of evolutionary computation; apply the principles of multiparameter optimisation; describe the principles of global optimisation; describe the typical applications of genetic algorithms; implement an application of genetic algorithms; combine and apply different soft computing methods; design, implement, test and document a simple soft computing application.
Content: Neural networks, fuzzy logic, genetic algorithms, evolutionary strategies, interval arithmetics, applications from engineering and science, use of Matlab Soft Computing Toolboxes.
Teaching Methods: Lectures 24 hours, exercises 20 hours, project work 20 hours
Modes of Study: Exam (AUTO2051 3 ECTS) and project work AUTO2052 2 ECTS
Languages: Language of instruction: teaching English / exercises English; completion language(s) English
Grading: Scale 1–5 or fail
Responsible person: Jarmo Alander

Teacher(s): Jarmo Alander/Vladimir Bochko
Responsible Unit: Department of Electrical Engineering and Energy Technology
Additional Information: Annual course

PROBABILITY AND STATISTICS
Todennäköisyyslaskenta ja tilastotiede
Code: MATH1170
Credits: 5 ECTS
Prerequisites: Basic differential and integral calculus
Learning Outcomes: The student can summarize data in terms of statistics and diagrams, can calculate probabilities of events and conditional probabilities, can apply the most important discrete and continuous probability distributions, joint distributions, moment generating functions, and sampling distributions. The student can apply the method of least squares and conduct inference concerning one and two means, variances, and proportions, correlation, and concerning linear regression coefficients.
Content: Population and Sample, descriptive statistics, probability of events, conditional probability, continuous and discrete random variables and their distributions, joint distributions, moment generating functions, sampling distributions, inferences concerning one and two means, variances, and proportions, the method of least squares, correlation, and regression inference.
Study Materials:
Johnson/Freund/Miller: Probability and Statistics for Engineers, Chapters 1–11
Teaching Methods: Lectures 40h and exercises 20h
Modes of Study: Exam
Language: English
Grading: Scale 1–5 or failed
Responsible Person: Bernd Pape
Teacher: Bernd Pape
Responsible Unit: Department of Mathematics and Statistics
Additional Information: This course with a main focus on probability calculus is targeted mainly at Faculty of Technology students as a replacement for Tilastotieteen perusteet (Introduction to Statistics STAT1030) which has a stronger focus on statistics. It is not possible to earn credits for both Tilastotieteen perusteet and Probability and
Statistics (or Basic Course in Statistics STAT1020). This course is strongly recommended as a prerequisite for the course Probability and Stochastic Processes.

Complementary Studies

Mandatory courses

| PERSONAL STUDY PLAN (PSP) |
| Henkilökohtainen opintosuunnitelma HOPS |

**Code:** OPIS0039  
**Credits:** 0 ECTS  
**Prerequisites:** –  
**Learning Outcomes:** –  
**Content:** All Master’s degree students make a Personal Study Plan (PSP) in the beginning of theirs studies under the guidance of the Coordinator of International Education. PSP is an informal agreement between the student and the Faculty (student advisor/teacher) and it can be checked and corrected during the studies. In general the PSP comprises a timetable of the courses the student is planning to take. It also includes information about thesis, estimated graduation time and some open questions. PSP forms are available online. More information about PSP is given during the orientation days and in the programme meetings arranged in the beginning of the academic year.  
**Study Materials:** Handbook of the programme, website of the University of Vaasa  
**Teaching Methods:** –  
**Modes of Study:** Personal study plan PSP  
**Languages:** Finnish, English  
**Grading:** Pass/fail  
**Responsible Person:** Head of Study Affairs  
**Teacher(s):** Head of the Program, Coordinator of International Education  
**Responsible Unit:** Faculty of Technology  
**Additional Information:** www.uva.fi/en/for/student/studies/planning/psp

| WRITING ACADEMIC ENGLISH |

**Code and credits:** KENG9212, 5 ECTS  
**Course aim:** B2–C1  
**Learning outcomes:** The student becomes aware of the characteristic features of academic writing, can identify, practice and master the principles of academic writing, and can apply them. The student develops critical and analytical reading skills, and can produce and review academic texts. The student also recognizes the challenges s/he faces as the user of English as a foreign language, and learns what constitutes plagiarism and academic dishonesty.  
**Content:** The students will be introduced to the notions of audience, purpose, register and style as they pertain to academic writing. They will also learn about the structure and organization of academic texts such as summaries, definitions, data commentaries, reviews, research plans and research papers. The students will practice analytical reading, and identify rhetorical strategies used in academic writing. The students will also develop critical reading and note-taking skills, as well as learn and apply the principles of documentation. In addition, attention will be brought to frequent patterns produced by users of English as a foreign language in academic texts.  
**Teaching:** 30 hours  
**Requirements for the credit units:** The students produce short written assignments and a longer final written assignment. They should also participate actively in class.  
**Literature:** The Harbrace College Handbook and other materials as instructed.  
**Evaluation:** Scale of 1–5 or fail.  
**Time:** 1st year, autumn  
**Contact person:** Course provided by the Language Centre.

| FINNISH FOR FOREIGNERS I |

**Suomea ulkomaalaisille**  
**Code:** KSUO5111  
**Credits:** 5 ECTS  
**Course Aim:** CEFR Level A1.1  
**Aim:** The student has basic knowledge of Finnish pronunciation. S/he is able to communicate in everyday life situations, to read simple texts and to write about a familiar subject, such as her/his own life.  
**Content:** Basic grammar and vocabulary for everyday life in Finnish. Short introduction to Finnish culture.  
**Teaching:** Lectures and exercises 60 hours  
**Requirements for the Credit Units:** Participation in lectu-

**Literature:**

**Supplementary material:**

**Evaluation:** Scale of 1–5 or fail. The grade consists of attendance and active participation in class, assessment of work done during the course and a written exam at the end of the course.

**Contact person:** Marjut Männistö
**Time:** 1st year, autumn
**Language of instruction:** To be taught in Finnish and English.

**INFORMATION SKILLS I**
*Tiedonhankintataidot I*

**Code:** OPIS0025
**Credits:** 1 ECTS
**Recommended Time of Completion:** First autumn semester
**Prerequisites:** –

**Learning Outcomes:** Students are able to use Finnish library and information services effectively, know how to apply various information retrieval tools efficiently and use information ethically.

**Content:** General principles of information seeking, basic information retrieval techniques, information resources and Finnish library services needed in the studies, information ethics.

**Study Materials:** Online course material
**Teaching Methods:** Obligatory workshops 2 x 2 h, online training
**Modes of Study:** Online assignments and a multiple choice exam
**Languages:** English
**Grading:** Pass/fail
**Responsible Person:** Information Specialist Heidi Troberg

**Teacher(s):**
**Responsible Unit:** Tritonia
**Additional Information:** www.tritonia.fi/?d=139&l=3

**WIRELESS NETWORKS**
*Langattomat verkot*

**Code:** TLTE2090
**Credits:** 5 ECTS (5 op)

**Learning Outcomes:** Setting skills required for wireless communication. Each student has to give a presentation and must write a report about a topic chosen from the list provided by the lecturer. The students will learn to prepare a presentation for the chosen topic from research papers like IEEE, GLOBECOM etc. and must explain their investigations for the audience on an understandable level.

**Content:** Each participant must give a presentation of 45 minutes, write a report and must pass an exam (materials of all the presentations + reports) to pass the course. The topic has to be chosen from a list provided by the lecturer. All topics are in the field of wireless networks or they are closely related to wireless networks.

**Study Materials:** Presentations, reports and final examination
**Teaching Methods:** Lectures 24 h
**Modes of Study:** Exam, presentation and report (or exam and homeworks)
**Languages:** English
**Grading:** Scale 1–5 or fail, presentation + report (50 %) and final examination (50 %)
**Responsible Person:** Mohammed Elmusrati
**Teacher(s):** Tobias Glocker
**Responsible Unit:** Department of Computer Science
**Additional Information:** Annual course, website teg.uwasa.fi/courses/tlte2090

**COMPUTER ARCHITECTURES**
*Tietokoneen arkkitehtuurit*

**Code:** TLTE2100
**Credits:** 5 ECTS

**Learning Outcomes:** This course aims to teach the skills necessary for understanding the architecture of computers and microcontrollers. After completing this course the student will be able to understand the design principles
of modern processors and bus systems. In addition, the student will also learn how to implement programs with assembly programming language. The skills learned in the lectures must be applied in the exercises.

**Content:** In the lectures the theoretical parts required for the exercises are presented. To the course contents belong the design principles of modern processors, execution of instructions, RISC vs. CISC, memory, address mode, interrupts, assembly language and peripherals.

**Study Materials:** Lecture slides and course book (see course website)

**Teaching Methods:** Lectures 24h and exercises 24h

**Modes of Study:** Lectures, practical exercises and final examination

**Languages:** English

**Grading:** Scale 1–5 or fail, final examination

**Responsible Person:** Mohammed Elmusrati

**Teacher(s):** Tobias Glocker

**Responsible Unit:** Department of Computer Science

**Additional Information:**

Additional courses, enough to reach a total of 30 ECTS must be chosen (in case mandatory courses make less than 30)

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**MOBILE COMMUNICATION SERVICES AND SYSTEMS**

*Matkapuhelinjärjestelmät*

**Code:** TLTE2010

**Credits:** 5 ECTS (5 op)

**Prerequisites:** Telecommunication Architectures

**Learning Outcomes:** This course aims to teach the students the principles of mobile communication, mobile sets, and mobile networks, since the mobile networks are very important sector of telecommunication business, these concepts are crucial for the students in telecommunication engineering, after completing this course successfully, the student will be able to demonstrate the mobile network (for both GSM/UMTS) structure, they will be able to define the relations between the mobile network blocks, moreover, they can make simple mobile network planning.

**Content:** The course consists of different topics on mobile communications such as introduction to mobile communication systems, GSM network architecture, handover principles in GSM, GPRS, EGSM, system capacity and network planning, UMTS network architectures, services offered by UMTS, the integration of UMTS and GSM systems, and HSDPA, other different wireless communication topics will be prepared by the students in form of course report, example of those topics are: Bluetooth, Zigbee, LTE, WiMAX, DECT Phones, VoIP, and WiFi.

**Study Materials:**

2. H. Holma and A. Toskala: WCDMA for UMTS
3. course handouts
4. different references based on students’ search

**Teaching Methods:** Lectures 24 h, project work (each
student prepares and presents one oral presentation on a related topic given by the teacher), quizzes, and final examination

Modes of Study: Lectures 24 h, project work (each student prepares and presents one oral presentation on a related topic given by the teacher), quizzes and final examination

Languages: English
Grading: Scale 1–5 or fail
Responsible Person: Timo Mantere
Teacher(s): Timo Mantere
Responsible Unit: Department of Computer Science
Additional Information: Annual course, website cs.uwasa.fi/courses

TELECOMMUNICATION SOFTWARE
Tietoliikenneohjelmistot
Code: TLTE2040
Credits: 5 ECTS (5 op)
Learning Outcomes: This course aims to teach the skills necessary for the design, implementation and the test of mobile phone applications. The applications are developed with Java Mobile and Android. After completing this course the student will be able to develop Graphical User Interface (GUI) applications with Java Mobile and Android. The student will learn the skills required for a complete Software Development Process by doing a certain project work. To get high points from the project work the student must be creative by adding additional program features. The student will be able to choose the best development platform for a certain project.

Content: In the lectures the theoretical parts required for the exercises and project work are presented. To the course contents belong the memory management, development rules for applications, dynamically linked libraries, concurrency, managing resources, Android example applications, Java Mobile applications and security. The contents of the exercises are the development of Android and Java Mobile applications.


Teaching Methods: 12 h lectures and 12 h exercises

Modes of Study: Lectures, practical exercises, project work and final examination
Languages: English (lectures and exercises)
Grading: Scale 1–5 or fail, final examination (60 %) and project work (40 %)
Responsible Person: Mohammed Elmusrati
Teacher(s): Tobias Glocker
Responsible Unit: Department of Computer Science
Additional Information: Annual course, website teg.uwasa.fi/courses/tlte2040

TELECOMMUNICATION ELECTRONICS
Tietoliikennetekniikan elektroniikka
Code: TLTE2050
Credits: 5 ECTS (5 op)
Prerequisites: Basic studies in electronics and telecommunication
Learning Outcomes: After completing this course successfully, the student will be able to explain what is the meanings of signals in time and frequency domains, what is modulation and demodulations, what is amplitude and frequency modulations and the difference between them, what is analog and digital modulations and the benefits of each of them, the students will be able also to design simple filters and to demonstrate the concepts of electronic circuits required to build analog and digital communication systems.

Content: This course covers the main concepts of signals in time and frequency domains, sensors, filter analysis and design, oscillators, Analog/Digital Phase Locked Loops (PLL) with some applications, AM, PM and FM modulation and demodulation circuits, automatic gain control circuits, digital communication circuits, Analog to Digital Converters (ADC), and some communication systems.

Study Materials:
1. course handout

Teaching Methods: 24 h lectures

Modes of Study: Lectures 24 h, quizzes and final examination
Languages: English
Additional courses, enough courses to reach a total of 30 ECTS must be chosen (in case mandatory courses make less than 30)

NUMERICAL METHODS
Numeeriset Menetelmät

Code: MATH2030
Credits: 5 ECTS
Prerequisites: Basic studies in mathematics
Learning Outcomes: Concepts of numerical methods and softwares

Study Materials:

Teaching Methods: No lectures, book exam
Modes of Study: Exam
Languages: Finnish/English
Grading: 1–5 or fail
Responsible Person: Marko Moisio
Teacher(s): Ehsan Azmoodeh
Responsible Unit: Department of Mathematics and Statistics
Additional Information: –

ADVANCED OPTIMIZATION
Optimoinnin erikoiskurssi

Code: MATH2040
Credits: 5 ECTS
Prerequisites: Calculus, also recommended Linear Algebra and Operations Analysis
Learning Outcomes: To deepen concepts of operation analysis and to give examples of some application areas of optimization.
Content: Limited and unlimited non-linear optimization, special issues of LP model, numerical finding of local extreme, examples of some the special methods of optimization (heuristic methods, dynamic optimization etc.).

Course Study Materials: Lecture material
Teaching Methods: Lectures 36 h and exercises 14 h
Modes of Study: Attendance to exercises and exam
Languages: Finnish/English
Grading: Pass/fail, or on scale 1–5 or fail
Responsible Person: Seppo Hassi
Teacher(s):
Responsible Information: Department of Mathematics and Statistics
Additional information: No teaching, exercise-work, contact responsible person

INFORMATION SECURITY
Tietoturva

Code: TITE2120
Credits: 5 ECTS
Timing: Spring term
Prerequisites:
Learning Outcomes: After completing this study module the student can name and define the fundamental concepts of information security, the student understands the significance information security for the organization and can apply some of its basic concepts in practice, the student is capable to identify and categorize the fundamental elements of security system and by combining them to build a fundamental level of information security system for the company, the student is also capable to identify simple security risks and threads and also propose solutions for them, the student knows and is capable to install a network protocol analyzer and a network surveillance tool.
Content: Introduction to information security, common se-
security models for progress of information security, information security threats and risks assessment

**Study Materials:**
2. Information security handbook: A guide for Managers, NIST special Publication 800-100
3. Contingency Planning Guide for Information Technology Systems, NIST Special Publication 800-34
4. other material provided by the lecturer

**Teaching Methods:** Project work, no teaching in English

**Modes of Study:** Exam and project work

**Grading:** 1–5 or fail (exam), accepted or fail (project work)

**Languages:** Self-study in English, supervising of project work in English

**Responsible Person:** Hannu K. Niinimäki

**Teacher(s):** Hannu K. Niinimäki

**Responsible Unit:** Department of Computer Science

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**DIGITAL CONTROL**

*Digitaalinen säätö*

**Code:** AUTO2090

**Credits:** 5 ECTS

**Prerequisites:** Integral Transforms in addition Digital Signal Processors is recommended

**Learning Outcomes:** After completing this course the student will able to define the basic concepts and terminology of control theory; explain the principle of operation of the digital controller; use PID controller application; calculate and analyse feedback system in frequency plane; simulate simple control systems. The student will know typical applications of digital control such as electrical motor and diesel engine control

**Content:** Laplace transform, transfer functions, feedback, stability, functioning of a digital controller, principles of discrete control, simulation of a controller system with Matlab Control Toolbox, applications and examples of control in automation.

**Study material:**
4. lecture notes and materials

**Teaching Methods:** Lectures 24 hours, exercises 16 hours, project work 20 hours

**Modes of Study:** Exam (AUTO2091 3 ECTS) and project work AUTO2092 2 ECTS

**Languages:** Language(s) of instruction: English; completion language(s): English

**Grading:** Scale 1–5 or fail

**Responsible Person:** Jarmo Alander

**Teacher(s):** Vladimir Bochko

**Responsible Unit:** Department of Electrical Engineering and Energy Technology

**Additional Information:** Annual course

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**Major Studies 40 ECTS**

**Mandatory Courses 13 ECTS**

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**EMBEDDED C-PROGRAMMING**

*Sulautettu C-ohjelmointi*

**Code:** TLTE3170

**Credits:** 5 ECTS

**Learning Outcomes:** This course aims to teach the skills necessary to design and program applications for microcontrollers. After completing this course the student will be able to develop C applications for microcontrollers, besides the programming part, the student will learn the architecture of microcontrollers and the basics of electronic circuits. The student must apply the learned skills in the exercises, to deepen the knowledge each student has to write an exercises report that contains the explanations of the solved exercise tasks.

**Content:** In the lectures the theoretical parts required for the exercises and project work are presented. To the course contents belong I/O ports, delays, interrupts, timer, Pulse Width Modulation, Analog to Digital Converter, Universal Asynchronous Receiver/Transmitter and Serial Peripheral Interface. The exercises contain the development of Embedded C applications related to the previous mentioned course contents.
**Study Materials:** Lecture slides, datasheets of ATMEL ATmega16

**Teaching Methods:** 12 h lectures and 12 h exercises

**Modes of Study:** Lectures, practical exercises and final examination

**Languages:** English (lectures and exercises)

**Grading:** Scale 1–5 or fail, final examination

**Responsible Person:** Timo Mantere

**Teacher(s):** Tobias Glocker

**Responsible Unit:** Department of Computer Science

**Additional Information:** Annual course, website teg.uwasa.fi/courses/TLTE3130

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**ADVANCED COURSE IN SIGNALS AND SYSTEMS**

*Signaalit ja systeemit*

**Code:** TLTE3150

**Credits:** 5 ECTS (5 op)

**Prerequisites:** Digital Signal Processors

**Learning Outcomes:** Improving mathematical skills of the students and introducing new mathematical tools for systems analysis.

**Content:** Time invariant systems, Laplace and Fourier transform and their applications in linear systems, analog filters, state space representation, system modeling using state space representation, difference equations, z-transform, DFT/FFT, digital filter design, introduction to Matlab applications in linear system analysis and simulations.

**Study Materials:**
1. S. Karris: Signals and Systems with MATLAB Computing and Simulink Modeling, Orchard Publications; 3rd edition, 2006 or later
3. lecture notes

**Teaching Methods:** Lectures and exercises 28 h

**Modes of Study:** Exam and homeworks

**Languages:** English

**Grading:** Scale 1–5 or fail

**Responsible Person:** Reino Virrankoski

**Teacher(s):** Reino Virrankoski

**Responsible Unit:** Department of Computer Science

**Additional Information:** Annual course, website cs.uwasa.fi/courses/tlte3010
Major courses, enough to reach a total of 40 ECTS much be chosen

➤ RADIO RESOURCE MANAGEMENT  
Radioresursien hallinta
Code: TLTE3050  
Credits: 5 ECTS (5 op)  
Prerequisites: Digital Communication  
Learning Outcomes: This course aims to cover the main concepts of radio resource scheduling and management as well as its applications to current and future wireless communication networks. After completing this course successfully, the student will be able to explain what are the radio resources and the relations between them. Moreover, the student will be able to compute the optimum transmission power and data rate in multi-user wireless networks. The student will be able also to explain the antennas beamforming and the optimum procedures for admission control.  
Content: This course covers multiple access fundamentals, mobile channel modeling, CDMA systems, performance measure, handover and mobility, power and rate control, dynamic channel allocation, and high-speed packet scheduling techniques.  
Study Materials:  
3. lecture notes  
Teaching Methods: 24 h lectures + 10 h exercises  
Modes of Study: Quizzes, and exam  
Languages: English  
Grading: Scale 1–5 or fail  
Responsible Person: Professor / University Teacher  
Teacher(s): Timo Mantere  
Responsible Unit: Department of Computer Science  
Additional Information: Annual available course, website cs.uwasa.fi/courses/tlte3160

➤ BROADBAND WIRELESS COMMUNICATION  
Laajakaistatekniika
Code: TLTE3030  
Credits: 5 ECTS (5 op)  
Prerequisites: Digital Communication  
Learning Outcomes: This course aims to teach the major theoretical background behind modern wireless high rate networks, there are different broadband wireless network standards such as LTE, WiMAX, IEEE 802.11n, etc., however, the major background to achieve high data rate in a limited bandwidth is common between all standards, after completing this course successfully, the student will be able to explain the main challenges to achieve high data rate in wireless networks, moreover, s/he will be able to demonstrate different techniques to overcome the challenges such as using MIMO, coding, diversity, beamforming,
and OFDM, furthermore, they will be able to classify between the different standards.

**Content:** This course covers wireless channels, efficient digital modulation methods, channel coding, MIMO concepts and methods, Diversity, beamforming, broadband systems: UltrawideBand, LTE, WiMAX, and IEEE 802.11n.

**Study Materials:**
2. A. Goldsmith, Wireless Communication, Cambridge Univ. Press, 2005
3. lecture notes

**Teaching Methods:** 24 h lectures + 10 h exercises

**Modes of Study:** Quizzes, presentation and report

**Languages:** English

**Grading:** Scale 1–5 or fail

**Responsible Person:** Timo Mantere

**Teacher(s):** –

**Responsible Unit:** Department of Computer Science

**Additional Information:** Every second year, website cs.uwasa.fi/courses/tlte3030

## SPECIAL TOPICS IN TELECOMMUNICATIONS

*Tietoliikennetekniikan erityiskysymyksiä*

**Code:** TLTE3070

**Credits:** 1–8 ECTS

**Prerequisites:** Depend on particular topic

**Learning Outcomes:** Communication and systems engineering and their applications is one of the fastest growing fields in the applied science, hence, the aim of this course is to introduce new topics and subjects to track new fields, the main goal is to introduce new topics and quickly react to the needs of evolving modern telecommunications, automation and energy technology, participants should learn a topical subject or deepen their insight in a theoretical question.

**Content:** This course has changing content; the current content is always indicated by the course subtitle presented on the course website.

**Study Materials:** Depend on the topic

**Teaching Methods:** Depend on the topic; it can be organized as normal lectures or reading books/papers or both

**Modes of Study:** Varying and depend on the topic

**Languages:** English

**Grading:** Scale 1–5 or fail, or pass/fail (depending on the topic)

**Responsible Person:** Mohammed Elmusrati

**Teacher(s):** Mohammed Elmusrati

**Responsible Unit:** Department of Computer Science

**Additional Information:** Annual course, website cs.uwasa.fi/courses/tlte3070

## PROJECT WORK IN COMMUNICATIONS AND SYSTEMS ENGINEERING

*Tietoliikennetekniikan projektityö*

**Code:** TLTE3080

**Credits:** 3–15 ECTS

**Prerequisites:** Related subject studies on communications and systems engineering

**Learning Outcomes:** Communication and systems engineering and its applications consists of many and vast different topics. The aim of this course is to give the students the chance to study and perform small projects related to some interesting topics in communications, automation and energy. The student learns to study/handle real life scientific problems, the topic of the project work must be decided with the agreement with the supervisor. In general, suitable topics can be suggested from network design, dimensioning, performance analysis, electronics, service concepts and hardware/software design, automation, energy delivery systems, discussions solving a small research problem as well as literature surveys are also possible project work topics.

**Content:** This course has changing content; the current content is always indicated by the course subtitle presented on the course website.

**Study materials:** Depend on the topic

**Teaching Methods:** Depend on the topic

**Modes of Study:** Varying and depend on the topic

**Languages:** English

**Grading:** Scale 1–5 or fail, or pass/fail (depends on the topic)

**Responsible Person:** Mohammed Elmusrati

**Teacher(s):** Mohammed Elmusrati

**Responsible Unit:** Department of Computer Science

**Additional Information:** Annual course, website cs.uwasa.fi/courses/tlte3080
COMMUNICATIONS AND SYSTEMS ENGINEERING SEMINAR
Tietoliikennetekniikan seminaari

Code: TLTE3090
Credits: 3–10 ECTS
Prerequisites: Related subject studies on communications and systems engineering
Learning Outcomes: The aim of this course is to introduce research oriented topics in telecommunications and systems, after completing this course successfully, the student will be able to seek scientific information and to prepare and give seminar presentations, moreover, they will be able to demonstrate the principles of the seminar topic.
Content: This course has varying contents, the current content is always indicated by the course subtitle presented in the course website.
Study Materials: Depend on the topic
Teaching Methods: Depend on the topic
Modes of Study: Attending seminar sessions, quizzes, preparing scientific report and giving at least one presentation
Languages: English
Grading: Scale 1–5 or fail or passed/failed (depends on the topic)
Responsible Person: Mohammed Elmusrati and Reino Virrankoski
Teacher(s): Mohammed Elmusrati and Reino Virrankoski
Responsible Unit: Department of Computer Science
Additional Information: Annual course, website cs.uwasa.fi/courses/tlte3090

TELETRAFFIC THEORY
Tietoliikenneteoria

Code: TLTE3040
Credits: 5 ECTS (5 op)
Prerequisites: Telecommunication Architectures and basic course in probability
Learning Outcomes: This course covers elementary queueing theory and its application to teletraffic and network modelling, in addition, performance analysis methods and network dimensioning based on grade of service constraints are addressed.
Content: This course covers revision for probability theory, time interval modeling, Erlang loss systems, Dimensioning of telecommunication networks, Markovian process, Queuing networks, and performance measurements and simulation.
Study Materials:
1. lecture notes
Teaching Methods: Lectures 24 h and exercises 12 h
Modes of Study: Exam and homeworks
Languages: English
Grading: Scale 1–5 or fail
Responsible Person: Timo Mantere
Teacher(s): —
**COMPUTER SIMULATION IN COMMUNICATION AND SYSTEMS**
_Tietoliikennejärjestelmien simulointi_

**Code:** TLTE3120  
**Credits:** 5 ECTS

**Prerequisites:** The basics courses of mathematics

**Learning Outcomes:** The students will learn how to design and perform simulations by using MATLAB and SIMULINK by following system engineering practices, other simulation software may be visited briefly.

**Content:**

**Study Materials:**
1. lecture notes  
2. MATLAB documentation, www.mathworks.com  
3. SIMULINK documentation

**Teaching Methods:** Lectures 24 h, exercises 24 h, mandatory homework

**Modes of Study:** Passing the exam, exercises and mandatory homework

**Languages:** English

**Grading:** Scale 1–5 or fail

**Responsible Person:** Timo Mantere

**Teacher(s):** Reino Virrankoski

**Responsible Unit:** Department of Computer Science

**Additional Information:** Annual course, website cs.uwasa.fi/courses/tlte3120

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**INTRODUCTION TO RADIO TECHNOLOGY**  
_Radiotekniikka_

**Code:** TLTE3060  
**Credits:** 5 ECTS (5 op)

**Prerequisites:** Physics and Telecommunication Electronics

**Learning Outcomes:** This course aims to cover the concepts of RF electronic components, transmission lines, and circuits at high frequencies. After completing this course successfully, the student will be able to model several electronic components at very high frequencies. Moreover, they will be able to explain the theoretical concepts of electromagnetic propagation, antennas, microwave equipment, and RF amplifiers. The student will be able to analyse transmission lines at high frequencies using Smith Charts as well as matching techniques.

**Content:** This course covers introduction to electromagnetic and Maxwell’s equations, antennas and propagation, passive RF component modeling, transmission line analysis, Smith chart, matching techniques, single and multi-port network analysis, waveguides, active RF components, RF amplifiers and microwave equipment.

**Study Materials:**
1. lecture notes  

**Teaching Methods:** Lectures 24 h, quizzes and exam

**Modes of Study:** Lectures 24 h, quizzes and exam

**Languages:** English

**Grading:** Scale 1–5 or fail

**Responsible Person:** Timo Mantere

**Teacher(s):** –

**Responsible Unit:** Department of Computer Science

**Additional Information:** Every second year, website cs.uwasa.fi/courses/tlte3060

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**CRYPTOGRAPHY**  
_Salausmenetelmät_

**Code:** TITE3140  
**Credits:** 5 ECTS

**Recommended time of completion:** Spring term

**Prerequisites:** Information Security

**Learning Outcomes:** To understand principles of classic modern cryptography, is familiar with the operation of the most common public key and secret key encryption methods, and knows how to use them, understands principles of modern hash methods and knows how to use them to improve information security.

**Content:** Basic methods of cryptography, progress of cryptography, modern secret key and public-key encryption, and authentication.

**Study Materials:**
1. lecture slides
ANALYSIS AND DESIGN OF HUMAN COMPUTER INTERACTION

Code: TITE3070
Credits: 5 ECTS
Prerequisites: –

Learning Outcomes: After passing this course the student has adopted the basic concepts and terminology in the field, the student understands the basic functions and functional principles of user interfaces, and has reached the readiness for analyzing and developing human-computer interaction in a user-centered design process towards improved usability, the student is able to apply and modify the user-centered interface design process for small user interface development projects, the student is able to extend his/her skills and knowledge by studying the subject further on independently

Content: Introduction to analysis and design of human computer interaction, practical analysis and design exercises

Study Material:
1. Material informed during lectures
Recommended reading:
   - Benyon, David (2014), Designing interactive systems: a comprehensive guide to HCI, UX and interaction design, Pearson
   - Cooper, Reimann, Cronin & Noessel (2014), About the Face, The essential of interaction design, Wiley
   - Shneiderman B., and Plaisant C. (2005 or newer): Designing the User Interface, Addison-Wesley


   Teaching Methods: Lectures 24 h, exercises 20 h, supervision of project work

   Modes of Study: Project works and exercises

   Languages: Language of instruction: English; completion language(s): English or Finnish

   Grading: 1–5 or fail

   Responsible Person: Laura Lappalainen

   Teacher(s): Laura Lappalainen

   Responsible Unit: Department of Computer Science

   Additional Information: –

DIGITAL SIGNAL PROCESSORS

Signaaliprosessorit

Code: AUTO3310
Credits: 5 ECTS
Prerequisites: Sound Processing

Learning Outcomes: After completing the course, student can:

- design digital filters and other typical algorithms of signal processing,
- implement filters efficiently by utilizing the peculiarities of DSP processors,
- explain and take into account the finite word length effects in signal processing, and
- explain the possibilities and requirements of multirate signal processing.

Content: Design of FIR and IIR filters and their implementation topologies, features of DSP processors, fixed-point calculation, multirate signal processing, finite word length phenomena, applications, and student labs/projects using a DSP processor.

Study Materials:
4. Lecture notes
Teaching Methods: Lectures 24 h, exercises 16 h, project work 20 h
Modes of Study: Exam (AUTO3311 3 ECTS) and project work (AUTO3312 2 ECTS)
Languages: English
Grading: 1–5 or fail
Responsible Person: Janne Koljonen
Teacher(s): –
Responsible Unit: Department of Electrical Engineering and Energy Technology
Additional Information: Every second year, next time 2016–2017

**SOUND PROCESSING**

*Sound Processing*

**Code:** AUTO3290  
**Credits:** 5 ECTS  
**Prerequisites:** Basic knowledge in Signal Processing and Programming  
**Learning Outcomes:** After completing the course the student can:  
- explain the basics common sound and signal processing methods,  
- implement and analyze sound and signal processing methods,  
- design, implement, test, and report a simple sound processing application  
**Content:** Digitalization, storing, and compression of sound; frequency analysis; audio signal restoration; pitch shift; digital filters; sound effects; speech recognition; vibration analysis; independent component analysis (ICA), signal processing in Matlab.  
**Study Materials:** Literature provided by the teacher  
**Teaching Methods:** The course is mainly studied independently; there are additionally 26 h of lectures/exercises/guidance to assist learning  
**Modes of Study:** Exam, 8 sets of exercises, and project work  
**Languages:** English  
**Grading:** 1–5 or fail  
**Responsible Person:** Janne Koljonen  
**Teacher(s):** Janne Koljonen  
**Responsible Unit:** Department of Electrical Engineering and Energy Technology  
**Additional Information:** Annual course

**MACHINE VISION**

*Konenäkö*

**Code:** AUTO3110  
**Credits:** 5 ECTS  
**Prerequisites:** Digital Signal Processors, recommended Sound Processing  
**Learning Outcomes:** After completing the course the student can:  
- Design a machine vision system in its entirety  
- Use Matlab in image processing and complete own image processing functions in M# language  
- Use a smart camera and choose the appropriate functions suitable for solving the problem at hand  
- Test and compare the suitability of different machine vision functions  
- Acknowledge the good practices as well as the potentially problematic areas of group work and how different personalities impact group dynamics  
**Content:** Typical machine vision systems and their components, image processing, calibration, 3D geometry and applications  
**Study Materials:**  
2. Lecture notes  
**Teaching Methods:** Lectures 24 h (in Finnish only), exercises 16 h (in Finnish only), project work 20 h  
**Modes of Study:** Exam (AUTO3111 3 op) and project work (AUTO3112 2 op)  
**Languages:** Finnish, possible to complete in English (exam and project work)  
**Grading:** 1–5 or fail  
**Responsible Person:** Janne Koljonen  
**Teacher(s):** Janne Koljonen  
**Responsible Unit:** Department of Electrical Engineering and Energy Technology  
**Additional Information:** The course is organized every second year, organized during 2015–2016
1.8.2014, all master’s theses will be checked with the Turnitin plagiarism detection software.

Business Studies

Mandatory for Finnish Students, recommended for others.

Choose at least 14 ECTS from the following courses (in Finnish only):

TUOTEKEHITYS JA IPR
Product Development and IPR
Koodi: AUTO3350
Laajuus: 4–8 op
Edellytykset: –
Osaamistavoitteet: Opintojakson suoritettua opiskelija osaa: suunnitella, toteuttaa, testata ja raportoida yksinkertaisen tuotantoautomaation tuotekehitysprojektin niin teknisesti kuin liiketoiminnan, erityisesti IPR, näkökulmasta (patentointi, lisensiointi yms.).
Sisältö: Automaation aihealueisiin liittyvää itsenäisesti tai pienryhmissä tehtävää käytännönläheisen tuotekehitys tms. työ, raportti ja esittely, yksilöllisiä töitä, aiheesta ja laajuudesta sovittava etukäteen ohjaajan kanssa, voidaan hyväksyä myös esimerkiksi tietotekniikan, sähköteknikan ja tuotantotalouden aihealueilta tehtäviä töitä, joihin sisältyy IPR-osuus, IPR-oikeudet ja niiden käsittely tuotekehityksessä ja liiketoiminnassa, tuotekehitys osana liiketoimintaa. HUOM! järjestetään yhteistyössä useamman oppiaineen ja oppilaitoksen sekä alueen teollisuuden kanssa.
Oppimateriaali ja kirjallisuus: Luennoilla ilmoitettava kirjallisuus
Toteutustavat: Luennot 10 h, seminaari 20 h (esitelmät), pienryhmätyöskeltely (workshop), yritysvierailut n. 10 h
Suoritustavat: Harjoitustyöraportit ja esitelmät
Opetus- ja suorituskieli: Suomi/englanti (tarpeen mukaan)
Arvostelu: Asteikolla 1–5 tai hylätty
Vastuuhenkilö: Jarmo Alander
Opettaja: Jarmo Alander ja NN
Vastuuorganisaatio: Sähkö- ja energiatekniikan yksikkö
Lisätietoja: Vaihtuvalaajuinen, voi koostua useasta pienemmästä projektista, järjestetään joka vuosi, harjoitustyö

**ENERGIATEKNIIKAN PROJEKTITYÖ 1-3**

*Project Work in Energy Technology 1 to 3*

**Koodi:** ENER3070  
**Laajuus:** Enintään 20 op

**Edellytykset:**

**Osaamistavoitteet:** Opiskelija ratkaisee jonkin energiatekniikan ajankohtaisen ongelman, kehittää jokin energiatekniikan menetelmän tai sovelluksen tai syventyy jonkin energiatekniikan ajankohtaisen pulma- tai tutkimuskysymyksen taustoittamiseen.

**Sisältö:** Sisällöltään muuttuva-aiheinen opintojakso, jossa yllä mainitut tavoitteet saavutetaan, voidaan sisällyttää opintoihin 1…3 kertaa erisisältöisenä.

**Oppimateriaali ja kirjallisuus:** Tavoitteen mukaan

**Toteutustavat:**

- Itsenäinen, yksilöllisesti sovittu tai ryhmätyö
- Laboratoriomittaus tulosanalysointeen, luentokoelma, kongressi- tai symposiumireferaatti, vierailuluennot, tms.

**Suoritustavat:** Sovitaan erikseen

**Opetus- ja suorituskieli:** Suomi

**Arvostelu:** Asteikolla 1–5 tai hylätty (harjoitustyöt)

**Vastuuhenkilö:** Seppo Niemi

**Oppettaja:** Seppo Niemi

**Vastuuorganisaatio:** Sähkö- ja energiatekniikan yksikkö

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**PÄÄTÖKSENTEKO EPÄVARMUUDEEN VALLITESSA**

*Decision Analysis*

**Koodi:** ORMS2020  
**Laajuus:** 5 op

**Edellytykset:** Talousmatematiikan perusteet ja Tilastotieteen perusteet

**Osaamistavoitteet:** Opintojakson suorittamalla saadaan opiskelija ymmärtää, että epävarmuuden vallitessa tapahtuvaa päätöksentekoa on mahdollisuus etukäteen analysoida ja tietysten määräntä vastaamalla päätöksenteeseen päätöspuun ja -matriisin muotoon, ratkaista sen sekä ymmärtää ja osaa mallintaa myös käytettävissä/hankittavissa olevan lisäinformaation merkityksen päätöstitanteessa

**Sisältö:** Todennäköisyyskäsitteet ja -laskenta, päätösmatrissi, päätöspuut, todennäköisyyskien estimointi, hyötyteoria, hyötyteorian kriitikki

**Oppimateriaali ja kirjallisuus:**

1. Hyvönen, Eero, toim. (2003), Ohjelmistoliiketoiminta, WSOY
2. Tieteelliset artikkelit sekä luontomateriaali

**Toteutustavat:** Monimuoto-opetus 40 h

**Suoritustavat:** Tentti ja harjoitustyöt

**Opetus- ja suorituskieli:** Suomi

**Arvostelu:** Asteikolla 1–5 tai hylätty (tentti), hyväksytty/hylätty (harjoitustyöt)

**Vastuuhenkilö:** Johanna Aalto

**Oppettaja:** Ilmoitetaan myöhemmin

**Vastuuorganisaatio:** Tieto- ja tietoliikennetekniikan yksikkö

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**OHJELMISTOLIIKETOIMINTA**

*Software Business*

**Koodi:** TITE3300  
**Laajuus:** 5 op

**Edellytykset:** Ohjelmistotuotanto, lisäksi suositellaan liiketoimintaosaamisen opintoja

**Osaamistavoitteet:** kurssin suorittanut tuntee ohjelmistoalaa ja yrittäjyyden ulottuvuuksia ja on tutustunut ohjelmistoalan liiketoimintamalleihin, ohjelmistojen ja niihin liittyvien palvelujen tuotteistamiseen, jakeluvälineiden luomiseen ja markkinointiin, olemassa olevien yritysten analysointi ja tieteellisten tutkimusartikkelien käsitteily rakentaa kokonaiskuvan toimialasta

**Sisältö:** Ohjelmistoala, alan liiketoimintamallit, ohjelmistojen tuotteistaminen ja markkinointi, ohjelmistoyrityksen rahoitus, talous, oikeuskysymykset ja johtaminen

**Oppimateriaali ja kirjallisuus:**

1. Hyvönen, Eero, toim. (2003), Ohjelmistoliiketoiminta, WSOY
2. Tieteelliset artikkelit sekä luontomateriaali

**Toteutustavat:** Monimuoto-opetus 40 h

**Suoritustavat:** Tentti ja harjoitustyöt

**Opetus- ja suorituskieli:** Suomi

**Arvostelu:** Asteikolla 1–5 tai hylätty (tentti), hyväksytty/hylätty (harjoitustyöt)

**Vastuuhenkilö:** Johanna Aalto

**Opettaja:** Ilmoitetaan myöhemmin

**Vastuuorganisaatio:** Tieto- ja tietoliikennetekniikan yksikkö

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**Vastuuorganisaatio:** Matemaattisten tieteiden yksikkö

**Lisätietoja:** www.uwasa.fi/~tsottinen/orms2020, ei järjestetä lv 2015–2016
JOHDATUS VERKKOLIIKETOIMINTAAN

Introduction to E-business

Koodi: TITE2220

Laajuus: 5 op

Edellytykset: –

Osaamistavoitteet: Opintojakson suoritettuaan opiskelija pystyy selittämään e-liiketoiminnan keskeisimmät termit, opiskelija pystyy tunnistamaan yksinkertaisen sähköisen kauppapaikan toiminnan kannalta keskeiset komponentit ja tietää niiden merkityksen kauppapaikalle, opiskelija osaa myös asentaa ja muokata perustavan, avoimen lähdekoodin perustuvan kehittyneemman sovelluksen ja osaa muokata sitä ja lisätä siihen uusia moduleja.

Sisältö: Kurssilla käsitellään hakukoneoptimointia eli sitä, kuinka verkkosivut suunnitellaan ja toteutetaan hakukoneita ajatellen, lisäksi tarkastellaan pilvilaskennan kehitystä ja käyttöä Internetissä, opiskelijat toteuttavat harjoitustyönä avoimen lähdekoodin sisällönhallintajärjestelmän ja siihen liittyvän blogin.

Oppimateriaali ja kirjallisuus:
3. opetusmoniste ja muu luennolla ilmoitettava materiaali

Toteutustavat: Luennot 24 h, harjoitukset 12 h

Suoritustavat: Tentti ja harjoitustyö

Opetus- ja suorituskieli: Suomi

Arvostelu: Asteikolla 1–5 tai hylätty

Vastuuhenkilö: Johanna Aalto

Opettaja: –

Lisätietoja: Järjestetään joka toinen vuosi, ei järjestetä lukuvuonna 2015–2016

INFORMAATIOYHTEISKUNTA

Information Society

Koodi: TITE3060

Laajuus: 5 op

Edellytykset: –

Osaamistavoitteet: Opintojakson jälkeen opiskelija osaa arvioida erilaisista näkökulmista yhteiskunnan kehittymistä informaatioyhteiskunnaksi ja tämän kehityksen vaikutuksia monipuolisesti koko yhteiskunnan osalta

Sisältö: Opetellaan kriittisesti arvioimaan informaatioyhteiskuntaukselle keskeisten elementtien merkityksiä ja vaikutuksia, sekä analyyyttisesti tarkastelemaan yhteiskunnan muutoksen vaikutuksia sekä elämänmuutamisessa

Oppimateriaali ja kirjallisuus: Luennolla ilmoitettava materiaali

Toteutustavat: Luennot ja seminaari-istunnot 24 h

Suoritustavat: Esset ja seminaariesitelmä

Opetus- ja suorituskieli: Suomi

Arvostelu: Asteikolla 1–5 tai hylätty

SÄHKÖISEN KAUPANKÄYNNIN ERIKOISKURSSI

Special Course in e-Commerce

Koodi: TITE3160

Laajuus: 5 op

Edellytykset: Web-teknologiat, suositellaan Ohjelmointia

Osaamistavoitteet: Opintojakson suoritettuaan opiskelija osaa optimoida yrityksen tai organisaation verkkosivut hakukoneita varten ja tietää hakukoneoptimoinnin peruskäsitteistön, lisäksi opiskelija osaa pilvilaskennan peruskäsitteet ja palvelut sekä osaa selittää mitä pilvilaskennalla tarkoitetaan, opiskelija osaa myös asentaa avoimeen lähdekoodiin perustuvan kehittyneemän sovelluksen ja osaa muokata sitä ja lisätä siihen uusia moduleja.

Sisältö: Kurssilla käsitellään hakukoneoptimointia eli sitä, kuinka verkkosivut suunnitellaan ja toteutetaan hakukoneita ajatellen, lisäksi tarkastellaan pilvilaskennan kehitystä ja käyttöä Internetissä, opiskelijat toteuttavat harjoitustyönä avoimen lähdekoodin sisällönhallintajärjestelmän ja siihen liittyvän blogin.

Oppimateriaali ja kirjallisuus:
3. opetusmoniste ja muu luennolla ilmoitettava materiaali

Toteutustavat: Luennot 24 h, harjoitukset 12 h

Suoritustavat: Tentti ja harjoitustyö

Opetus- ja suorituskieli: Suomi

Arvostelu: Asteikolla 1–5 tai hylätty

Vastuuhenkilö: Johanna Aalto

Opettaja: –

Lisätietoja: Järjestetään joka toinen vuosi, ei järjestetä lukuvuonna 2015–2016
Optional Studies

**PRACTICAL TRAINING**
Työh Harjoittelu

**Code:** TLTE3950
**Credits:** 1–10 ECTS

**Prerequisites:** Communication and systems engineering basic studies

**Learning Outcomes:** In practical training the student familiarizes with working environment and work in communications and systems field by working in a company or an organization and learns to apply studied theory in practice.

**Content:** Training/internship in a company or organization, the aim is to gather practical work experience in the field of communications and systems engineering.

**Literature:** –

**Study Materials:** –

**Teaching Methods:** Practical work experience

**Modes of Study:** Practical training and written report

**Languages:** Finnish, English

**Grading:** Pass/fail

**Responsible Person:** Professor / University Teacher

**Teacher(s):** Professor / University Teacher, Reino Virrankoski

**Responsible Unit:** Department of Computer Science and Telecommunication

**Additional Information:** www.uva.fi/en/for/student/studies/study/practice/internship/credits

**Participation:** Training/internship, a two week (á 40 hours) training period is equivalent to 1 ECTS credit, the Department approves the course credits on the basis of the student’s written internship report and the attached work certificate, training should be discussed and agreed beforehand with the supervisor.

**FINNISH FOR FOREIGNERS II**
Suomea ulkomaalaisille II

**Credits:** 5 ECTS

**Code:** KSUO5112

**Semester:** –

**Previous studies:** Finnish for Foreigners I, or equivalent knowledge of Finnish.
**Course Aim:** CEFR Level A2  
**Aim:** The student can express her/his opinion, arrange for a meeting and write brief texts on familiar subjects (for example an email message).

**Content:** The emphasis is on different kinds of themes such as me and my history, everyday life, working life and society. Students will improve their practical language skills.

**Teaching:** Lectures and exercises 60 hours  
**Requirements for the credit units:** Participation in lectures and exercises. Oral and written exercises in class. A passing grade in group work. A written exam.

**Literature:**  
- White, Leila (2008): Suomen kieliooppia ulkomaalaisille
- Other materials provided by the lecturer

**Evaluation:** on a scale of 1–5 or fail. The grade consists of attendance, active participation in class and a written exam at the end of the course.

**Contact person:** Marjut Männistö  
**Language of instruction:** To be taught in Finnish and English.

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**FINNISH FOR FOREIGNERS III**  
*Suomea ulkomaalaisille III*

**Credits:** 3 ECTS  
**Code:** KSUO5113  
**Semester:** –

**Previous studies:** Finnish for Foreigners I–II, or equivalent knowledge of Finnish.

**Course Aim:** CEFR Level A2.1  
**Aim:** The student can express her/himself in versatile ways (to express wishes, opinions and thoughts). The student can use polite Finnish and begins to recognize different language registers. The student is able to read simple newspaper texts using a dictionary.

**Contents:** The student’s oral and written language skills will be improved and the vocabulary expanded by means of different kind of texts and articles.

**Teaching:** Lectures and exercises 30 hours  
**Requirements for the credit units:** Participation in lectures and exercises. A written exam.
INFORMATION SKILLS II
Tiedonhankintataidot II

Code: OPIS0026
Credits: 1 ECTS
Recommended time of completion: First year
Prerequisites: OPIS0025 Information Skills 1
Learning Outcomes: Students are able to retrieve scholarly information from international databases using advanced search techniques and know how to evaluate search results critically.
Content: Systematic information seeking, construction or search strategies using advanced search techniques, knowledge of subject specific resources and reference techniques in the student’s own discipline, critical evaluation of information sources.
Study Materials: Online course material
Teaching Methods: Obligatory lecture 2 h, online training
Modes of Study: Online assignments and a multiple choice exam
Languages: English
Grading: Pass/failed
Responsible Person: Information Specialist Heidi Troberg
Teacher(s): –
Responsible Unit: Tritonia
Additional Information: www.tritonia.fi/?d=139&l=3

INTRODUCTION TO E-BUSINESS
Johdatus verkkoliiketoimintaan

Code: TITE2220
Credits: 5 ECTS
Timing: Autumn term
Prerequisites: –
Learning Outcomes: After completing this course student is familiar with the terminology of E-commerce. Student can recognize the central components for an E-commerce site and understands the meaning of those components for the business. Student knows how to install and modify a small open-source application related to the topic.
Content: basics of E-commerce, infrastructure and components, internet security, online payments, online marketing
Study Materials:
Turban E., King, Lee, Liang & Turban D. (2008 or newer), Electronic Commerce 2008 - A Managerial Perspectice, Prentice Hall,
Laudon & Traver (2010 or newer), E-Commerce: Business, Technology, Society, Pearson
Teaching Methods: lectures 24 h, exercises 12 h
Modes of Study: exam and project work
Language(s): Teaching language: English, Completion language: English or Finnish
Grading: 1–5 or failed
Responsible Person: Johanna Aalto
Teacher(s): University Teacher
Responsible Unit: Department of Computer Science
Additional Information: Exchange students are required to register for the course beforehand to KILMO
kilmo.uwasa.fi/index.php?page=exchange

Other Mathematical, Automation, Energy, and Communications and Systems engineering courses