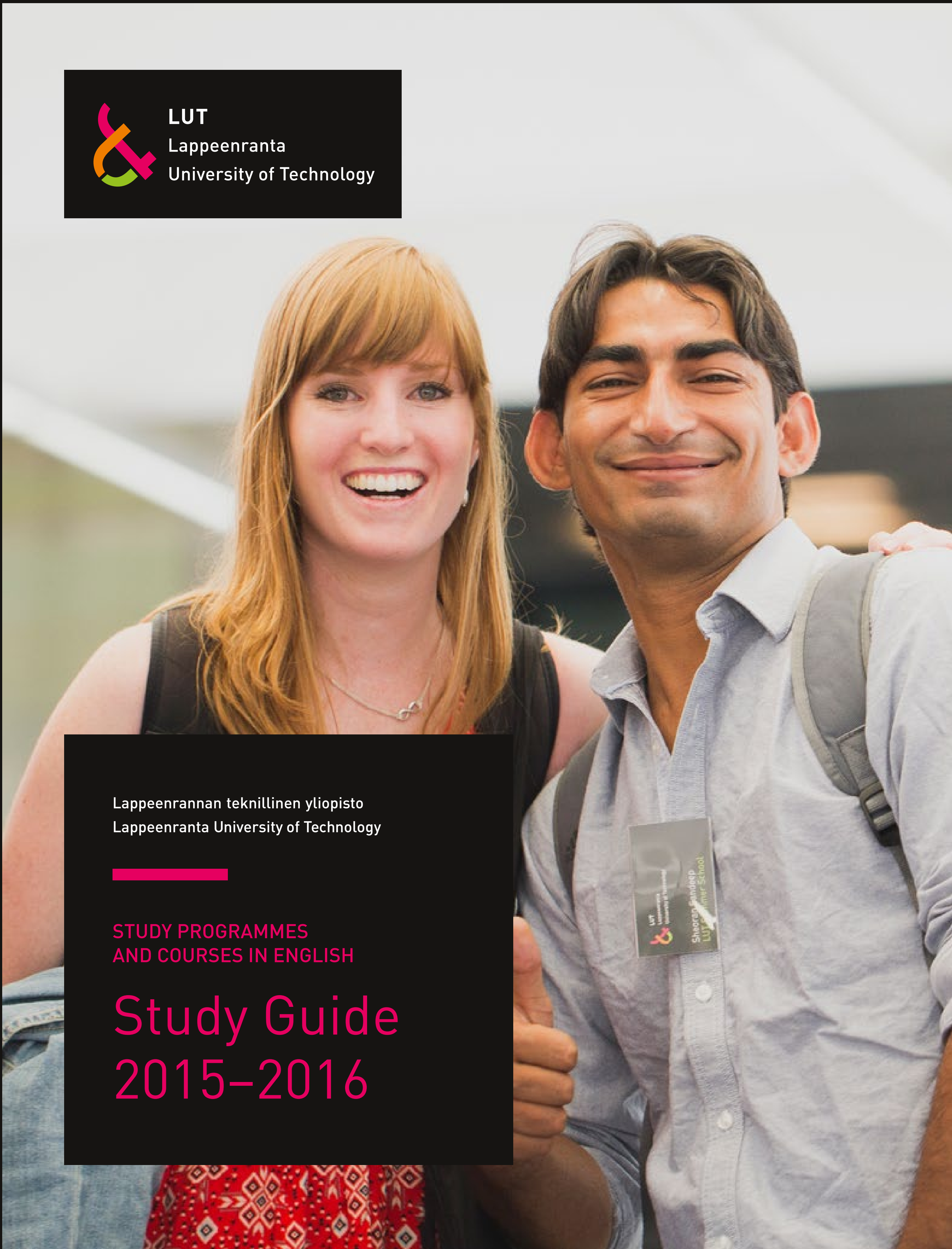

LUT
Lappeenranta
University of Technology

Lappeenrannan teknillinen yliopisto
Lappeenranta University of Technology

STUDY PROGRAMMES
AND COURSES IN ENGLISH

Study Guide 2015–2016

STUDY GUIDE 2015-2016

STUDY PROGRAMMES AND COURSES IN ENGLISH

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LUT
Lappeenranta
University of Technology

WE SHOW THE WAY

Clean energy and water, a circular economy and sustainable business are pivotal questions for humankind to which LUT seeks solutions through expertise in technology and business. We educate experts not only for a changing world, but to change the world.

The four key questions of the LUT Trailblazer strategy are: Will we burn up everything? Is humanity condemned to suffer from the water it has polluted? Will waste be the grave of our future? Will we let Europe degenerate to the world's backyard? The answer is: no. We are the difference-makers.

In the THE ranking, LUT was among the world's top 300 universities and the best under 50-year-old university in the Nordic countries. LUT's 6500 students and experts represent nearly 70 different nationalities. Our strengths are our agility, optimal size, specialisation and way of working together. The LUT School of Business and Management, the LUT School of Energy Systems and the LUT School of Engineering offer a wide range of possibilities to cross the boundaries of different fields of science and to think and work in a new way.

Make the most of your studies at our university in an "open your mind" spirit and start shaping the future.

THE UNIVERSITY'S ACADEMIC YEAR

1 August 2015 – 31 July 2016

<u>AUTUMN SEMESTER 2015</u>

Orientation days for new students	31.8. – 4.9.2015
1st teaching period, weeks 37 – 42	7.9. – 16.10.2015
Intensive and exam week, week 43	19.10. – 23.10.2015
2nd teaching period, weeks 44 – 49	26.10. – 4.12.2015
Intensive and exam week, weeks 50 and 51	7.12. – 18.12.2015
No instruction or examinations, weeks 52 and 53	21.12.2015 – 1.1.2016

<u>SPRING SEMESTER 2016</u>

Intensive week, week 1, only intensive instruction	4.1. – 8.1.2016
3rd teaching period, weeks 2 - 7	11.1. – 19.2.2016
Exam week, week 8	22.2. – 26.2.2016
Intensive week, week 9, also exam retakes in the evening	29.2. – 4.3.2016
4th teaching period, weeks 10 - 15	7.3. – 15.4.2016
Intensive week, weeks 16 and 17, only intensive instruction	18.4. – 29.4.2016
Exam week, weeks 18 – 20	2.5. – 20.5.2016
Intensive week, week 21, also exam retakes In the morning and evening	23.5. – 27.5.2016

During the teaching periods the examination schedule includes exams on Mondays, Tuesdays, Wednesdays and Thursdays from 16:15 to 19:15 (four-hour exams from 16:15 to 20:15).

On examination weeks exams are arranged from Monday to Friday:

8:30-11:30
12:00-16:00 only Language Centre exams
16:15-19:15 (four-hour exams from 16:15 to 20:15)

The **exam and course schedules** are available in the Uni portal.

1. STUDYING AT LAPPEENRANTA UNIVERSITY OF TECHNOLOGY

Study guides

This study guide includes information on all of the Master's programmes in English at Lappeenranta University of Techology and on all of the university's courses in English. The guide includes the degree structures, curricula and courses of the Master's programmes, minor subjects in English and Language Centre courses. In addition, it gives instructions and explains practical matters related to studies. Please read the study guide carefully – it will provide answers to many questions related to your studies.

Information on degree programmes in Finnish is available in the LUT's other study guides. Details on language studies are given in the Language Centre study guide. All study guides are available in the university's Uni portal.

Changes to the information in the study guides may be made during the course of the academic year. Further information on such changes will be provided in the Uni portal.

Uni portal

The Uni portal is a student online service which provides access to information and information systems related to studies. On the Uni's personalized home page, students can view information from Moodle, Noppa and their e-mail account, and the page provides direct access to all of these systems.

Current issues concerning studies and teaching are informed jointly in LUT News-section of Uni portal so News should be followed regularly. Current issues concerning courses are informed in Moodle or Noppa.

The Studies page in the Uni portal includes all of the information needed in studies, such as examinations, course schedules, student services and graduation. Information and instructions specific to each degree programme can be found under the degree programme. In Uni portal you can find the information about the Doctoral Studies and our Campus area.

Uni can be accessed at uni.lut.fi.

Study Right and Registration

LUT degree students must register each academic year as attending or non-attending. Each student who wishes to take part in lectures, assignments, examinations or other forms of teaching or wishes to graduate must register as attending and pay the student union membership fee.

Registration for the academic year 2015-2016 starts 1 June 2015 and ends 31 August 2015. The re-enrolment fee will be charged if the registration is late. **The student union membership fee must be paid by all undergraduate students registered as attending.** ***You may not register for courses or exams before you have registered for the academic year and paid the student union fee.*** Students who have not registered by the deadline will be removed from the student register and will no longer be entitled to study at LUT.

Under the Universities Act, students who have been admitted to only the Master's degree (120 ECTS cr) must carry out their studies in 4 years. LUT's Master's programmes in English may have their own restrictions regarding the duration of the programme and the right to study.

For further information on registration, please contact the LUT Student Services Centre.

WebOodi

WebOodi is the user interface for LUT students through which they register for exams, courses, midterms and the academic year, and also monitor the records on the courses they complete. In WebOodi you can also request that an unofficial transcript of records be sent to you directly via e-mail.

The WebOodi web page is weboodi.lut.fi, and the system can also be accessed directly through the Uni portal. New students will receive instruction on the use of WebOodi during orientation.

You should primarily register through WebOodi. If for some reason you cannot do so, you may also register by sending an e-mail to the LUT Student Services Centre, opinto(at)lut.fi, by the registration deadline. If necessary, you may also telephone or visit the LUT Student Services Centre during its opening hours.

Students themselves are responsible for updating their personal information in the student register, so that the university staff will be able to contact when needed. You should update the information (e.g. address, e-mail and telephone) in WebOodi. If you cannot access WebOodi, you should give the information directly to the LUT Student Services Centre.

Registration for Courses

The times and places of the courses are given in the course schedule in the Uni portal.

You must register for a course before it begins. You should register for courses again each year if you wish to take part in the related lectures, tutorials or other instruction. Students register for courses through WebOodi.

Enrolment for courses in the autumn semester 2015 starts on 1 August 2015, and for courses in the spring semester 2016 on 1 December 2016. Enrolment for each period ends as follows:

Registration for courses in Period 1 ends	Sat, 5 Sep 2015 at 20:00
Registration for courses in Period 2 ends	Mon, 19 Oct. 2015 at 23:59
Registration for courses in Period 3 ends	Mon, 4 Jan. 2016 at 23:59
Registration for courses in Period 4 ends	Mon, 29 Febr. 2016 at 23:59

Registration for courses arranged during the intensive weeks ends a week before the start of the intensive week, on Mondays.

In the autumn semester, lectures start on Monday 7 September 2015, and in the spring semester on Monday 11 January 2016.

Remember to register for both courses and exams separately, because the registration for a course is not a registration for an exam.

Registration for Exams and Midterms

The dates of examinations (incl. final exams, midterms, Language Centre exams) are available in the examination schedule in the Uni portal. Students register for examinations through WebOodi.

Registration starts four weeks before the exam date and ends one week before the exam.

Students may take each course examination three times. If a student does not pass the examination after taking it three times, he or she may apply in writing for an additional retake. Each registration for a course examination (under the same course code) counts as an examination taken, regardless of when you have taken the examination or whether you have retaken the entire course. Instructions and an application form for an additional retake are available in Uni.

Students who have registered for an exam but are unable to take it must cancel their registration through WebOodi at least two working days before the exam. It is very important that you

cancel your registration because each registration is considered an exam taken! If a student is suddenly taken ill after the cancellation deadline and is unable to take the examination, the student must provide a doctor's certificate to the LUT Student Services Centre in order to be able to retake the exam.

Exam Date	Registration Deadline	Cancellations
Monday	Monday, a week before the exam	Thursday, a week before the exam
Tuesday	Tuesday, a week before the exam	Friday, the week before the exam
Wednesday	Wednesday, a week before the exam	Monday, the week of the exam
Thursday	Thursday, a week before the exam	Tuesday, the week of the exam
Friday	Friday, the week before the exam	Wednesday, the week of the exam

In exam sessions according to the examination schedule, students may only take one examination. On special grounds, students can be allowed to take two examinations at the same time. To this end, students must contact the LUT Student Services Centre at least a week before the exam date and fulfil the special requirements. Further information is available in the Uni portal.

Moodle and Noppa

Moodle is the virtual learning environment for LUT, which is used to support teaching. It enables interactive teaching. Moodle is available at moodle.lut.fi and Uni-portal.

Noppa is a study portal, which contains information about courses. It can also be used to distribute educational material and to inform the students about the course grades. Noppa is available at noppa.lut.fi and Uni-portal.

Evaluation of Completed Courses

Courses are evaluated either on the scale excellent (5), very good (4), good (3), very satisfactory (2), satisfactory (1) and failed (0), or pass – fail. The basis for the course evaluation (exam, assignment etc.) is given in the course descriptions in the study guide.

Partial study attainments are valid in all LUT degree programmes for at least a year after the period in which the teaching ends. If the faculty or degree programme has given further instructions on the expiration of partial study attainments, they can be found in the degree programme's section in the study guide.

If students are not satisfied with their grades, they may request a correction in writing from the teacher who gave the grade. Students must submit the request in writing within 14 days of the day the grade was made known. They also have the right to find out why they were given the grade. If the student is not satisfied with the teacher's reply to the correction request, he or she may take the matter up with the university’s degree committee. The correction request must be submitted in writing to the Registrar’s Office within 14 days of receiving the teacher’s reply. The decision of the degree committee is final, no appeal can be made.

Instructions and Regulations on Studies

LUT is a university pursuant to the Universities Act (558/2009).

Provisions on education, studying and degrees are laid down in the Government Decree on University Degrees (794/2004) and LUT’s regulations for teaching and studying. The decree and regulations are available in the Uni portal.

LUT’s regulations on teaching and studying define the framework within which studies are arranged and completed at LUT – how teaching and studies are organised and degrees are completed. The regulations state the rights and obligations of students, teachers and other university actors. The regulations aim to guarantee students’ rights and equal treatment. In addition to students’ rights, the regulations naturally include obligations for students.

Final Thesis Instructions

Final thesis instructions apply mainly to Master's theses at Lappeenranta University of Technology. They may also be used, where applicable, for Licentiate theses, Bachelor's theses and written assignments. The degree programmes may give more detailed instructions on the preparation of theses.

Instructions are available at Uni-portal.

Ethical Guidelines for Academic Studies

Students commit themselves to follow the ethical guidelines for academic studies while studying at LUT. The purpose of the ethical guidelines for academic studies is to help LUT students understand what is expected of them. Students must read the ethical guidelines and observe them throughout their studies.

The ethical guidelines are summarised in three statements which will help students to ensure that their activity is ethical: use information correctly, follow the rules and be honest and fair. Unethical activity and misconduct in studies will lead to consequences.

Proven misconduct will lead to disciplinary measures, which may include a written reprimand, a caution and suspension for a fixed term. In the case of exchange and double degree students, the home university will always be informed. The identification and consequences of misconduct are described in more detail in LUT's guidelines for handling misconduct.

The ethical guidelines for academic studies and LUT's guidelines for handling misconduct are available in the Uni portal, Student Services at LUT -pages, section Studies. Please read the ethical guidelines carefully!

Degree Certificates

Students must fill out an application for the degree certificate. The forms are available in the Uni portal.

Graduates from English Master's programmes receive both a Finnish and an English degree certificate.

The certificate will show e.g. the graduate's degree, Master's degree programme, major and minor subjects and the name and the grade for Master's thesis.

The student is given an overall grade, which is the weighted average of all the student's LUT courses that were graded with a number, excluding the student's thesis. An overall grade is given only when a minimum of 40 ECTS credits in the degree (excluding the Master's thesis) have been completed at LUT and assessed on a scale of 1-5. The overall grades are determined as follows:

Average	**Grade**
1.00 – 1.49	Satisfactory
1.50 – 2.49	Very Satisfactory
2.50 – 3.49	Good
3.50 – 4.49	Very Good
4.50 – 5.00	Excellent

Degree certificates include transcripts in Finnish and English indicating all courses completed for the degree and their grades. Also major and minor subjects are given an overall grade in the transcript according to the table above. The overall grade is the average of all the LUT courses completed by the student in the subject in question, weighted according to the workload of each course.

Students will receive a special mention in their Master's degree (120 ECTS cr) certificate of having carried out their studies *with distinction* if their overall grade is at least 4 and the grade for their Master's thesis is 5 (in technology) and at least eximia cum laude approbatur (in business). In addition to this, at least 40 credits included in the degree must be carried out at LUT and graded on a scale of 1–5.

Those who have completed their studies with distinction receive a scholarship from LUT.

The degree certificates include a Diploma Supplement in English. A transcript of possible complementary studies completed by the student is annexed to the degree certificate. In addition, the graduate may request a separate transcript of other studies completed at LUT but not included in the degree.

2. LUT STUDENT SERVICES CENTRE

LUT Student Services supports you in your studies throughout your study path – from submitting an application to graduation at the Master's or doctoral level. With the support of Student Services, you will be able to prepare a study plan that meets your needs, complete your studies according to the plan and graduate within the target schedule. Our Study Guidance Team and Customer Service Team will help and support you in all study-related matters. Studying and completing courses is your responsibility, but we will help you in any other aspects of your studies. Our motto is: "The student is King, and *noblesse oblige*".

Study Guidance Team

You will receive personal study counselling and guidance from study coordinators, student advisers and study secretaries. Our well-organised student guidance aims to ensure that you reach your goals according to plan. We will help you to start your studies during the Orientation Days for new students, introducing you to your studies and degree structure. Peer tutors assist new students with practical arrangements at the beginning of their studies. We provide advice and guidance in preparing and updating your personal study plan. You will be given information on the substitution of courses, the recognition of prior learning and studies abroad, and other matters subject to application (e.g. study right extensions). Guidance related to the content of studies is also offered by the teacher tutors in our degree programmes.

Internationalisation and the principles of sustainable development are a natural part of every LUT student's study path. We will assist both incoming and outgoing students in matters involving international student exchange. LUT recommends that its students take part in student exchange abroad for at least one semester. Thanks to an extensive cooperation network, LUT students have the opportunity to take part in exchange programmes in a number of destinations around the world. More information on study opportunities abroad is available in the Uni portal.

We also offer a variety of support services for incoming and outgoing students in intern exchange. A comprehensive information package on international internships is available in the Uni portal.

We also coordinate the International Business and Technology Management programme. Its courses in English are available to both international exchange students and other LUT students. The programme provides a good opportunity for internationalisation. Further details about the curriculum are provided in the Uni portal and at the end of this guide.

Customer Service Team

The Customer Service Team provides information and assistance in all practical matters involving studies, such as enrolment for the academic year and registration for examinations. We will provide you with certificates of attendance, certificates entitling you to student discounts in public transportation, and official transcripts of records. You should contact the customer service team whenever you have questions regarding e.g. your right to study or the entry of grades into the student register. We also issue letters of recommendation, testimonials, etc. upon request. Degree certificates and matters related to graduation (maturity tests, approval of final theses) are also handled by the Customer Service Team.

The customer service numbers are +358 29 446 3040 and +358 29 446 3041, and the e-mail address is opinto(at)lut.fi.

The university's student financial aid services deal with financial aid applications of LUT students, and assist in any matters related to student financial aid. The customer service numbers are +358 29 446 3032 and +358 29 446 3037, and the e-mail address is opintotuki(at)lut.fi.

Both teams are located on the third floor of Building 2. We are a "one-stop shop", and we will find a solution to your question, no matter who you contact.

Answers to frequently asked questions about studies can be found in this guide and the Uni portal, which also contains the contact information of the LUT Student Services Centre.

Career Services

Career Services supports students in job-hunting e.g. by organising CV workshops, training related to searching for work, and the annual DuuniDay recruitment event. A comprehensive information package on searching for employment is available in the Uni portal. Remember to read the vacancy announcements in Uni! The LUTassistant service gives students an opportunity to earn some pocket money.

Mervi Karhula, Secretary, Career Services
Telephone: +358 40 516 4356
E-mail: careerservice(at)lut.fi

LUT Doctoral School

LUT Doctoral School helps doctoral students and those interested in doctoral studies in the following issues:

- guidance for applicants
- general study guidance
- study administrative issues connected to doctoral studies and dissertation process
- graduation and degree certificates

Further information on services and contact information is available in Uni portal (Doctoral studies).

Lappeenranta Academic Library

Lappeenranta Academic Library is the only academic library in the region. The Library is open for anyone. The main library is located in the Lappeenranta University of Technology building on Skinnarila campus. Another library unit is on the Linnala campus of Saimaa University of Applied Sciences in Imatra.

The Library has an extensive collection of literature, book titles and journals, both in print and in electronic format. The library collection covers widely the fields of teaching and research both in LUT and in Saimia. The Library is also one of the European Documentation Centres in Finland.

In the Lappeenranta Academic Library, there is self-service in borrowing, returning, and picking up reserved material. Reservations can be placed in the Wilma database on titles, which are currently on loan. Whenever the Skinnarila campus library is closed, loans can be returned to the return box situated just next to the library entrance. Material that is not stocked in the collection of Lappeenranta Academic Library can be ordered for customers from other libraries. The interlibrary lending service is subject to a fee.

There is always help and guidance available in the service point. Guidance for Library use and information skills training is available to students throughout their studies from introductory courses for new students to discipline-specific advanced stage courses. More information about services and guidance can be found on the Library's website.

The Skinnarila campus library is open during terms Mon-Thu 8.00 am – 6.00 pm, Fri 8.00 am – 3.30 pm. Service time may differ from opening hours. Changes in the opening and service hours will be published on the Library's website, on Facebook and on notices in the Library.

Home page: www.lut.fi/library

Like Lappeenranta Academic Library in Facebook and you'll keep up with what's going on in the Library. You'll find Library's accounts also in Pinterest and in Twitter.

Origo Service Desk

Origo provides students a working and study environment complete with information services. Origo houses both the Lappeenranta Academic library and the Origo Service Desk. The facilities are equipped with top-of-the-line technology and software for e.g. group work, online studies, electronic exams, information retrieval, assignments, and final theses.

The Origo Service Desk provides services over the phone 040 1590 777, by e-mail origo(at)lut.fi or in person at the fourth floor service desk. The Origo Service Desk provides students information and communication technology support and assistance in the use of the university's electronic services. The service desk also lends out equipment needed for studies. The Origo Service Desk also sees to the use of the exam aquarium. Further information on Origo Service Desk is available in the Uni portal.

Study Counselling Psychologist

University studies can be the time of your life, but they may, at times, also be very stressful. The reasons behind the stress may be study-related or personal. The study counselling psychologist helps students overcome the challenges that may prevent them from seizing all of the opportunities offered by the university, supports the development of the student and is involved in developing a more learning-centred education culture at the university. Key services include individual and group counselling and the development of education from many aspects. The study guidance psychologist supports the students in challenges related to learning, motivation, self-regulation, stress management and learning skills. Studies are taken into account as one aspect of the student's life.

The study counselling psychologist can be reached by e-mail opintopsykologi(at)lut.fi and the urgent issues by phone 040 143 3205. The time reserved for meeting by email. Information on study counselling psychologist services is available in the Uni portal.

3. MASTER'S PROGRAMMES IN ENGLISH AT LUT

At Lappeenranta University of Technology, the higher university degrees are :

Degree		**Extent**
Master of Science (Technology) M.Sc. (Tech.)	Diplomi-insinööri DI	120 ECTS credits (including Master's Thesis)
Master of Science (Economics and Business Administration) M.Sc. (Econ. & Bus. Adm.)	Kauppatieteiden maisteri KTM	120 ECTS credits (including Master's Thesis)

The Master's degree programmes in English at LUT are:

- Master's Programme in Energy Technology
- Master's Programme in Chemical and Process Engineering
- Master's Programme in Mechanical Engineering
- Master's Programme in Computational Engineering and Physics
- Master's Programme in Computer Science
- Erasmus Mundus Master's Programme in Pervasive Computing and Communications for Sustainable Development (PERCCOM)
- Master's Programme in Global Management of Innovation and Technology (GMIT)
- Master´s Programme in Supply Management (MSM)
- Master's Programme in Strategic Finance and Business Analytics (MSF)
- Master's Programme in International Marketing Management (MIMM)
- Master's Programme in Strategy, Innovation ans Sustainability (MSIS)

Measurement of Studies

The studies are measured in ECTS credits (cr). The average annual workload of a student is 1600 hours of work, which is worth 60 ECTS credits. One credit refers to an average input of 26 hours of work by a student. Credits are recorded only in whole numbers, not decimals.

Courses included in the degrees are either obligatory, alternative or elective.

Personal Study Plan

A personal study plan is an outline prepared by the student of the content and schedule of his/her studies. The plan includes the courses the student wishes to include in the degree and the organisation of the studies, following the requirements set in the study guide. The obligatory studies are completed according to the study guide.

The study plan is made for the entire duration of the studies. At LUT, the personal study plans are reviewed and revised twice during the studies (Master's degree students): at the beginning of studies and when applying for the Master's thesis topic.

Further information: Uni portal, the study guidance of the degree programme.

Recognition of prior learning

Studies in universities
Credits for studies in other Finnish or foreign universities may be transferred to LUT Master's degrees as applicable and as defined by LUT's instructions and regulations

Recognition of prior learning
Knowledge and skills acquired outside of universities may be included in the degree where applicable. The recognition of prior learning is based on the learning outcomes set for the degree and the specific course in the degree. The student demonstrates the required skills to the coordinating teacher of the course. The teacher decides the demonstration method.

Further information on credit transfer and the recognition of prior learning: Uni portal, the study guidance of the degree programme.

Supplementary studies for those admitted directly to a Master's programme

When a student has been admitted to complete only the Master's degree (120 ECTS credits), the degree programme may, depending on the student's educational background, require the completion of supplementary studies of up to 60 ECTS credits. Supplementary studies are not included in the Master's degree, but must be completed in addition to the degree studies.

Internship

The Master's degree may include an internship. Further information: degree programme structure and internship course descriptions in the study guide, Uni portal.

Master's thesis

The Master's thesis is the final project of the Master's degree studies. It is included in the compulsory major studies of the Master's degree, and it is worth 30 ECTS credits.

The Bachelor's degree and possible supplementary studies must be completed before the approval of the Master's thesis topic.

The director of the school approves and assesses the Master's thesis. The Master's thesis in technology is evaluated on the scale excellent (5), very good (4), good (3), very satisfactory (2), satisfactory (1) and failed (0). The Master's thesis in business is evaluated on the scale laudatur, eximia cum laude approbatur, magna cum laude approbatur, cum laude approbatur, non sine laude approbatur, lubenter approbatur, approbatur, improbatur (failed).

The vice-rector for education issues university-wide general instructions regarding final theses. The instructions can be found in the Uni portal. Degree programmes may also give additional instructions. Further information is available in the Uni portal on the degree programme pages.

Maturity Tests

Students must complete a maturity test in the Master's degree to prove that they know the topic of their Master's thesis. LUT accepts the public-access abstract of the thesis as the maturity test in terms of content. The abstract is a one-page introduction of the thesis that can be understood independently. It includes the identification data, objectives, key content and key results of the work. In addition to the abstract, Master's level students take a separate maturity test only if they need to prove their Finnish or Swedish skills. In such cases, the guidelines for Bachelor's level maturity tests are applied.

The maturity test is graded *passed* or *failed*.

Further information: Uni portal, instructions and regulations

4. LUT SCHOOL OF ENERGY SYSTEMS

4.1 Master's Programme in Energy Technology

Aims and Learning Outcomes

The Degree Programme in Energy Technology aims to provide a holistic approach to a diverse field of advanced energy engineering issues relating to clean and sustainable energy systems, power production and use, efficient exploitation and cycling of materials, advanced control and process systems engineering for energy efficiency, efficient energy markets and smart grids. The Programme is designed to give students the opportunity to develop the knowledge, skills and abilities that will facilitate intellectual, creative, responsive and professional growth, and lifelong learning for continuous improvement. Students in Energy Technology can choose to specialize in a number of specific areas, such as bioenergy technology, sustainable technology and business, nuclear energy technology, industrial electronics, and electricity market and power systems.

The Programme prepares students to go on to careers as professionals and experts in the fast developing, multidisciplinary area of energy and environment, or to continue their studies within PhD programmes. The Programme takes two years, corresponds to 120 ECTS credits and leads to the degree of Master of Science in Technology.

The Master's Degree Programme in Energy Technology is specifically aimed at students who wish to receive versatile and target-oriented training in energy technology. Students graduating from the programme are professionally and academically prepared to address the needs of international enterprises that are seeking for networking opportunities in a global energy market.

The educational objective of the Master's Degree Programme in Energy Technology is to train industrially oriented professionals with firm theoretical understanding and profound expertise in the following fields of specialization:

- Bio-Energy Technology – includes topics such as biofuel production and refining technologies, bioenergy end-use technologies and international trade of biofuels.
- Sustainable Technology and Business – focuses on reducing the environmental impacts of energy production, utilizing renewable energy production technologies and state-of-the-art pollution control technologies.
- Nuclear Energy Engineering – provides studies in design, operation and basic structures of nuclear power plants, modeling and optimization of nuclear systems, radiation and nuclear safety as well as radioactive waste management.
- Industrial Electronics – includes studies in electrical drives technology and control engineering, focusing on electromagnetism, power electronics, electromechanical and electrothermal processes, industrial applications of real-time control systems, embedded systems, digital signal processing, and on the application of these to the modeling and control of electrical drives and power electronics.
- Electricity Market and Power Systems – focuses on studies in electricity transmission and distribution technology, electricity market and electricity distribution business.

After completing the study programme the graduate will have acquired comprehensive knowledge in sustainable energy systems, and the specific knowledge and competencies necessary to have the expertise in the chosen area of specialization.

Knowledge and skills

The graduate will
- be able to demonstrate a comprehensive understanding of the important technologies, practical applications, processes and actions concerning energy generation, power systems and energy markets, and the use of energy
- have adopted the principles of life cycle thinking and sustainable development in the domain of energy and environment
- be able to demonstrate a critical understanding of relevant theories and techniques, problem-solving skills, and ability to independently use knowledge, equipment and tools for the design and development of practical applications

General competence

The graduate will have the ability
- to logically think through a problem and solve it,
- to contribute to innovative thinking and
- to unambiguously communicate knowledge and solutions to the energy community and society, at large, in spoken and in written.

Career prospects

The degree programme aims at training top international professionals for the needs of both the public and private. Graduates are trained to work in international, multidisciplinary and multicultural environments. Graduates with wide-ranging knowledge will have possibilities to seek employment in diverse jobs in different branches of industry and society. Jobs and careers for Masters of Science in Energy Technology include, for instance, specialist tasks, design and product development, production and operation, management, sales and marketing, research and education, and positions in public authorities and professional organisations. The studies also give graduates a firm basis for doctoral studies in the field of their major subject.

Degree Structure

<table>
<tr><td rowspan="6">Master of Science (Technology)</td><td colspan="6">Master’s Programme in Energy Technology 120 ECTS cr</td></tr>
<tr><td colspan="6">Master’s Thesis on major subject 30 ECTS credits</td></tr>
<tr><td colspan="5">Major Subjects (60-66 ECTS cr):</td><td>Minor Subjects (20-22 ECTS cr):</td></tr>
<tr><td rowspan="2">Sustainable Technology and Business</td><td rowspan="2">Bio-Energy Technology</td><td rowspan="2">Nuclear Energy Engineering</td><td rowspan="2">Industrial Electronics</td><td rowspan="2">Electricity Market and Power Systems</td><td>- Bio-Energy Technology
- Sustainable Technology and Business
- Industrial Embedded Systems
- Power Electronics and Electrical Drives
- Modelling of Energy Systems
-Renewable Energy and Energy Efficiency</td></tr>
<tr><td>Elective studies 18-26 ECTS cr</td></tr>
<tr><td colspan="5">General studies 14 ECTS cr</td><td></td></tr>
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Degree Structure		
General Studies	14	ECTS cr
Major Subject	60-66	ECTS cr
Minor Subject	20-22	ECTS cr
Elective Studies	18-26	ECTS cr
Total	*120 (min.)*	*ECTS cr*

General Studies

Obligatory Studies (14 ECTS cr)		*year*	*per.*	*ECTS cr*
FV11A6500	Presenting in English	M.Sc. (Tech.) 1-2	per 1/ INT 43/per 2/per 3/INT 10 /per 4	2
FV11A9800	Academic Writing in English Course 1	B.Sc. (Tech.) 2-3 M.Sc. (Tech.) 1 B.Sc. (Econ. & Bus. Adm.) 2-3 M.Sc. (Econ. & Bus. Adm.) 3	1/3	2
FV11A9900	Academic Writing in English Course 2	B.Sc. (Tech.) 3 M.Sc. (Tech.) 1 B.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 3	2/4	2
FV18A9101	Finnish 1	M.Sc. (Tech.) 1-2	1/3	2
FV18A9201	Finnish 2	M.Sc. (Tech.) 1-2	2/4	2
BH60A4400	Introduction to Sustainability	M.Sc. (Tech.) 1	1	3
BH60A4600	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1-2	1

Major Studies

1. Major Subject in Industrial Electronics

The person responsible for major in Industrial Electronics is professor, D.Sc. (Tech.) Juha Pyrhönen

Obligatory Studies (66 ECTS cr)		*year*	*per.*	*ECTS cr*
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BL30A0400	Design of an Electrical Machine	M.Sc. (Tech.) 1	1	6
BL30A0600	Power Electronics	M.Sc. (Tech.) 1	1-2	6
BL30A1001	Electrical Drives	M.Sc. (Tech.) 2	2-3	8
BL30A1200	Numerical Methods in Electromagnetism	M.Sc. (Tech.) 2	3	4
BL40A1100	Embedded System Programming	M.Sc. (Tech.) 1	1-2	4
BL50A0600	Electromagnetic Compatibility in Power Electronics	M.Sc. (Tech.) 1	1	2
BL10A8600	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

2. Major Subject in Electricity Market and Power Systems

The person responsible for major in Electricity Market and Power Systems is professor, D.Sc. (Tech.) Jarmo Partanen

Obligatory Studies (61 ECTS cr)		*year*	*per.*	*ECTS cr*
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH60A4700	Climate Finance and Carbon Markets	M.Sc. (Tech.) 1	3-4	3
BL20A0201	Power Exchange Game for Electricity Markets	M.Sc. (Tech.) 1	2-3	3
BL20A0401	Electricity Market	M.Sc. (Tech.) 1	1	5
BL20A0501	Electricity Distribution Technology	M.Sc. (Tech.) 1	2-3	8
BL30A0600	Power Electronics	M.Sc. (Tech.) 1	1-2	6
BL10A8600	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

3. Major Subject in Bio-Energy Technology

The person responsible for major in Bio-Energy Technology is professor, D.Sc. (Tech.) Esa Vakkilainen

Obligatory Studies (60 ECTS cr)		*year*	*per.*	*ECTS cr*
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 2	2	5
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH50A1300	Maintenance Management	M.Sc. (Tech.) 2	1-2	4
BH50A1400	Steam Boilers	M.Sc. (Tech.) 2	1-2	6
BH50A1500	Bioenergy Technology Solutions	M.Sc. (Tech.) 2	2-3	6
BH61A0600	Bioenergy	M.Sc. (Tech.) 1	1	3
BH10A2000	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

4. Major Subject in Nuclear Energy Engineering

The person responsible for major in Nuclear Energy Engineering is professor, D.Sc. (Tech.) Juhani Hyvärinen

Obligatory Studies (51 ECTS cr)		*year*	*per.*	*ECTS cr*
BH30A0701	Reliability Engineering	M.Sc. (Tech.) 1	1-2	4
BH30A1403	Nuclear Engineering	M.Sc. (Tech.) 1	1-2	6
BH30A1800	Applied Reactor Physics	M.Sc. (Tech.) 2	3	3
BH30A1900	Thermal Hydraulics of Nuclear Power Plants	M.Sc. (Tech.) 2	3	3
BH30A2103	Introduction to Reactor Dynamics	M.Sc. (Tech.) 1	2	2
BH30A2200	Experimental Nuclear Thermal Hydraulics	M.Sc. (Tech.) 1	INT 16-INT 17	3
BH10A2000	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

List of selectable courses, choose enough credits to attain 60 ECTS cr		*year*	*per.*	*ECTS cr*
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH50A1300	Maintenance Management	M.Sc. (Tech.) 2	1-2	4
BH60A1600	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1	2	5
BL20A0401	Electricity Market	M.Sc. (Tech.) 2	1	5

5. Major Subject in Sustainable Technology and Business

The person responsible for major in Sustainable Technology and Business is professor D.Sc. (Tech.) Risto Soukka

Obligatory Studies (63 ECTS cr)		*year*	*per.*	*ECTS cr*
BH60A1600(*	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1	2	5
BH60A4700	Climate Finance and Carbon Markets	M.Sc. (Tech.) 1	3-4	3
BH60A2101	Advanced Course in Life Cycle Assessment	M.Sc. (Tech.) 2	3-4	7
BH60A2200(*	Air Pollution Control	M.Sc. (Tech.) 1	3-4	3
BH60A2401(*	Energy Recovery from Solid Waste	M.Sc. (Tech.) 2	1-2	4
BH60A3501	Sustainable Innovation and System Transition	M.Sc. (Tech.) 1	1-3	5
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Tech.) 1	1-4	3
BH61A0600	Bioenergy	M.Sc. (Tech.) 1	1	3
BH60A5000	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

*) The student must have completed this course (or corresponding knowledge) before attending BH60A2101 Advanced Course in Life Cycle Assessment

Minor Studies

The recommended major and minor subject combination is shown in the table below. However, the student may choose any of the minor subjects offered by LUT School of Energy Systems.

Subject combination	
Major Subject →	**Minor Subject**
Industrial Electronics	Industrial Embedded Systems Renewable Energy and Energy Efficiency
Electricity Market and Power Systems	Power Electronics and Electrical Drives Renewable Energy and Energy Efficiency
Sustainable Technology and Business	Bio-Energy Technology Green Chemistry
Bio-Energy Technology	Sustainable Technology and Business Modelling of Energy Systems
Nuclear Energy Engineering	Modelling of Energy Systems

1. Minor Subject in Industrial Embedded Systems

Obligatory Studies (22 ECTS cr)		*year*	*per.*	*ECTS cr*
BL40A1000	Real-time Operating Systems and Programs	M.Sc. (Tech.) 2	1-2	5
BL40A1201	Digital Control Design	M.Sc. (Tech.) 1	1-2	5
BL40A1811	Introduction to Embedded Systems	B.Sc. (Tech.) 3	3-4	6
BL50A1300	Advanced Course in Electronics	M.Sc. (Tech.) 1	3-4	6

2. Minor Subject in Power Electronics and Electrical Drives

Select a minimum of 20 ECTS cr		*year*	*per.*	*ECTS cr*
BL30A1200	Numerical Methods in Electromagnetism	M.Sc. (Tech.) 2	3	4
BL40A1100	Embedded System Programming	M.Sc. (Tech.) 1	1-2	4
BL40A1811	Introduction to Embedded Systems	B.Sc. (Tech.) 3	3-4	6
BL50A0600	Electromagnetic Compatibility in Power Electronics	M.Sc. (Tech.) 1	1	2
BL50A1300	Advanced Course in Electronics	M.Sc. (Tech.) 1	3-4	6

3. Minor Subject in Bio-Energy Technology

Obligatory Studies (16 op)		*year*	*per.*	*ECTS cr*
BH50A1200(*	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH50A1300	Maintenance Management	M.Sc. (Tech.) 2	1-2	4
BH50A1400(*	Steam Boilers	M.Sc. (Tech.) 2	1-2	6
BH50A1500	Bioenergy Technology Solutions	M.Sc. (Tech.) 1-2	2-3	6

*) Alternative to each other

List of selectable courses, choose enough credits to attain 20 ECTS cr		*year*	*per.*	*ECTS cr*
BH30A0701	Reliability Engineering	M.Sc. (Tech.) 1	1-2	4
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 2	2	5
BH60A1600	Basic Course on Environmental Management and Economics	B.Sc. (Tech.) 2	2	5
BL20A0401	Electricity Market	M.Sc. (Tech.) 1	1	5

4. Minor Subject in Sustainable Technology and Business

Obligatory Studies (22 ECTS cr)		*year*	*per.*	*ECTS cr*
BH60A1600(*	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1	2	5
BH60A4700	Climate Finance and Carbon Markets	M.Sc. (Tech.) 1	3-4	3
BH60A2101	Advanced Course in Life Cycle Assessment	M.Sc. (Tech.) 2	3-4	7
BH60A2200(*	Air Pollution Control	M.Sc. (Tech.) 1	3-4	3
BH60A2401(*	Energy Recovery from Solid Waste	M.Sc. (Tech.) 2	1-2	4

*) The student must have completed this course (or corresponding knowledge) before attending BH60A2101 Advanced Course in Life Cycle Assessment

5. Minor Subject in Modelling of Energy Systems

Obligatory Studies (21 ECTS cr)		*year*	*per.*	*ECTS cr*
BH40A1500	Turbulence Models	M.Sc. (Tech.) 2	3-4	4
BH70A0001	Numerical Methods in Heat Transfer	M.Sc. (Tech.) 1	1-2	6
BH70A0101	Advanced Modeling Tools For Transport Phenomena	M.Sc. (Tech.) 1	3-4	5
BH70A0200	Advanced Topics in Modelling of Energy Systems	M.Sc. (Tech.) 1	1-2	6

6. Minor Subject in Green Chemistry

Obligatory Studies (15 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4020	Methods in Green Chemistry	M.Sc. (Tech.) 1	4	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5

List of selectable courses, choose enough credits to attain 20 ECTS cr		*year*	*per.*	*ECTS cr*
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1-2	2	6
BJ02A3030	Solid-Liquid Separation	M.Sc. (Tech.) 1	3	5

7. Minor Subject in Renewable Energy and Energy Efficiency

Select a minimum of 20 ECTS cr		*year*	*per.*	*ECTS cr*
BL10A8400(*	Solar Economy and Smart Grids	M.Sc. (Tech.) 1-2	INT.	3
BL20A1300(**	Energy Resources	M.Sc. (Tech.) 1	1-2	6
BL20A1400	Renewable Energy Technology	M.Sc. (Tech.) 2	1-2	6
BL20A1500(***	Energy Scenarios	M.Sc. (Tech.) 2	3-4	6
BL40A2301	Energy Efficiency	M.Sc. (Tech.) 1	3	6
BL40A2401	Electrical Engineering in Wind and Solar Systems	M.Sc. (Tech.) 2	3-4	6

*) LUT Summer School-course (10.-14.8.2015)
**) will be lectured every other year, next during the academic year 2016-2017
***) will be lectured every other year, next during the academic year 2015-2016

Elective Studies

Elective studies can include any courses offered by LUT if the required prerequisites are completed. Studies in other universities may be included upon application. Elective studies may include a maximum of 10 ECTS credits of traineeship improving expertise.

Recommended elective courses when the student chooses the major in Sustainable Technology and Busine		*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	2	3
BH50A1200	Energy Systems Engineering	1-2	6
BH40A1301	Power Machines in Renewable Energy	2	5
BH50A1500	Bioenergy Technology Solutions	2-3	6
BH61A0600	Bioenergy	1	3
BM20A3401	Design of Experiments	4	4
CS10A0770	Cleaner Technologies and Markets	3-4	5
CS30A1690	Social Sustainability	4	5
CS31A0602	Investointihankkeiden elinkaarilaskelmat	1	5
CT10A7001	Green IT and Sustainable Computing	3-4	5

Master’s Thesis 30 ECTS cr

Thesis topics arise from various application areas, research projects and contacts with different universities. Typically, the thesis contains a theoretical study, experimental part and analysis of the experimental results.

In Master's degree programmes taught in English, the Master's thesis is always prepared in English.

Degree Structure for Double Degree Students of Energy Technology

Double degree students come from the LUT partner universities. The student takes his Master’s degree from both partnering universities, and will be awarded the degree certificate of LUT and the diploma of the home university. The maximum credit transfer to be accepted to the LUT degree from the previous studies in the student’s home university is 50 ECTS cr.

1. Major Subject in Industrial Electronics

Degree Structure		
Major Subject (amount of ECTS depends on specialisation)	58-66	ECTS cr
Elective Studies	4-12	ECTS cr
Credit transfer from studies at home university, a max. of 50 ECTS	50	ECTS cr
Credits	120 (min.)	ECTS cr

Obligatory to All (48 ECTS cr)		*year*	*per.*	*ECTS cr*
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BL30A0600	Power Electronics	M.Sc. (Tech.) 1	1-2	6
BL40A1100	Embedded System Programming	M.Sc. (Tech.) 1	1-2	4
BL50A0600	Electromagnetic Compatibility in Power Electronics	M.Sc. (Tech.) 1	1	2
BL10A8600	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

Obligatory to Students Specialising in Electrical Machines (18 ECTS cr)		*year*	*per.*	*ECTS cr*
BL30A0400	Design of an Electrical Machine	M.Sc. (Tech.) 1	1	6
BL30A1001	Electrical Drives	M.Sc. (Tech.) 1	2-3	8
BL30A1200	Numerical Methods in Electromagnetism	M.Sc. (Tech.) 1	3	4

Obligatory to Students Specialising in Control Engineering (10 ECTS cr)		*year*	*per.*	*ECTS cr*
BL40A1000	Real-time Operating Systems and Programs	M.Sc. (Tech.) 1	1-2	5
BL40A1201	Digital Control Design	M.Sc. (Tech.) 1	1-2	5

2. Major Subject in Electricity Market and Power Systems

Degree Structure		
Major Subject	61	ECTS cr
Elective Studies	9	ECTS cr
Credit transfer from studies at home university, a max. of 50 ECTS	50	ECTS cr
Credits	120 (min.)	ECTS cr

Obligatory Studies (61 ECTS cr)		*year*	*per.*	*ECTS cr*
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH60A4700	Climate Finance and Carbon Markets	M.Sc. (Tech.) 1	3-4	3
BL20A0201	Power Exchange Game for Electricity Markets	M.Sc. (Tech.) 1	2-3	3
BL20A0401	Electricity Market	M.Sc. (Tech.) 1	1	5
BL20A0501	Electricity Distribution Technology	M.Sc. (Tech.) 1	2-3	8
BL30A0600	Power Electronics	M.Sc. (Tech.) 1	1-2	6
BL10A8600	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

3. Major Subject in Bio-Energy Technology

Degree Structure		
Major Subject	60	ECTS cr
Elective Studies	10	ECTS cr
Credit transfer from studies at home university, a max. of 50 ECTS	50	ECTS cr
Credits	120 (min.)	ECTS cr

Obligatory Studies (60 ECTS cr)		*year*	*per.*	*ECTS cr*
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 1	2	5
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH50A1300	Maintenance Management	M.Sc. (Tech.) 1	1-2	4
BH50A1400	Steam Boilers	M.Sc. (Tech.) 1	1-2	6
BH50A1500	Bioenergy Technology Solutions	M.Sc. (Tech.) 2	2-3	6
BH61A0600	Bioenergy	M.Sc. (Tech.) 1	1	3
BH10A2000	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

4. Major Subject in Nuclear Energy Engineering

Degree Structure		
Major Subject	60	ECTS cr
Elective Studies	10	ECTS cr
Credit transfer from studies at home university, a max. of 50 ECTS	50	ECTS cr
Credits	120 (min.)	ECTS cr

Obligatory Studies (51 op)		*year*	*per.*	*ECTS cr*
BH30A0701	Reliability Engineering	M.Sc. (Tech.) 1	1-2	4
BH30A1403	Nuclear Engineering	M.Sc. (Tech.) 1	1-2	6
BH30A1800	Applied Reactor Physics	M.Sc. (Tech.) 1	3	3
BH30A1900	Thermal Hydraulics of Nuclear Power Plants	M.Sc. (Tech.) 1	3	3
BH30A2103	Introduction to Reactor Dynamics	M.Sc. (Tech.) 1	2	2
BH30A2200	Experimental Nuclear Thermal Hydraulics	M.Sc. (Tech.) 1	INT 16-INT 17	3
BH10A2000	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

List of selectable courses, choose enough credits to attain 60 ECTS cr		*year*	*per.*	*ECTS cr*
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH50A1300	Maintenance Management	M.Sc. (Tech.) 1	1-2	4
BH60A1600	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1	2	5
BL20A0401	Electricity Market	M.Sc. (Tech.) 1	1	5

5. Major Subject in Sustainable Technology and Business

Degree Structure		
Major Subject	61	ECTS cr
Elective Studies	10	ECTS cr
Credit transfer from studies at home university, a max. of 50 ECTS	50	ECTS cr
Credits	120 (min.)	ECTS cr

Obligatory Studies (61 ECTS cr)		*year*	*per.*	*ECTS cr*
BH60A4600	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1-2	1
BH60A1600	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1	2	5
BH60A2101	Advanced Course in Life Cycle Assessment	M.Sc. (Tech.) 1	3-4	7
BH60A2200	Air Pollution Control	M.Sc. (Tech.) 1	3-4	3
BH60A2401	Energy Recovery from Solid Waste	M.Sc. (Tech.) 1	1-2	4
BH60A3501	Sustainable Innovation and System Transition	M.Sc. (Tech.) 1	1-3	5
BH60A4400	Introduction to Sustainability	M.Sc. (Tech.) 1	1	3
BH61A0600	Bioenergy	M.Sc. (Tech.) 1	1	3
BH60A5000	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

Elective Studies

Recommended elective courses when the double degree student chooses the major in Sustainable Technol		*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	2	3
BH40A1301	Power Machines in Renewable Energy	2	5
BH50A1200	Energy Systems Engineering	1-2	6
BH50A1500	Bioenergy Technology Solutions	2-3	6

BH60A4700	Climate Finance and Carbon Markets	3-4	3
BH60A4500	Corporate Responsibility and Management 1	1-4	3
BM20A3401	Design of Experiments	4	4
CS10A0770	Cleaner Technologies and Markets	3-4	5
CS30A1690	Social Sustainability	4	5
CS31A0602	Investointihankkeiden elinkaarilaskelmat	1	5
CT10A7001	Green IT and Sustainable Computing	3-4	5
FV11A9800	Academic Writing in English Course 1	1/3	2
FV11A9900	Academic Writing in English Course 2	2/4	2

Additional Information

Personal Study Plan
A personal study plan (PSP) is the student's tool for planning and monitoring university studies. The PSP is based on the degree structure described in the Study Guide. There are three official check-points of the PSP:
- at the beginning of the M.Sc. studies during the 1st period
- upon approval of topic application for a Master's thesis
- upon graduation.

The students of the LUT School of Energy Systems make the PSP in an electronic form by using the ePSP tool at WebOodi.

Credit Transfer
ECTS credits can be transferred from the student's previous university level studies or higher university degrees from Finnish or foreign universities. For more information and application forms please check Uni-portal.

Complementary Studies
The student with a Finnish degree from the University of Applied Sciences or equivalent may have to study complementary studies. The extent of these studies depends on the content of the previous degree. For more information please check Uni-portal.

Internship
The Internship in the Master's degree can be worth 10 ECTS credits. Employment prior to to the studies at LUT may be accepted, if it has not been included in any previous degrees.. The traineeship is approved by internship coordinators.

Maturity Test
Students must complete a maturity test in the Master's degree to prove that they know the topic of their Master's thesis. LUT accepts the public-access abstract of the thesis as the maturity test in terms of content. The abstract is a one-page introduction of the thesis that can be understood independently. It includes the identification data, objectives, key content and key results of the work.

In addition to the abstract, Master's level students take a separate maturity test only if they need to prove their Finnish or Swedish skills. In such cases, the guidelines for Bachelor's level maturity tests are applied. The maturity test is graded passed//failed.

Contact Information

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Course Descriptions in Energy Technology

		ECTS cr
BH10A1500	Work internship in Master’s degree	2 - 10
BH10A1600	Energy Technology Project Work	2 - 30
BH10A2000	Master's Thesis	30
BH30A0701	Reliability Engineering	4
BH30A1403	Nuclear Engineering	6
BH30A1800	Applied Reactor Physics	3
BH30A1900	Thermal Hydraulics of Nuclear Power Plants	3
BH30A2103	Introduction to Reactor Dynamics	2
BH30A2200	Experimental Nuclear Thermal Hydraulics	3
BH40A0801	Turbomachinery	4
BH40A1301	Power Machines in Renewable Energy	5
BH40A1500	Turbulence Models	4
BH50A1200	Energy Systems Engineering	6
BH50A1300	Maintenance Management	4
BH50A1400	Steam Boilers	6
BH50A1500	Bioenergy Technology Solutions	6
BH60A1101	Environmental Technology Project Work	1 - 7
BH60A1600	Basic Course on Environmental Management and Economics	5
BH60A2101	Advanced Course in Life Cycle Assessment	7
BH60A2200	Air Pollution Control	3
BH60A2401	Energy Recovery from Solid Waste	4
BH60A2801	Energy and Environmental Challenges in Russia	3
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BL30A0600	Power Electronics	6
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BL40A1201	Digital Control Design	5
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BL40A2301	Energy Efficiency	6
BL40A2401	Electrical Engineering in Wind and Solar Systems	6
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BH10A1500	WORK INTERNSHIP IN MASTER'S DEGREE	2 - 10 ECTS cr
	DI-tutkinnon työharjoittelu **No course registration (replaced by submitting the application for approval of the internship coordinator).**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Laboratory Engineer, Lic.Sc. (Tech.) Simo Hammo Person in Charge: Professor, D.Sc. (Tech.) Esa Vakkilainen	
Aims	After the work environment internship, the student will have the basic knowledge of work, working environment and working community in his/her own field. The student will be able to apply the knowledge and skills acquired during the course of studies to work in his/her own field.	
Content	The student obtains a (summer) job from a company, works there as a paid employee, requests for a certificate of employment and applies for the approval of the work as an internship for the Master's degree. Full-time employment relationships of at least four weeks can be approved as internships. The completion of the Master's thesis is not accepted as an internship. An employment relationship preceding the studies can be approved as an internship, provided that it has not been accepted and included in any other previous degree.	
Modes of Study	The first 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to the beginning of an employment relationship (e.g. orientation, the rules of the employment relationship and the workplace) 15 h, observing (while working) how the working community operates (e.g. how work/production is organized, supervision, the working manners of the working community/teams, the social environment of the workplace) 22 h, a written internship report 5 h (2 - 3 pages); total workload 52 h. 3 - 10 ECTS credits: having different tasks in a company 26 - 208 h (1 ECTS credit/26 h). The number of ECTS credits of the compulsory internship varies depending on the degree programme in question; further information is available in the degree structures in the study guide.	
Evaluation	Pass/Fail. Internship report 100 %.	

BH10A1600	ENERGY TECHNOLOGY PROJECT WORK	2 - 30 ECTS cr
	Energy Technology Project Work **The course is mainly intended for foreign visiting students. The students register for the course by contacting the supervisor.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 1-4	
Teacher(s)	Professor, D.Sc. (Tech.) Jari Backman, Professor, D.Sc. (Tech.) Timo Hyppänen, Professor, D.Sc. (Tech.) Esa Vakkilainen, Professor, D.Sc. (Tech.) Juhani Hyvärinen, Professor, D.Sc. (Tech.) Tapio Ranta Person in Charge: Professor, D.Sc. (Tech.) Esa Vakkilainen	
Aims	Upon completion of the course the student will 1. be able to apply research methodology from the different viewpoints of energy technology, 2. be able to prepare a literature search on a limited topic, 3. be able to prepare a research report, and 4. have an independent attitude towards working autonomously in the field of technology.	
Content	Preparation of a research report on a given subject which can be acquired from the industry. The report is premised on an extensive literature search.	
Modes of Study	1st–4th period: Advanced special research report or seminar paper 100 - 780 h.	

Further Information	Modes of study will be agreed upon with the professor responsible for the field. No contact teaching. This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH10A2000	***MASTER'S THESIS*** ***30 ECTS cr***
	Master's Thesis **In Master*s degree programmes taught in English, the Master's thesis is always prepared in English.**
Year and Period	M.Sc. (Tech.) 2 Period 1-4
Teacher(s)	professors of the degree programme Person in Charge: Professor, D.Sc. (Tech.) Esa Vakkilainen
Aims	Upon completion of the course the students will be able to 1. formulate the research problem, 2. select the methods appropriate for the research problem, 3. find sources of information suitable for the research problem, and evaluate their validity and the quality and reliability of the data, 4. utilise and interpret the sources of information correctly, and 5. report the research in writing according to the scientific principles, considering the conventions used within the field of energy technology.
Content	The fundamentals of scientific research. Good scientific working methods when setting the research problem, selecting the research methods, and reporting the research, considering the conventions used within the field of energy technology. The utilisation of scientific information in problem solving. Information literacy. Scientific reports. Information retrieval. Correctness of the language. Master's thesis.
Modes of Study	The presentation of the thesis will be arranged with the supervising professor. There will be no separate seminar.
Evaluation	0 - 5. Master's thesis 100 %.

BH30A0701	***RELIABILITY ENGINEERING*** ***4 ECTS cr***
	Reliability Engineering **This course will be lectured on alternating years with BH30A0600 Radiation Protection.** **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Juhani Hyvärinen
Aims	Upon completion of the course the students will be able to: 1. calculate the reliability parameters for separate components and simple systems, 2. form fault and event trees for systems, and 3. estimate the effect of human factors.
Content	Introduction to reliability engineering. Boolean algebra. The reliability parameters of components. The reliability engineering structure of systems; examples from different fields. Structural functions, reliability flow charts, fault trees, event trees, minimal cut sets. The reliability parameters of systems and their determination using different methods. Damage and effect analysis. The determination of parameters and trends from flaw observations. The improvement of the usage reliability of a system. Humans as a part of systems. Common mode failures, uncertainty analysis and importance measures. The reliability of structures.
Modes of Study	1st period: 15 h of lectures, 12 h of tutorials.

	2nd period: 15 h of lectures, 12 h of tutorials. Preparation for the examination 47 h and written examination 3 h. Total workload 104 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 100 %. Possible to raise the grade by tutorials.
Study materials	Moodle.McCormick, Norman J.: Reliability and risk analysis: Methods and nuclear power applications, Academic Press, 1981. Pages, Gondran: System Reliability Evaluation and Prediction in Engineering 1986, North Oxford Academic Publishers. Henley & Kumamoto: Probabilistic Risk Assessment, IEEE Press 1992. Villemeur, A.: Reliability, Availability, Maintainability and Safety Assessment, John Wiley, 1992. Birolini A.: Reliability engineering: Theory and Practice, Berlin: Springer, 1999.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH30A1403	***NUCLEAR ENGINEERING*** ***6 ECTS cr***
	Nuclear Engineering
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Juhani Hyvärinen
Aims	Upon completion of the course the student will be able to 1. explain design principles of nuclear power reactors, 2. describe the functionality, main systems and components of light water reactors
Content	Nuclear reactions and their cross sections. Reactor physics, a simplified criticality calculation. The design principles for the reactor core. The development history, structure and operation of light water reactors, the main components of the nuclear power plant, the most important safety and auxiliary systems and instrumentation. A look at the nuclear power programmes of different countries. Health physics and radiation protection. The course is related to sustainability.
Modes of Study	1st period: 24 h of lectures, 12 h of tutorials, preparation of a presentation 10 h, preparation for the examination 7 h and written interim examination 3 h, independent study 13 h. 2nd period: 24 h of lectures, 12 h of tutorials, independent assignments 28 h, preparation for the examination 7 h and written interim examination 3 h, independent study 13 h. Total workload 156 h. One independent assignment and a country presentation, two interim exams or one final exam. This course is lectured only in English, together with BH30A0200 Nuclear Power Engineering I. Tutorials, assignments, presentations on this course are all in English. Moodle is used in this course.
Evaluation	0 - 5. Examination 70 %, assignments and presentations 30 %. Possible to raise the grade by tutorials.
Study materials	Moodle. Lamarsh & Baratta, Introduction to Nuclear Engineering, as applicable.

BH30A1800	***APPLIED REACTOR PHYSICS*** ***3 ECTS cr***
	Applied Reactor Physics
Year and Period	M.Sc. (Tech.) 2 Period 3 The course is suitable also for doctoral studies.
Teacher(s)	Visiting lecturers. Person in Charge: Professor, D.Sc. (Tech.) Juhani Hyvärinen
Aims	Upon completion of the course the students will be able to

	1. understand the deterministic reactor physics calculation system: transport codes for fuel bundle calculations and nodal methods for the whole core calculations, 2. define the limitations in In-Core Fuel Management work, and 3. carry out simple Monte-Carlo calculations of reactor physics.
Content	Different calculation methods of reactor physics for different purposes.
Modes of Study	3rd period: 12 h of lectures, 10 h of tutorials, 4 h of computer calculations, preparation for the tutorials 8 h, preparation for the examination 41 h and written examination 3 h. Total workload 78 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 100 %. Possible to raise the grade by tutorials.
Study materials	Moodle. Reuss: Neutron Physics, Duderstadt & Hamilton: Nuclear Reactor Analysis, Stacey: Nuclear Reactor Physics, where applicable.
Prerequisites	BH30A0001 Introduction to Nuclear Engineering, BH30A0200 Nuclear Power Engineering I and BH30A0301 Nuclear Power Engineering II, BH30A1700 Nuclear Reactor Physics, or BH30A1403 Nuclear Engineering and BH30A2103 Introduction to Reactor Dynamics.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH30A1900	***THERMAL HYDRAULICS OF NUCLEAR POWER PLANTS*** ***3 ECTS cr***
	Thermal Hydraulics of Nuclear Power Plants
Year and Period	M.Sc. (Tech.) 1 Period 3 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Juhani Hyvärinen, Postdoctoral Researcher, Arto Ylönen, Doctoral Student, M.Sc. (Tech.) Otso-Pekka Kauppinen Person in Charge: Professor, D.Sc. (Tech.) Juhani Hyvärinen
Aims	Upon completion of the course the students will be able to 1. understand one-dimensional fluid flow, heat transfer, boiling and condensation in pipelike geometry, 2. master the basic continuity and constitutive equations for two-phase flow thermal hydraulics, 3. utilise the basic equations in manual calculations, 4. understand the basic equations used in computer models, and 5. demonstrate basic knowledge about the system codes (APROS/TRACE).
Content	The normal use, as well as the thermo hydraulic phenomena in disturbance and accident situations, of the reactor circuit and containment of a nuclear power plant. Continuity equations, closure laws, phenomenological models for phase interactions. Two-phase flow calculations. Short introduction to the use of APROS and TRACE software.
Modes of Study	3rd period: 12 h of lectures, 12 h of tutorials, 4 h of computer calculations, preparation for the examination 47 h and written examination 3 h. Total workload 78 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 100 %. Possible to raise the grade by tutorials.
Study materials	Moodle. Todreas, Kazimi: Nuclear Systems I & II, where applicable. Winterton: Thermal Design of Nuclear Reactors, where applicable. Wallis: One-dimensional Two-phase flow.
Prerequisites	BH30A0001 Introduction to Nuclear Engineering, BH30A0200 Nuclear Power Engineering I and BH30A0301 Nuclear Power Engineering II.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH30A2103	*INTRODUCTION TO REACTOR DYNAMICS 2 ECTS cr*
	Introduction to Reactor Dynamics
Year and Period	M.Sc. (Tech.) 1 Period 2
Teacher(s)	Doctoral Student, M.Sc. (Tech.) Ville Rintala, Professor, D.Sc. (Tech.) Juhani Hyvärinen Person in Charge: Professor, D.Sc. (Tech.) Juhani Hyvärinen
Aims	Upon completion of the course the student will be able to: 1. explain reactor kinetics and related feedback mechanisms, 2. design reactor control systems.
Content	Nuclear reactor dynamic response and control. Neutron sources, approach to criticality, reactivity feedbacks in critical reactors, reactor power management, reactivity excursions. The course is related to sustainability.
Modes of Study	2nd period: 12 h of lectures, 8 h of tutorials, preparation for the examination 29 h and written interim examinations 3 h. Total workload 52 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 100 %. Possible to raise the grade by tutorials.
Study materials	Moodle. Reuss: Neutron Physics, Part I, as applicable.
Prerequisites	BH30A1403 Nuclear Engineering.

BH30A2200	*EXPERIMENTAL NUCLEAR THERMAL HYD-RAULICS 3 ECTS cr*
	Experimental Nuclear Thermal Hydraulics
Year and Period	M.Sc. (Tech.) 1 INT 16-INT 17 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Juhani Hyvärinen, Postdoctoral Researcher, Arto Ylönen, Research Scholar, M.Sc. (Tech.) Vesa Riikonen, Researcher, M.Sc. (Tech.) Antti Räsänen, Doctoral Student, M.Sc. (Tech.) Otso-Pekka Kauppinen Person in Charge: Professor, D.Sc. (Tech.) Juhani Hyvärinen
Aims	Upon completion of the course the students will be able to: 1. describe basic measurement techniques for one- and two-phase flows, 2. understand similitude and scaling, 3. understand thermal-hydraulic phenomena occurring in nuclear reactors and containments, in normal and abnormal operating conditions, 4. understand the interaction between experiments and code calculations, 5. describe advanced flow structure mapping techniques (e.g. wire mesh sensing, particle image velocimetry).
Content	Temperature, pressure, pressure drop, liquid level and flow measurement techniques. Void fraction measurement. Similitude, scaling laws. Models for phenomena such as critical flow, dryout, reflooding and rewetting, natural circulation, counter-current flow, two-phase flow instabilities in pipes and pools, heat transfer in tube bundles, loop seal behaviour, direct contact condensation. Designing experiments for computer code validation. Advanced flow structure measurement techniques.
Modes of Study	Week 16: 12 h of lectures, 12 h of tutorials, 8 h of laboratory demonstrations and exercises, independent study 8 h. Week 17: 8 h of lectures, 8 h of tutorials, 8 h of laboratory demonstrations and exercises, 4 h of computer calculations, preparation for the examination 7 h and written examination 3 h. Total workload 78 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 100 %. Possible to raise the grade by tutorials.
Study materials	Moodle. Ghiaasian: Two-Phase Flow, Boiling and Condensation, as applicable.

Prerequisites	BH30A0001 Introduction to Nuclear Engineering, BH30A0200 Nuclear Power Engineering I and BH30A0301 Nuclear Power Engineering II or BH30A1403 Nuclear Engineering.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH40A0801	*TURBOMACHINERY* 4 ECTS cr
	Turbomachinery **Korvaaa opintojakson BH40A0800 Termiset virtauskoneet. Luennot englanniksi. Kurssimateriaali ja tenttiminen mahdollista myös suomen kielellä.**
Year and Period	M.Sc. (Tech.) 1 Period 1
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Jari Backman
Aims	Upon completion of the course the students will be able to 1. demonstrate knowledge about modern turbo compressors, gas turbines, as well as turbo chargers, and their design, 2. calculate the operating values of turbomachinery, 3. define and describe the most important characteristics and the optimisation of a gas turbine power plant, and 4. calculate the thrust of a jet engine.
Content	Turbomachinery types. Gas turbines and turbo chargers. The mechanical structure of gas turbines and turbo chargers. The operation of industrial gas turbines. The structure and operation of jet engines. The course is related to sustainability.
Modes of Study	1st period: 40 h of self-study, 12 h of learning events. 3 h of Quiz tests on Moodle. Written examination. Total workload 104 h. Moodle is used in this course.
Evaluation	0 - 5. Written examination in the examination Acquarium 80 %, learning events on Moodle 20 %.
Study materials	Larjola: Turbokoneet, suunnittelun ja laskennan perusteet, parts I and II. Dixon, S. L.: Fluid Mechanics, thermodynamics of turbomachinery. Wilson, D. G.: The design of high-efficiency turbomachinery and gas turbines. Further material will be announced during lectures. Part of the assignments and study material on Moodle.
Prerequisites	BH20A0700 Fundamentals of Engineering Thermodynamics attended or equivalent course experience.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BH40A1301	*POWER MACHINES IN RENEWABLE ENERGY* 5 ECTS cr
	Power Machines in Renewable Energy
Year and Period	M.Sc. (Tech.) 2 Period 2
Teacher(s)	Professor, D.Sc. (Tech.) Jari Backman and Associate Professor, D.Sc. (Tech.) Aki-Pekka Grönman
Aims	Upon completion of the course the students will be able to 1. choose and calculate the main performance of wind turbines, 2. explain where wind turbines, gas turbines, steam turbines and organic rankine cycles can be used to utilize renewable energy, and 3. understand where fuel cells can be used.
Content	Gas turbines, micro turbines, wind turbines, fuel cells. The course is related to sustainability.
Modes of Study	2nd period: 12 h of lectures and tutorials. 40 h of self-study, 3 h of Quiz tests on Moodle. Students are expected to familiarize themselves in advance with the Material Notebook and Moodle to make the expected exercises and quizzes.

	Total workload 130 h. Moodle is used in this course.
Evaluation	0 - 5. Evaluation is based on the quizzes and final exam, which will be done in the Exam Aquarium. Approved (50 %) performance in the quizzes and exercises may add extra points to the final exam assessment.
Study materials	Material Notebook, Moodle course material: summary, exercises, quizzes.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BH40A1500	***TURBULENCE MODELS 4 ECTS cr***
	Turbulence Models
Year and Period	M.Sc. (Tech.) 2 Period 3-4
Teacher(s)	Docent, D.Sc. (Tech.) Teemu Turunen-Saaresti
Aims	Upon completion of the course the student will be able to recognize the characteristics of turbulence models and to estimate the suitability of different turbulence models for various fluid mechanical problems. In addition, the student will be able to interpret the physical basis and the theory of turbulence models.
Content	Navier-Stokes equations, RANS equations, eddy viscosity, algebraic, one equation and two equation models, Reynolds stress model and Large Eddy Simulation. This course is also suitable for postgraduate students. The course is related to sustainability.
Modes of Study	3rd period: 12 h of lectures, 12 h of tutorials. 4th period: 12 h of lectures, 12 h of tutorials. Homework 36 h, preparation for the exam 16 h, written examination 3 h. Total workload 103 h.
Evaluation	0 - 5. Examination 50 %, homework 50 %.
Study materials	David C. Wilcox: Turbulence models for CFD. Noppa portal (noppa.lut.fi).
Prerequisites	BH70A0001 Numerical Methods in Heat Transfer
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH50A1200	***ENERGY SYSTEMS ENGINEERING 6 ECTS cr***
	Energy Systems Engineering
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Esa Vakkilainen
Aims	Upon completion of the course the student will be able to 1. describe different types of energy production processes, 2. utilize thermodynamics and heat and mass balances in the design of small scale energy systems, 3. use a “Systems Engineering” type approach to define the design values for energy production processes, 4. define small scale bioenergy production projects, 5. understand how plant requirements affect the planning and implementation phases of small energy systems, and 6. define economic constraints to small scale energy processes.
Content	History and fundamentals of thermodynamics and energy engineering. Modern problems of power plant engineering, combined heat and power production, especially from biomass. Fundamentals of steam and gas turbines in energy production. Systems engineering. Planning and implementation of energy systems. Economic optimization of energy system projects. The course is related to sustainability.
Modes of Study	1st period: 12 h of lectures and case exercises. 2nd period: 12 h of lectures and case exercises. Written assignment, written examination. Independent study approximately: Written assignment 80 h. Preparation for the examination 16 h and the examination 3 h. Studying given materials 33 h.

	Total workload 156 h.
Evaluation	0 - 5. Examination 70 %, written assignment 30 %.
Study materials	Lecture notes. Noppa.
Prerequisites	Understanding of basic thermodynamics.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH50A1300	*MAINTENANCE MANAGEMENT 4 ECTS cr*
	Maintenance Management
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Docent, D.Sc. (Tech.) Juha Kaikko Person in Charge: Professor, D.Sc. (Tech.) Esa Vakkilainen
Aims	Upon completion of the course the student will be able to 1. identify the terminology used in maintenance management, 2. explain maintenance strategies, 3. describe failure mechanisms, 4. utilize the concepts of reliability and availability, 5. describe how maintenance management is organized in power industry, and 6. use maintenance information systems.
Content	Terminology. Maintenance strategies and monitoring. Failure mechanisms and reliability. Organisation and functions of maintenance management. Preventive maintenance. Spare part management. Maintenance information systems. The course is related to sustainability.
Modes of Study	1st period: 12 h of lectures and case exercises. 2nd period: 6 h of lectures and case exercises. Written assignment. Written examination. Independent study approximately: Written assignment 32 h. Preparation for the examination 14 h + the examination 3 h. Studying given materials 37 h. Total workload 104 h. Moodle is used in this course.
Evaluation	0 - 5. Written assignment 30 %, examination 70 %.
Study materials	Crespo Márquez, A.: The Maintenance Management Framework: Models and Methods for Complex Systems Maintenance, Springer-Verlag, 2007 Dhillon, B.S.: Engineering Maintenance: A Modern Approach, CRC Press, 2002. Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH50A1400	*STEAM BOILERS 6 ECTS cr*
	Steam Boilers
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Esa Vakkilainen
Aims	Upon completion of the course the student will be able to 1. list typical biomass fuels and their properties, 2. understand the terminology used in maintenance management, 3. understand steam generation processes, especially from biomass, 4. describe the construction of steam boilers, 5. apply different types of steam boilers using different types of fuels, and 6. realize restrictions caused by corrosion, erosion and fouling.
Content	Characteristics of fuels, especially of biofuels. Combustion and gasification. Design of a steam boiler and its components. CCS. Energy balances. Solving steam boiler problems by mathematical modelling and algorithmization. Operation and maintenance of boilers: corrosion, fouling, emissions. The course is related to sustainability.

Modes of Study	1st period: 12 h of lectures and case exercises. 2nd period: 12 h of lectures and case exercises. Written assignment. Independent study approximately: Written assignment 48 h. Preparation for the examination 18 h and the examination 3 h. Studying given materials 63 h. Total workload 156 h.
Evaluation	0 - 5. Examination 70 %, written assignment 30 %.
Study materials	Lecture notes. Noppa. Teir, Sebastian: Steam Boiler Technology, 2nd ed. 2006.
Prerequisites	Recommended: BH50A1200 Energy Systems Engineering
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH50A1500	***BIOENERGY TECHNOLOGY SOLUTIONS***	***6 ECTS cr***
	Bioenergy Technology Solutions	
Year and Period	M.Sc. (Tech.) 2 Period 2-3 The course is suitable also for doctoral studies.	
Teacher(s)	Professor, D.Sc. (Tech.) Esa Vakkilainen	
Aims	Upon completion of the course the student will be able to Upon completion of the course the student will be able to 1. discuss the EU bioenergy policies including the effects of carbon trading, Res and energy efficiency, 2. understand the role and limitations of bioenergy use in Europe, 3. create a strategic vision for any country to use bioenergy, 4. understand different bioenergy generation technologies, and 5. list the biofuel production technologies, and 6. Independently follow discussions around future directions of Bioenergy technoclogy.	
Content	Comparison of various bioenergy visions. Technological solutions and case studies from biomass supply and biofuel refining, end-use technologies of biofuels in different sectors. The course is related to sustainability.	
Modes of Study	12 h of lectures. Group assignment, seminar presentation. Written examination. Independent study approximately: Written assignment 48 h. Preparation for the examination 16 h + the examination 3 h. Studying given materials 77 h. Total workload 156 h.	
Evaluation	0 - 5. Examination 60 %, assignment 40 %.	
Study materials	Lecture notes. Noppa.	
Prerequisites	BH61A0600 Bioenergy	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BH60A1101	***ENVIRONMENTAL TECHNOLOGY PROJECT WORK***	***1 - 7 ECTS cr***
	Ympäristötekniikan erikoistyöt	
Year and Period	M.Sc. (Tech.) 1 Period 1-4	
Teacher(s)	Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen	
Aims	Upon completion of the course the student is expected to be able to 1. choose appropriate research methods for a research problem in a given field of environmental technology, 2. find and select appropriate reference material for research, 3. indipendently make the timetable and conduct a compact research project, and 4. prepare a written report on his/her work according to instructions.	

Content	Producing a research report on a given subject on the basis of a literature review. The subject of the research can also be assigned by an enterprise.
Modes of Study	1st - 4th periods: Advanced practical or seminar work 50 - 180 h (=independent work). The method of completion is agreed on with the supervising professor. No contact teaching.
Evaluation	0 - 5. Project work 100 %.
Prerequisites	The prerequisites are set individually depending on the case.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH60A1600	***BASIC COURSE ON ENVIRONMENTAL MANAGEMENT AND ECONOMICS*** ***5 ECTS cr***
	Basic Course on Environmental Management and Economics **Opintojakso luennoidaan englanniksi, mutta harjoitustyöt ja tentti on mahdollista tehdä suomen kielellä. Ole yhteydessä vastuuopettajaan, jos haluat suorittaa opintojakson suomen kielellä.**
Year and Period	B.Sc. (Tech.) 2 Period 2
Teacher(s)	Senior Researcher, D.Sc. (Tech.) Virgilio Panapanaan Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen
Aims	Upon completion of the course the student is expected to be able to: 1) describe the challenges that sustainable development poses to society and businesses; 2) understand how and what environmental responsibility and sustainability means for business; 3) identify corporate stakeholders and analyse their importance and environmental viewpoints; 4) understand the basics of environmental regulations, environmental strategy and risk management; 5) use and compare the indicators of eco-efficiency; 6) explain the basics of life cycle thinking, management and related concepts; 7) explain the steps of planning and implementing environmental management system; 8) know the different environmental communication and marketing tools; and 9) synthesise the basic environmental management tools and explain the reasons for their application.
Content	Identifying the influence of sustainable development on business. Learning the basic concepts related to corporate responsibility and corporate environmental management. Identifying corporate stakeholders and their importance. Understanding the basics of environmental regulations and the concepts of environmental strategy and risk management. Recognising the indicators of eco-efficiency. Knowing the basics of life cycle analysis and related concepts on environmental product design. Knowing the basics of building and maintaining an environmental management system. Understanding the basics of environmental communication (environmental marketing, eco-labelling and sustainability reporting). The course is related to sustainability.
Modes of Study	2nd period: 24 h of lectures, including two voluntary case exercises (group work). Share of individual work (approx. 106 h): Written assignment, approx. 56 h, Written examination and preparation for it, approx. 50 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 70 %, written assignment 20 %, case-exercises 10 %.

Study materials	Schaltegger, S., Burritt R. & Petersen H. 2003. An Introduction to Corporate Environmental Management. Striving for Sustainability. (Supplementary reading materials will be provided). Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH60A2101	***ADVANCED COURSE IN LIFE CYCLE ASSESSMENT*** ***7 ECTS cr***
	Advanced Course in Life Cycle Assessment **Luennointikieli englanti.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Risto Soukka
Aims	Upon completion of the course the student is expected to be able to 1. explain the basic life cycle concepts, 2. plan, implement and analyse assessments to select products and services which fulfil the requirements of sustainable development, 3. plan, implement and analyse assessments to reveal development needs of products and services, 4. implement the life cycle costing calculation of a product or service, 5. recognise the most inexpensive ways to reduce the environmental impact, and 6. perform life cycle assessments using software.
Content	Introduction to life cycle assessment, carrying out life cycle assessment, aspects related to inventory analysis, aspects related to impact assessment, calculating a carbon footprint, introduction to life cycle costing, aspects related to life cycle costing, LCA and LCC examples. This course is also suitable for postgraduate students. The course is related to sustainability.
Modes of Study	3rd period: 8 h of lectures, 3 h of computer training. Assignment 1 with a literature and computational part, individual work (approx. 38 h). 4th period: 6 h of lectures, 4 h of computer training. Assignment 2 with Life cycle modelling task and final report, team work (approx. 82 h). Oral examination and preparation for it (approx. 41 h). Total workload 182 h. Moodle is used in this course.
Evaluation	0 - 5. Written assignments 75 %, examination 25 %.
Study materials	Walter Klöpffer, Birgit Grahl Life Cycle Assessment (LCA), A Guide to Best Practice. Moodle.
Prerequisites	Understanding the basics of life cycle thinking. BH60A1600 Basic Course on Environmental Management and Economics.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH60A2200	***AIR POLLUTION CONTROL*** ***3 ECTS cr***
	Air Pollution Control **Ympäristötekniikan suomen kielistä tutkintoa suorittavat opiskelijat suorittavat opintojakson BH60A0450 Kaasumaisten päästöjen hallinta.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Risto Soukka
Aims	Upon completion of the course the student is expected to be able to 1. comprehend the air pollution control terminology, 2. apply methods for improving air quality in cities,

	3. apply methods for decreasing the carbon footprint of products and services, 4. comprehend the formation and treatment methods of air pollution, and 5. comprehend air pollution control technologies and processing systems.
Content	Greenhouse gas emissions. Control of sulphur and nitrogen oxides. Control of particulates. Control of other gaseous emissions. The course is related to sustainability.
Modes of Study	3rd - 4th period: 8 h of lectures. Independent work (approx. 70 h): Seminar work and written assignment, approx. 35 h (pair work). Participation in seminar presentations. Written examination and preparation for it, approx. 35 h. Total workload 78 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 50 %, seminar work and written assignment 50 %.
Study materials	De Nevers Noel: Air Pollution Control Engineering Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH60A2401	***ENERGY RECOVERY FROM SOLID WASTE 4 ECTS cr***
	Energy Recovery from Solid Waste
Year and Period	M.Sc. (Tech.) 2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Mika Horttanainen, D.Sc. (Tech.) Mika Luoranen Person in Charge: Professor, D.Sc. (Tech.) Mika Horttanainen
Aims	Upon completion of the course the student is expected to be able to 1. describe the properties of waste as fuel, 2. explain the most common waste-to-energy technologies and their suitability for different energy recovery applications and materials, 3. determine the waste-to-energy recovery potential of a region, 4. describe the most important flue gas emissions and their reduction technologies characteristic for the combustion of waste, and 5. analyse the role of energy recovery in municipal waste management.
Content	Waste-to-energy in Finland and other countries, properties of waste as a fuel, waste handling before thermal conversion, preparation of recycled fuel, mass combustion of waste, combustion of recycled fuel, gasification of waste, energy recovery in combustion of waste, emission reduction during combustion, flue gas treatment, utilisation and treatment of ash, anaerobic digestion of waste, landfill gas utilisation in energy production. The course is related to sustainability.
Modes of Study	1st period: 14 h of lectures, 12 h of exercises. 2nd period: 6 h of lectures, 2 h of exercises. 2nd period: Assignment info (2 h). Group assignment including calculations, written group report (approx. 44 h). Excursion (approx. 6 h). Written examination and preparation for it, approx. 20 h. Total workload 106 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 60 %, practical assignment 40 %.
Study materials	Course book (to the appropriate extent): Niessen, W., 2002. Combustion and incineration processes. Marcel Dekker, Inc., New York. SBN: 0-8247-0629-3. Moodle.
Prerequisites	Basic knowledge on thermodynamics, chemistry and power plant technology.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH60A2801	***ENERGY AND ENVIRONMENTAL CHALLENGES IN RUSSIA***	***3 ECTS cr***
	Energy and Environmental Challenges in Russia	
Year and Period	B.Sc. (Tech.) 3, B.Sc. (Econ. & Bus. Adm.) 3 Period 3	
Teacher(s)	Visiting professors Person in Charge: Professor, D.Sc. (Tech.) Mika Horttanainen	
Aims	Upon completion of the course the student is expected to be able to 1. list the main challenges in energy production in Russia, 2. list the main environmental challenges in Russia, 3. describe the reasons for the energy and environmental challenges in Russia, 4. explain the main improvement needs in the energy and environmental sector in Russia, and 5. report orally and in writing in English about the example problems.	
Content	Energy production challenges, electricity market structure, issues on energy efficiency and resource saving, environmental policy and legislation, the state of water purification and waste water treatment, waste generation and organization of waste management. The course is related to sustainability.	
Modes of Study	3rd period: 12 h of lectures, 4 h of seminars. Written assignment approx. 30 h. Written examination and preparation for it approx. 30 h. Total workload 76 h. Moodle is used in this course.	
Evaluation	0 - 5. Examination 50 %, seminar work and written assignment 50 %.	
Study materials	Literature will be announced later. Moodle.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BH60A3501	***SUSTAINABLE INNOVATION AND SYSTEM TRANSITION***	***5 ECTS cr***
	Sustainable Innovation and System Transition **The maximum number of participants is limited to 25 students.**	
Year and Period	M.Sc. (Tech.) 1 Period 1-3	
Teacher(s)	Visiting lecturers Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen	
Aims	Upon the completion of the course the student is expected to be able to: 1. comprehend the concept of sustainable innovation and system transition, 2. work with complex sustainability challenges, and develop solutions that fill all aspects of sustainability, and 3. work in a multicultural group and produce a scientific written report and a seminar presentation about his findings.	
Content	Sustainability and innovation, system innovation and transition. Practice based innovation, innovation processes and networks. The student writes a learning diary with which he/she reflects the content of the course, his/her personal learning and the progress of the project work. The students produce a large project work in groups on the basis of a real life case example or a literature review. The course themes are both from developing and developed country settings. The course is related to sustainability.	
Modes of Study	1st period: 18 h of lectures, independent work approx. 9 h (preassignment and learning diary).	

	2nd period: 8 h of tutorials, independent work approx. 42 h (project work, learning diary). 3rd period: 5 h of tutorials, 6 h of seminars, independent work approx. 42 h (project work, learning diary). Total: Lectures and tutorials 31 h, lecture diary 20 h, project work 70 h and seminar presentation 6 h. Total workload 130 h, of which independent work approximately 93 h. Moodle is used in this course.
Evaluation	0 - 5. Lecture diary 20 %, project work and seminars 80 %.
Study materials	Course material will be announced during the lectures. Moodle.
Prerequisites	B.Sc. studies or corresponding knowledge.

BH60A3700	***WORK INTERNSHIP IN MASTER'S DEGREE***	***2 - 10 ECTS cr***
	DI-tutkinnon työharjoittelu **No course registration (replaced by submitting the application for approval of the internship coordinator).**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Laboratory Engineer, Lic.Sc. (Tech.) Simo Hammo Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen	
Aims	After the work environment internship, the student will have the basic knowledge of work, working environment and working community in his/her own field. The student will be able to apply the knowledge and skills acquired during the course of studies to work in his/her own field.	
Content	The student obtains a (summer) job from the company, works there as a paid employee, requests for a certificate of employment and applies for the approval of the work as an internship for the Master’s degree. Full-time employment relationships of at least four weeks can be approved as internships. The completion of the Master’s thesis is not accepted as an internship. An employment relationship preceeding the studies can be approved as an internship, provided that it has not been accepted and included in any other previous degree.	
Modes of Study	The first 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to beginning of an employment relationship (e.g. orientation, the rules of the employment relationship and the workplace) 15 h, observing (while working) how the working community operates (e.g. how work/production is organized, supervision, the working manners of the working community/teams, the social environment of the workplace) 22 h, a written internship report 5 h (2 - 3 pages); total workload 52 h. 3 - 10 ECTS credits: having different tasks in a company 26 - 208 h (1 ECTS credit/26 h). The number of ECTS credits of compulsory internship varies depending on the degree programme in question; further information is available in the degree structures in the study guide.	
Evaluation	Pass/Fail. Internship report 100 %.	

BH60A4201	***MASTER´S THESIS***	***30 ECTS cr***
	Diplomityö **In Master's degree programmes taught in English, the Master's thesis is always prepared in English.**	
Year and Period	M.Sc. (Tech.) 2 Period 1-4	
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Risto Soukka	
Aims	Upon completion of the course the student is expected to be able to:	

	1. define a research problem, 2. choose and apply research methods relevant to the research problem, 3. search for suitable reference material, and assess the quality and reliability of the material and the information it contains, 4. use and interpret reference material correctly and diversely, 5. report on his or her work in writing, taking into account language and layout requirements, and 6. give a concise oral presentation on the content and results of the work.
Content	The thesis is a research or a planning project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the instructions for the Master's thesis.
Modes of Study	The presentation of the thesis will be arranged with the supervising professor. There will not be a separate seminar. Total workload approx. 780 h.
Evaluation	0 - 5. Master's thesis 100 %.

BH60A4300	***ENVIRONMENTAL TECHNOLOGY PROJECT WORK***	***2 - 30 ECTS cr***
	Environmental Technology Project Work **The students register for the course by contacting the professor (Master's degree students) / supervisor (exchange students), with an idea of the topic.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 1-4	
Aims	Upon completion of the course the student is expected to be able to: 1. choose appropriate research methods for a research problem in a given field of environmental technology, 2. find and select appropriate reference material for research, 3. independently make the timetable and conduct a compact research project, and 4. prepare a written report on his/her work according to instructions.	
Content	Producing a research report on a given subject on the basis of a literature review. The subject of the research can also be assigned by an enterprise.	
Modes of Study	1st-4th periods: Advanced practical or seminar work 50 - 780 h,(=independent work). The method of completion is agreed on with the supervising professor. No contact teaching.	
Evaluation	0 - 5. Project work 100 %.	
Prerequisites	The prerequisites are set individually depending on the case.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BH60A4400	***INTRODUCTION TO SUSTAINABILITY***	***3 ECTS cr***
	Introduction to Sustainability	
Year and Period	M.Sc. (Tech.) 1 Period 1	
Teacher(s)	Senior Researcher, D.Sc. (Tech.) Virgilio Panapanaan Person in Charge: Professor, D.Sc. (Tech.) Risto Soukka	
Aims	Upon completion of the course the students are expected to be able to: 1) explain the interaction between the environment, society and business and understand the relationships of various actors in these fields and their impacts on the society and the environment; 2) understand the core idea and thinking behind sustainability and its importance in order to limit or decelerate environmental damages and improve our quality of life while pursuing a more sustainable lifestyle and business within the planetary boundaries;	

	3) understand and apply practically the learned principles and concepts of sustainability in relation to current production and consumption habits; 4) know and be guided about the different value-adding activities and tools that promote sustainability; and 5) demonstrate the ability to reflect sustainability principles in the assignment, studies and desirably in thinking and lifestyles. boundaries, 3. understand and apply practically the learned principles and concepts of sustainability in relation to current production and consumption habits, 4. demonstrate the ability to reflect sustainability in the project, studies and desirably also in thinking and lifestyles, and 5. complete various assignments that support the application of sustainability elements in the future working environment.
Content	The general objective of the course is to introduce students to different sustainability challenges that our world is facing as a consequence of human activities and natural causes. The idea is to learn and understand those sustainability challenges and their interconnectedness, and find out how we could move or transit towards a more sustainable world. The course is related to sustainability.
Modes of Study	1st period: 14 h of lectures. Independent study (approx. 64 h): assignment (group work) and seminar (approx. 26 h). Preparation for the examination and the exam (approx. 38 h). Total workload 78 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 70%, assignment 30%.
Study materials	Will be announced during lectures. Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH60A4500	***CORPORATE RESPONSIBILITY AND MANAGEMENT 1*** ***3 ECTS cr***
	Corporate Responsibility and Management 1 **The course is intended for international students or Sustainability minor students. Literature examination in the exam aquarium. Registration for the course in WebOodi and registration for the exam using Origo's exam aquarium software. Noppa is used as a communication platform.**
Year and Period	M.Sc. (Tech.) 1 Period 1-4
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen
Aims	Upon completion of the course the student is expected to be able to: 1. explain the connection between corporate social responsibility and business strategies, 2. to analyze organizational, economic, and social issues related to corporate social responsibility, 3. to interpret and evaluate the relationship between a company and society, 4. to identify and evaluate different types and hierarchy of corporate social responsibility, and to understand the relevance of modern CSR, 5. name different areas and stakeholder groups related to corporate social responsibility, 6. explain the importance of stakeholders in his/her own words, and 7. analyze the operation process of corporate social responsibility.
Content	Corporate environmental strategies and application of the methods of environmental management. Analyzing the impacts that environmental management has on business. Identifying the sectors of responsible business operations. Basics of corporate ethics. Informing of and reporting on corporate responsibility issues to the stakeholders. Reporting of corporate social responsibility. The course is related to sustainability.

Modes of Study	Literature examination in the exam aquarium. All the exams done during one calendar month are to be reviewed by the 15th of the following month. See Noppa for further instructions and contact information.
Evaluation	0 - 5. Examination 100 %.
Study materials	Werther, William B. Jr., Chandler, David: Strategic Corporate Social Responsibility: Stakeholders in a Global Environment, 2010. Other material and literature specified in NOPPA course overview.
Prerequisites	BH60A1600 Basic Course on Environmental Management and Economics attended or equivalent knowledge.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BH60A4600	***INTRODUCTION TO M.SC. STUDIES 1 ECTS cr***
	Introduction to M.Sc. Studies
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Educational Coordinator and Tutor Teachers Person in Charge: Head of the Degree programme, Professor, D.Sc. (Tech.) Risto Soukka
Aims	Upon completion of the course the student is expected to be able to: 1. describe the content of the Degree Programme, interpret the study guide and also describe the research areas of School of Energy Systems, 2. prepare his/her individual study plan (ePSP) and follow the progress of his/her studies with the help of WebOodi's personal study plan, 3. observe the university's examination practices and degree programme practices (incl. instructions of the Master's Thesis), 4. use the services of the library, retrieve information independently and use the information sources in accordance with good practices, and also to observe the copyrights, 5. understand how to manage the studies and how to find help when needed during his/her studies, and 6. use the Moodle learning environment.
Content	1st period: Lectures together with all majors of International Master's program of Energy Technology: Getting to know the School of Energy Systems and the Maste'rs programs major and Minor Studies (incl. Master's Thesis). Study and exam culture in LUT. LUT library collections, databases, reference practices, and copyrights. ePSP workshop. Research areas of School of Energy Systems. 1st - 2nd period: One autumn lecture from Studentia Finlandia lecture series. The course is related to sustainability.
Modes of Study	1st period: 12 h of obligatory lectures (incl. participation in an ePSP workshop and library visit). 2nd period: Individual discussion with a teacher tutor 1 h. Individual work (total approx. 13 h): 1st period: An individual study plan. Assignments of information searching, library use, and databases on Moodle. 2nd period: Written assignment about study and career plans. Total workload 26 h. Moodle is used in this course.
Evaluation	Pass/fail.
Study materials	Study Guide, Moodle, LUT library collections, and databases.

BH60A4700	***CLIMATE FINANCE AND CARBON MARKETS 3 ECTS cr***
	Climate Finance and Carbon Markets
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Senior Researcher, D.Sc. (Tech.) Virgilio Panapanaan Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.), M.Sc. (Tech.) Lassi Linnanen

Aims	Upon completion of the course the student is expected to be able to: 1. know and understand the new global negotiations, agreements and mechanisms on climate change; 2. understand and explain the global climate finance and its role in mitigation and adaptation; 3. explain the role of carbon markets and emission trading schemes in and outside Europe; 4. and explain the impacts of an emission trading scheme on different stakeholders.
Content	Topics include: Global climate finance and the new climate agreements, climate finance architecture, actors and instruments, mitigation and adaptation climate financing in developing countries, carbon markets and different emerging carbon trading schemes, EU emission trading scheme, and the impacts of climate finance and emission trading. The course is related to sustainability.
Modes of Study	3rd period: 14 h of lectures 4th period: Assignment and seminars. Examination. Independent study (approx. 66 h): assignment 20 h, examination and preparation for it 36 h, seminars 8 h. Total workload 78 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 75 %, assignment and seminar presentation 25 %.
Study materials	Will be announced during the course.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH60A5000	***MASTER'S THESIS*** ***30 ECTS cr***
	In Master's degree programs taught in English, the Master's thesis is always prepared in English.
Year and Period	M.Sc. (Tech.) 2 Period 1-4
Teacher(s)	Professor, D.Sc. (Tech.) Risto Soukka
Aims	Upon completion of the course the student is expected to be able to: 1. define a research problem, 2. choose and apply research methods relevant to the research problem, 3. search for suitable reference material, and assess the quality and reliability of the material and the information it contains, 4. use and interpret reference material correctly and diversely, 5. report on his or her work in writing, taking into account language and layout requirements, and 6. give a concise oral presentation on the content and results of the work.
Content	The thesis is a research or a planning project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the instructions for the Master's thesis.
Modes of Study	The presentation of the thesis will be arranged with the supervising professor. There will not be a separate seminar. Total workload approx. 780 h.
Evaluation	0 - 5. Master's thesis 100 %.

BH61A0600	***BIOENERGY*** ***3 ECTS cr***
	Bioenergy
Year and Period	M.Sc. (Tech.) 1 Period 1
Teacher(s)	Professor, D.Sc. (Tech.) Tapio Ranta

Aims	Upon completion of the course the student will be able to understand the meaning of bioenergy, alternative biomass resources, supply methods, refining and end-user applications; describe the quality properties of solid biofuels and how they are measured and evaluated by using standards; and explain the meaning of sustainability in bioenergy systems.
Content	The role of bioenergy in the EU energy policy, incentive programmes and future plans. Raw-material sources of bioenergy, potential resources and current use. Biomass supply systems and logistics. Refined biofuel commodities, biogas and liquid biofuels. Biomass international trade. Quality properties of solid biofuels, quality measurement and standards. Sustainable bioenergy. The course is related to sustainability.
Modes of Study	1st period: 12 h of lectures. Written examination. Total workload 78 h, containing 63 h of self-study. Moodle is used in this course.
Evaluation	0 - 5. Examination 100 %.
Study materials	Energy Visions 2050, VTT. 2009. Chapters 2, 4.4, 5.2 - 5.4. Additional material will be announced later during lectures.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BH70A0001	***NUMERICAL METHODS IN HEAT TRANSFER 6 ECTS cr***
	Numerical Methods in Heat Transfer
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Docent, D.Sc. (Tech.) Teemu Turunen-Saaresti Person in Charge: Professor, D.Sc. (Tech.) Timo Hyppänen
Aims	This course acquaints students with the key numerical methods in heat and mass transfer and with the use of these methods. Upon completion of this course, students will be able to solve the different kind of heat transfer and fluid dynamic problems using numerical methods. Students will also be able to explain the theory and limitations of studied numerical methods and to form equations using the finite volume method. Students will be able to use numerical software for the computation of simple cases and interpret and analyze gained results.
Content	Numerical solution methods for the conservation of mass, momentum and energy. Solutions for heat conduction and convection. The finite volume method. Formulation of discretised conservation equations. The solution of equation sets. Unsteady Stability analyses. Setting boundary conditions. The basics of fluid dynamics software: the grid generation, solution and post-processing of results. The course is related to sustainability.
Modes of Study	1st period: 12 h of lectures, 12 h of exercises. 2nd period: 12 h of lectures, 12 h of exercises. Homework 24 h. Project work 74 h. Preparing for the examination 8 h. Oral examination 1 h. Total workload 155 h.
Evaluation	0 - 5. Examination 100 %.
Study materials	Noppa portal (noppa.lut.fi). Patankar, Suhas V.: Numerical heat transfer and fluid flow. Versteeg, H.K.: An introduction to computational fluid dynamics. The Finite Volume Method.
Prerequisites	BH20A0450 Lämmönsiirto and BH40A1400 Virtaustekniikka I

BH70A0101	*ADVANCED MODELING TOOLS FOR TRANSPORT PHENOMENA* *5 ECTS cr*
	Advanced Modeling Tools For Transport Phenomena
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Docent, D.Sc. (Tech.) Payman Jalali Person in Charge: Professor, D.Sc. (Tech.) Timo Hyppänen
Aims	Transport phenomena are dealing with the heat, mass and momentum transfer in engineering and science. In this course, advanced modeling tools and methods are introduced for students of energy technology and other departments with related background in heat transfer and fluid dynamics. Students will learn how the related computer packages such as FLUENT, COMSOL Multiphysics and MATLAB can be used to solve and analyze heat transfer and fluid flow problems using computational fluid dynamics (CFD). This course provides a mathematical basis for problem formulation, and coding/solving using the above-mentioned computational packages. Students will learn how to solve simple transport problems using their own codes in MATLAB. Then more complex problems will be taught to solve using COMSOL and FLUENT packages. Upon completion of this course, they will be able to start working on various topics in heat and fluid flow engineering for advanced designs or analysis.
Content	Introduction to ‘transport phenomena’ and related problems, feeding problems into CFD algorithms and methods (discretization of equations and domains, transforming differential equations into algebraic equations etc.), diffusion and convection equations solved by finite difference and finite volume methods, complexities due to property variation, geometry and boundary conditions, application of computational packages (such as MATLAB, FLUENT, COMSOL Multiphysics etc.) in solving transport phenomena problems. The course is related to sustainability.
Modes of Study	3rd period: 12 h of lectures, 12 h of exercises. 4th period: 12 h of lectures, 12 h of exercises. 3 - 6 homeworks and 2 projects. Total workload 130 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 40 %, homeworks and projects 60 %.
Study materials	J.D. Anderson: Computational Fluid Dynamics, McGraw-Hill, Inc. 1995. D.A. Anderson, J.C. Tannehill, R.H. Pletcher: Computational Fluid Mechanics and HeatTransfer, McGraw-Hill, Inc. 1984. J.H. Ferziger, M. Peric: Computational Methods for Fluid Dynamics, Springer-Verlag 1996. C. Hirsch: Numerical Computation of Internal and External Flows, Volume 1: Fundamentals of Numerical Discretization, John Wiley & Sons, 1988. MATLAB user manual. FLUENT user manual.COMSOL Multiphysics manual. Moodle.
Prerequisites	Basic knowledge on programming using MATLAB or any other language. Basic Fluid Mechanics and Heat Transfer courses passed.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BH70A0200	*ADVANCED TOPICS IN MODELLING OF ENERGY SYSTEMS* *6 ECTS cr*
	Advanced Topics in Modelling of Energy Systems
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Timo Hyppänen, Professor, D.Sc. (Tech.) Esa Vakkilainen, Docent, D.Sc. (Tech.) Teemu Turunen-Saaresti, Docent, D.Sc. (Tech.) Juha Kaikko, Associate Professor, D.Sc. (Tech.) Jouni Ritvanen, Associate

	Professor, D.Sc. (Tech.) Tero Tynjälä and Laboratory Engineer, D.Sc. (Tech.) Juhani Vihavainen Person in Charge: Professor, D.Sc. (Tech.) Timo Hyppänen
Aims	Upon completion of the course the student will be able to: 1. create stationary and time dependent mass, momentum and energy balances for various kinds of energy systems, 2. perform design tasks, utilize mathematical software in calculation, and analyze the characteristics of energy systems, 3. include material property definitions into mathematical software or into own code when simulating energy systems, 4. create, solve and analyze the set of stationary and time dependent balance equations using Excel and MATLAB, 5. create, solve and analyze stationary energy systems with IPSEpro software package, and 6. create, solve and analyze time dependent energy systems with APROS software package.
Content	Advanced problems in the modelling of energy systems needed by engineers and researchers. The course lectures provide mathematical basis for problem formulation, and exercises providing a chance to work with various computational packages.
Modes of Study	1st period: 12 h of lectures and 12 h of case exercises. 2nd period: 10 h of lectures, 10 h of case exercises and 4 h of seminars. Individual work: Written assignments 60 h. Seminar work 48 h. Total individual work 108 h. Total workload 156 h. Moodle is used in this course.
Evaluation	0 - 5. Written assignments 70 %, seminar work 30 %.
Study materials	Moodle.
Prerequisites	BH20A0450 Heat transfer (Recommended) BH20A0800 Engineering Thermodynamics (Recommended) BH40A1450 Fluid Dynamics II (Recommended)
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL10A8000	***WORK INTERNSHIP IN MASTER'S DEGREE***	***2 - 10 ECTS cr***
	DI-tutkinnon työharjoittelu **No course registration (replaced by submitting the application for approval of the internship coordinator).**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Laboratory Engineer, Lic.Sc. (Tech.) Simo Hammo Person in Charge: Professor, D.Sc. (Tech.) Pertti Silventoinen	
Aims	After the work environment internship, the student has obtained a basic knowledge of the work, work environment and working community in his/her own field. The student is able to apply and generalise knowledge and skills acquired during the course of studies to work in his/her own field.	
Content	The student obtains a (summer) job from the company, works as a paid employee, requests a certificate of employment and applies for the approval of the work as an internship for the Master's degree. Full-time employment relationships of at least four weeks can be approved as internships. The completion of the Master's thesis is not accepted as an internship. An employment relationship that took place before the studies can be approved as an internship providing that it has not been accepted and included in any other previous degree.	
Modes of Study	First 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to starting an employment relationship (e.g. orientation, the rules of the employment relationship and the work place) 15 h, observing (while working) how the	

	working community operates (e.g. how work/production is organised, supervision, the working manners of the working community/teams, the social environment of the work place) 22 h, a written internship report 5 h (2-3 pages), total 52 h. 3-10 ECTS credits: having different tasks in a company 26-208 h (1 ECTS credit/26 h). The number of ECTS credits of compulsory internship varies depending on the study programme in question, further information is available in the degree structures of the study guide.
Evaluation	Pass/Fail, internship report 100%.

BL10A8400	***SOLAR ECONOMY AND SMART GRIDS 3 ECTS cr***
	Solar Economy and Smart Grids **LUT Summer School -course, intensive course 10. – 14.8.2015**
Year and Period	M.Sc. (Tech.) 1-2 Period INT. The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Christian Breyer, LUT Professor, D.Sc. (Tech.) Jarmo Partanen, LUT Professor, D.Sc. (Tech.) Satu Viljainen, LUT Professor, D.Sc. (Tech.) Olli Pyrhönen, LUT Associate Professor Mats Nilsson, Luleå University of Technology Docent Jouni Keronen, CEO Climate Leadership Council Person in Charge: Professor, D.Sc. (Tech.) Christian Breyer, LUT
Aims	Upon completion of the course the student will be able to: 1. understand the basic processes of solar economy and Smart Grids, 2. recognise the key properties of global climate challenges, solar economy, electricity market models, wind and solar power technologies, energy storage technologies and the smart grid concept, 3. recognise the most important aspects, chances and challenges of transition from existing energy systems to sustainable energy systems.
Content	During the course the student will become familiar with the properties and application areas of: 1. Climate change 2. Solar economy 3. New electricity market 4. Wind power technology 5. Solar power technology 6. Energy Storages 7. Demand response 8. Regulation of electricity distribution business 9. Smart Grid concept Basic rules to improve the DFMA properties (design for manufacturability and assembly) of a product are presented and applied to typical energy technology applications. The course is related to sustainability.
Modes of Study	Introductory lectures and exercises 24 h. Team work and a limited project work 20 h. Presentations of the results of the team work/project work 8 h. Independent work 26 h. Total workload 78 h. Moodle is used in this course.
Evaluation	0-5, project work 70 %, presentation 30 %.
Study materials	Lecture notes.
Prerequisites	Previous studies either in electrical engineering, environmental engineering or energy technology are recommended.

BL10A8600	MASTER'S THESIS 30 ECTS cr
	Master's Thesis **In Master's degree programmes taught in English, the Master's thesis is always prepared in English.**
Year and Period	M.Sc. (Tech.) 2 Period 1-4
Aims	Upon completion of the course the student will be able to: 1. delineate a research problem, 2. select research methodology suitable for the study, 3. find relevant reference material and assess the credibility of sources, 4. apply the material correctly to his/her own work, 5. write a scientific report according to scientific practices with a special reference to electrical engineering.
Content	Fundamentals of scientific work. Good scientific conduct associated with definition of a research problem, selection of research methodology, problem solving and scientific reporting with special focus on electrical engineering practices. Application of scientific knowledge to problem solving. Good information processing skills. Scientific reporting. Information search. Scientific writing skills. Writing the M.Sc. thesis.
Modes of Study	Writing the M.Sc. thesis. The seminar part of the course is completed by presenting the M.Sc. thesis to the examiner and/or to the commissioner of the thesis.
Evaluation	0-5, M.Sc. thesis 100 %.

BL20A0201	POWER EXCHANGE GAME FOR ELECTRICITY MARKETS 3 ECTS cr
	Power Exchange Game for Electricity Markets
Year and Period	M.Sc. (Tech.) 1 Period 2-3 The course is suitable also for doctoral studies.
Teacher(s)	Doctoral Student, M.Sc. (Tech.) Petri Valtonen Person in Charge: Professor, D.Sc. (Tech.) Satu Viljainen
Aims	Upon completion of the course the student will be able to: Plan electricity purchase and sale in an economically viable way, recognize the most common risk management instruments and basic mechanisms of demand response in electricity markets, and exploit financial products of the power exchange in risk management and trade electricity in day ahead and intraday markets. These skills will be practised in a power exchange game, after which the student will be able to analyse and interpret the game results.
Content	Electricity purchase/sale, OTC markets, physical products on the power exchange (Elspot and Elbas), financial products on the power exchange (DS Futures and Futures), risk management. The course is related to sustainability.
Modes of Study	Lectures 8 h, weekly game situation practice 40 h, 2nd and 3rd period. Written homework, intermediate report and final report. Total workload 78 h. The lectures focus on the key learning objectives in the topic. Successful completion of the course requires student’s active independent work.
Evaluation	0-5, written report 100 %.
Study materials	Material handed out in class.
Prerequisites	BL20A0400 Sähkömarkkinat
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL20A0401	ELECTRICITY MARKET 5 ECTS cr
	Electricity Market
Year and Period	M.Sc. (Tech.) 1 Period 1
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Jarmo Partanen, Professor, D.Sc. (Tech.) Satu Viljainen
Aims	Upon completion of the course the student will be able to: 1. describe the characteristics of the different business sectors in the Nordic electricity market, 2. explain electricity price formation, 3. model electricity consumption, 4. explain the operation principle of the power exchange, 5. identify and describe the products of the power exchange, 6. select the right risk management method for electricity trade, 7. describe the tasks of the different parties in an electric power system in maintaining technical and commercial power balance, 8. conduct the balance settlement, 9. price the products of electricity trade and distribution and describe why and how electricity distribution business is regulated.
Content	The development of electricity markets, loads on the electricity network and load forecasts, power exchange, electricity trade, balance management, the fundamentals of pricing and regulation of distribution business. The course is related to sustainability.
Modes of Study	28 h of lectures, 14 h of tutorials, 1st period. Independent studies. Written examination. Total workload 130 h. The lectures focus on the core learning objectives in the topic. Successful completion of the course requires student's active independent work.
Evaluation	0-5, examination 100%.
Study materials	Material distributed in class.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL20A0501	ELECTRICITY DISTRIBUTION TECHNOLOGY 8 ECTS cr
	Electricity Distribution Technology
Year and Period	M.Sc. (Tech.) 1 Period 2-3 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Jarmo Partanen, Associate Professor, D.Sc. (Tech.) Jukka Lassila
Aims	Upon completion of the course the student will be able to: 1. perform technical and financial calculations related to electricity distribution networks: voltages, currents, losses, fault currents, reliability, investment, outage and maintenance costs, 2. compile long-term strategic development plans related to electricity distribution networks, 3. carry out techno-economic dimensioning of an electricity distribution network, 4. explain the targets and principles of the use of electricity distribution networks, 5. use the distribution automation applications in the operation of a distribution network and design short circuit and earth fault protection in electricity distribution networks. 6. have understanding of Smart Concept and it's impact on electricity distribution business.
Content	Network design; the use, protection and automation of distribution networks; information systems of distribution companies. Network design; the use, protection and automation of distribution networks; information systems of distribution companies.

Modes of Study	42 h of lectures, 28 h of tutorials, 2nd and 3rd period. Assignment. Written examination.
Evaluation	0-5, examination 100 %. Satisfactorily completed assignment required.
Study materials	Lakervi, E. & Partanen, J.: Sähkönjakelutekniikka (Otatieto, moniste 609).
Prerequisites	BL20A0700 Introduction to Electrical Power Systems, BL20A0601 Electrical Power Transmission and BL20A0401 Electricity Market attended.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL20A1300	***ENERGY RESOURCES 6 ECTS cr***
	Energy Resources **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Christian Breyer Person in Charge: Professor, D.Sc. (Tech.) Christian Breyer
Aims	Upon completion of the course the student will be able to: 1. Identify the contraints and potentials of all relevant energy sources in a global context. 2. Know all relevant energy conversion technologies on basis of their energy resource. 3. Analyse the principal structure of future energy systems on basis of energy resource characteristics. 4. Describe the special relevance of wind energy and solar energy for the on-going energy transformation.
Content	The main energy resources for the current and future energy system are: crude oil, natural gas, coal, uranium, hydro power, bioenergy, solar energy, wind energy, geothermal energy, ocean energy. These energy resources have different theoretical, technical and economic potentials as well as geographic variations in availability. The resources also differ considerably in the impact of the emissions related to the respective energy conversion technologies being relevant for the degree of sustainability. A broad variety of energy conversion technologies at different levels of maturity are used for utilizing the resources. The availability of resources and related emissions and techno-economic maturity of related energy conversion technologies provide a fundamental structure for the future energy system and the related energy transformation pathway. The course is related to sustainability.
Modes of Study	Lectures 12 h, exercises 12 h, 1st period. Lectures 12 h, exercises 12 h, 2nd period. Examination. Total workload 156 h. Moodle is used in this course.
Evaluation	0-5, examination.
Study materials	Material handed out in class.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL20A1400	***RENEWABLE ENERGY TECHNOLOGY 6 ECTS cr***
	Renewable Energy Technology
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Christian Breyer Person in Charge: Professor, D.Sc. (Tech.) Christian Breyer
Aims	Upon completion of the course the student will be able to: 1. Identify the major RE conversion technologies, mainly converting resources to electricity.

	2. Describe the major characteristics of the technologies, in particular applications, efficiency, economics, industrial scale and future prospects. 3. Analyse the need for storage technologies and their different fields of application based on their key technical and economic features.
Content	The renewable energy (RE) resources wind energy, solar energy, hydro power, bioenergy, geothermal energy and ocean energy can be utilized by a variety of different energy conversion technologies. The course is focused on the conversion of the resources to electricity. The RE technologies discussed in the course are: wind turbines, solar photovoltaics, solar thermal electricity generation, hydro power plants, biogas plants, solid biomass firing plants, biomass combined heat and power plants, geothermal power plants, tidal energy, wave energy and ocean current energy. The storage technologies covered comprise a general overview and in particular battery storage, pumped hydro storage and power-to-gas technologies. All technologies are classified in respect to their applications, efficiency, maturity, economics, industrial scaling and expected relevance for the ongoing energy transformation. The course is related to sustainability.
Modes of Study	1st lectures 12 h, exercises 12 h. 2nd lectures 12 h, exercises 12 h, examination. Total workload 156 h. Moodle is used in this course.
Evaluation	0-5, examination 100 %
Study materials	Material handed out in class.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL20A1500	***ENERGY SCENARIOS 6 ECTS cr***
	Energy Scenarios **The course will be lectured every other year, next during the academic year 2015 - 2016.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Christian Breyer Person in Charge: Professor, D.Sc. (Tech.) Christian Breyer
Aims	Upon completion of the course the student will be able to: 1. Describe the sustainability requirements of future energy systems as the major guard rail for the energy transformation. 2. Analyse energy transformation scenarios and identify the key technologies and setups for sustainable energy progress. 3. Describe the energy transformation in all sectors, the major technologies, the required transformation period and entire system cost optimization. 4. Describe the special role of power technologies for the energy transformation. 5. Recognize the difference between standard levelized cost of energy and total societal cost of energy.
Content	The energy demand is aggregated by power, heat, cooling, mobility, agriculture and industrial energy needs. The demand has to be matched with supply of energy fulfilling sustainability criteria, safety requirements and societal acceptance for the least cost. A complete set of demand curves, technical characteristics of all major technologies, current and projected technology costs and emission factors are taken into account for sustainable energy transformation pathway formulation. The special relevance of wind energy and solar photovoltaics, the increasing relevance of power technologies, the role of storage technologies and the necessity of societal cost of energy are discussed in detail. Real scenarios for Finland, Europe and the World used as references. The course is related to sustainability.
Modes of Study	3rd lectures 12 h, exercises 12 h,

	4th lectures 12 h, exercises 12 h, examination. Total workload 156 h. Moodle is used in this course.
Evaluation	0-5, examination 100 %
Study materials	Material handed out in class.
Prerequisites	BL20A1300 Energy Resources and BL20A1400 Renewable Energy Technology (at least one of the two courses)
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL30A0400	***DESIGN OF AN ELECTRICAL MACHINE 6 ECTS cr***
	Design of an Electrical Machine **Tenttiin saa vastata suomen kielellä.**
Year and Period	M.Sc. (Tech.) 1 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Juha Pyrhönen
Aims	Upon completion of the course the student will be able to: 1. perform a basic design of a rotating electrical machine, 2. name the simplest winding arrangements and other components of the machine, 3. explain the torque production process in electrical machines, 4. calculate the main data (equivalent circuit parameters) of an electrical machine from machine geometric and winding designs, 5. list the most important materials used in magnetic circuits and windings, 6. model the machine with an equivalent circuit, 7. compare machine designs with each other by using the per unit presentation of machines, 8. use phasor diagrams in the machine analysis, 9. discuss the problems of insulation systems and heat transfer.
Content	Electromagnetic principles used in machine design, the magnetic circuit of an electric machine, the windings of an electric machine, impacts of the structure of the electric motor on the motor characteristics, calculation of the parameters of an equivalent circuit from the dimensions of the machine (resistances, inductances), effective-value phasor diagrams for different machine types, principles of electric machine design, insulation materials and systems heat transfer. Suitable also for doctoral studies. The course is related to sustainability.
Modes of Study	Lectures, tutorials and assignment supervision 48 h, 1st period. The design assignment of an electric machine. Written examination. Total workload 156 h.
Evaluation	0-5, written examination 100 %. Satisfactorily completed assignment required.
Study materials	Pyrhönen, Jokinen, Hrabovcova: Design of Rotating Electrical Machines.
Prerequisites	Students are recommended to have completed BL30A0000 Electric Circuits, BL10A0100 Basics of Electric Engineering.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL30A0600	***POWER ELECTRONICS 6 ECTS cr***
	Power Electronics
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Lasse Laurila
Aims	Upon completion of the course the student will be able to: 1. demonstrate good general knowledge of the different basic main circuits in modern power electronics, 2. describe the features and functions of different rectifiers, switch-mode converters and inverters,

	3. calculate and simulate typical design tasks of the aforementioned circuits, 4. describe the joint operation of static converters and loads as well as the network interferences caused by converters and alternatives to reduce these interferences.
Content	Operation of the main circuits of different power converters: rectifiers (single and three-phase), DC-DC switch mode converters and power supplies (buck, boost, buck-boost, Cúk, flyback, forward), inverters (single and three-phase), resonance converters (ZVS, ZCS). Characteristics and operation. Pulse width modulation (PWM). Harmonic components. Simulation of power electronic circuits. The course is related to sustainability.
Modes of Study	12 h of lectures, 12 h of tutorials, 1st period. 12 h of lectures, 12 h of tutorials, 2nd period. Written examination. Independent study 108 h. Total workload 156 h.
Evaluation	0-5, examination 100 %. Possible extra assignments to gather extra points to the exam.
Study materials	Mohan, Undeland, Robbins: Power Electronics, converters, applications, and design, where applicable.
Prerequisites	BL30A0000 Electric Circuits. Integration and derivation (esp. sine and cosine functions). FFT. Laplace transforms.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL30A1001	***ELECTRICAL DRIVES*** ***8 ECTS cr***
	Electrical Drives **The course will be given in English. Tenttiin saa vastata suomeksi.**
Year and Period	M.Sc. (Tech.) 2 Period 2-3 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Juha Pyrhönen
Aims	Upon completion of the course the student will be able to: 1. describe the principles of scalar, vector and direct torque control of rotating field machines, 2. model the behaviour of different synchronous and asynchronous machines by using vector equivalent circuits and vector diagrams, 3. name the main ideas of the electromagnetic design and performance of different rotating machines, 4. select a suitable electrical machine for a certain purpose and evaluate their thermal limits in cyclic operation, 5. define the most important power electronic converters and their properties in different applications, 6. discuss the principles of PWM, space vector modulation and DTC, 7. discuss the adverse effects of PWM systems on motor behaviour and the wave nature of the motor cable.
Content	Theory of electric motor drives, operation and vector equivalent circuits. Synchronous machine drives, asynchronous machine drives, synchronous reluctance machine drives, permanent magnet synchronous machine drives, switched reluctance motor drives. Torque production in different machines. Power electronic converters suitable for motor and generator drives. Scalar control, vector control, direct flux linkage control and direct torque control (DTC). Motor cable wave nature, bearing currents. The course is related to sustainability.
Modes of Study	Lectures or seminars 24 h, tutorials 24 h, 2nd period. Lectures or seminars 24 h, tutorials 24 h, 3rd period. Independent study 112 h. Total workload 208 h. Moodle is used in this course.
Evaluation	0-5, written examination 100 %.
Study materials	Pyrhönen, Juha: Electrical Drives, lecture material.

Prerequisites	The students are recommended to have completed the courses BL30A0000 Electric Circuits, BL10A0100 Basics of Electric Engineering, BL30A0200 Laboratory Course in Electrical Engineering, BL30A0500 Introduction to Electrical Drives and BL30A0800 Electromagnetic Components and to have attended the courses BL30A0400 Design of an Electrical Machine and BL30A0900 Power Electronic Components.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL30A1200	*NUMERICAL METHODS IN ELECTROMAGNETISM 4 ECTS cr*
	Numerical Methods in Electromagnetism
Year and Period	M.Sc. (Tech.) 2 Period 3 The course is suitable also for doctoral studies.
Teacher(s)	Postdoctoral Researcher, D.Sc. (Tech.) Vesa Ruuskanen and Associate Professor, D.Sc. (Tech.) Janne Nerg Person in Charge: Associate Professor, D.Sc. (Tech.) Janne Nerg
Aims	Upon completion of the course the student will be able to model and analyse electrical machines using commercial finite element based calculation software.
Content	The fundamentals of the element method, boundary conditions, modelling of materials, post-processing of results. Iron loss models. Eddy current problems, utilisation of circuit model in calculation. The course is related to sustainability.
Modes of Study	24 h of supervised tutorials. 3rd period. Course requirements: participation in tutorials and a satisfactorily completed assignment. Self study: assignment and report 78 h. Total workload 102 h.
Evaluation	0-5, assignment 100 %.
Study materials	To be announced in class.
Prerequisites	BL30A0500 Introduction to Electrical Drives and BL30A0400 Design of an Electrical Machine.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL40A0701	*DIGITAL FILTERS 5 ECTS cr*
	Digital Filters **Korvaa opintojakson BL40A0700 Digitaalinen suodatus** **The course will be lectured every other year, next during the academic year 2015 - 2016.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Antti Kosonen, Associate Professor, D.Sc. (Tech.) Tuomo Lindh
Aims	Upon completion of the course the student will be able to: 1. describe the practical implementation of digital filters, 2. describe the finite word length effects on the frequency response and operation of a filter, 3. in order to minimise these effects, transform the direct-form implementations into a more beneficial format with respect to the finite word length effects and do the required scaling, 4. describe the representations of fixed and floating point numbers, 5. design FIR and IIR filters with the ready-made software and describe the basics of design methods, 6. identify and describe optimal, adaptive and median filters.

Content	The finite word length effects and elimination of these effects. Alternative structures for discrete-time systems and their programming implementation. Computer-aided design of digital filters. Optimal, adaptive and median filters. The course is related to sustainability.
Modes of Study	18 h of lectures, 12 h of tutorials, 3rd period. 18 h of lectures, 12 h of tutorials, laboratory assignment, 4th period. Written examination. Part of independent study 75 h. Total workload 135 h.
Evaluation	0-5, examination 100 %. Course requirements: satisfactorily completed laboratory assignment.
Study materials	Proakis, J. G. & Manolakis, D. G.: Digital Signal Processing, Principles, Algorithms, and Applications. Luukko, J.: Digitaalinen suodatus (lecture notes)
Prerequisites	BL40A0400 Digital Signal Processing or corresponding knowledge.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL40A1000	***REAL-TIME OPERATING SYSTEMS AND PROGRAMS 5 ECTS cr***
	Real-time Operating Systems and Programs
Year and Period	M.Sc. (Tech.) 2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Alexander Smirnov, Doctoral Student, M.Sc. (Tech.) Aleksei Romanenko Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Alexander Smirnov
Aims	Upon completion of the course the student will be able to: 1. use the services of a real-time operating system, 2. design the architecture of an application program using a real-time operating system as its basis, 3. implement a simple real-time operating system using the C language.
Content	Basic concepts of a real-time system. Services provided by a real-time operating system: task management, time management, semaphores, mutual exclusion semaphores (mutex), event flags, mailboxes, message queues and memory management. Implementation of a real-time operating system: context switch, interrupt management. Processor-specific parts of a real-time operating system and adapting the real-time operating system to a new processor. The course is related to sustainability.
Modes of Study	18 h of lectures, 12 h of tutorials, 1st period. 18 h of lectures, 12 h of tutorials, assignment, 2nd period. Written examination. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, examination 100 %. Satisfactorily completed assignment required.
Study materials	Labrosse, J.J.: MicroC/OS-II The Real-Time Kernel (2nd Edition).
Prerequisites	BL40A1100 Embedded System Programming.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL40A1100	***EMBEDDED SYSTEM PROGRAMMING 4 ECTS cr***
	Embedded System Programming
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Associate Professor, D.Sc. (Tech.) Tuomo Lindh
Aims	Upon completion of the course the student will be able to: 1. apply C language and its structures to embedded system programming,

	2. form complex data types such as structures, unions and buffers and use these in order to maintain information of different entities (e.g. processing units), 3. control the registers of a micro controller using C-language, 4. use different PUs of a micro controller.
Content	Design tools, C-language in embedded system programming, utilisation of a microcontroller environment (registers, timers, buses, A/D conversion etc.). Typical data structures, typical program structures in real-time applications. Programming the Windows interface, basic properties of real-time operating systems.
Modes of Study	12 h of lectures, 12 h of tutorials, 1st period. 12 h of lectures, 12 h of tutorials, 2nd period. Assignment. Written examination. Total workload 104 h.
Evaluation	0-5, assignment 1 20 %, examination 80 %. Satisfactorily completed assignment 2 required.
Study materials	Wolf, W.: Computers as components: principles of embedded computing system design. Lecture notes.
Prerequisites	Basics of C language.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL40A1201	***DIGITAL CONTROL DESIGN 5 ECTS cr***
	Digital Control Design
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Postdoctoral Researcher, D.Sc. (Tech.) Rafal Jastrzebski
Aims	Upon completion of the course the student will be able to: 1. build plant models of simple electromechanical systems and discretise them, 2. describe and explain the example control systems, interpret system responses and control design specifications in time continuous and time discrete domains, 3. compare and discriminate between different discretisation techniques and different control design methods, 4. relate knowledge from the areas such as system modelling, model discretisation, design of a digital control in a discrete time domain, computer simulation and digital implementation, 5. design and implement digital state-space controllers and transfer function controllers, 6. apply the selected control design methods and system modelling concepts to new control problems that involve various electromechanical systems.
Content	Different discretisation methods, discretisation of plants with time delay. State feedback, state estimation (predictive, current, reduced order, constant and sinusoidal disturbance estimation), sate-space control design (pole placement, optimal control, integral state augmentation and reference control) and polynomial control design (deadbeat control, cancelation of poles and zeros, integral control, reference control). Fundamentals of a multivariable control system. Simulation of a digital control system with Simulink. Programming of digital control for a microprocessor. Control design examples including control of real MIMO industrial systems. Application of MATLAB in control design. The course is related to sustainability.
Modes of Study	12 h of lectures, 12 h of tutorials, 1st period. 2 h of lectures, 2 h of tutorials, 6-12 h of demonstration lectures, 10 h of project work in computer class, written examination, 2nd period. Project assignment, 3rd period. Total workload 130 h.
Evaluation	0-5, examination 100 %. Satisfactorily completed assignment required.
Prerequisites	BL40A0200 Control Systems Introduction and BL40A0501 Digital Control, Introduction.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BL40A1601	EMBEDDED SYSTEM DESIGN 6 ECTS cr
	Embedded System Design **Korvaa opintojakson BL40A1600 Piirisuunnittelu**
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Jero Ahola
Aims	Upon completion of the course the student will be able to program with VHDL hardware design language and design and implement digital systems by using programmable logic circuits.
Content	Circuit design of digital electronics with programmable logic circuits. Principles of digital circuit design, system level synthesis, hardware design languages.
Modes of Study	Lectures 12 h, exercises, 12 h, 1st period. Lectures 12 h, exercises, 12 h, assignment, 2nd period. Examination. Total workload 156 h.
Evaluation	0-5, examination 100 %. Satisfactorily completed assignment required.
Prerequisites	Basics of digital design and digital electronics, basics of programming.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BL40A1811	INTRODUCTION TO EMBEDDED SYSTEMS 6 ECTS cr
	Johdanto sulautettuihin järjestelmiin
Year and Period	B.Sc. (Tech.) 3 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Jero Ahola and Postdoctoral Researcher, D.Sc. (Tech.) Tero Ahonen
Aims	The course is an introduction to embedded systems. Upon completion of the course the student will be able to: 1. identify different microprocessor types and peripheral components in embedded systems, 2. describe the operation principles of an embedded system and its peripheral components, 3. program and test applications to an embedded system by using C language.
Content	Architecture of a microprocessor, instruction set and operation, microcontrollers, memories, peripherals, embedded system design, programming and development of applications, embedded system design examples. The course is related to sustainability.
Modes of Study	Lectures 12 h, exercises, 12 h, 3rd period. Lectures 12 h, exercises, 12 h, 4th period, Assignments. Examination. Total workload 156 h.
Evaluation	0-5, examination 50 % and assignments 50 %. Satisfactorily completed assignments are required for passing the course.
Study materials	Vahid/Givargis: Embedded System Design - A Unified Hardware/Software Introduction. Lecture material.
Prerequisites	Introduction to digital electronics, basics of electronics, basics of programming.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BL40A2301	ENERGY EFFICIENCY 6 ECTS cr
	Energy Efficiency **Substitutes the course BL40A2300 Energiatehokkuus**
Year and Period	M.Sc. (Tech.) 1 Period 3

Teacher(s)	Professor, D.Sc. (Tech.) Jero Ahola, Postdoctoral Researcher, D.Sc. (Tech.) Tero Ahonen, different lecturers Person in Charge: Professor, D.Sc. (Tech.) Jero Ahola
Aims	Upon completion of the course the student will be able to: 1. determine actions for the energy efficiency of the energy conversion process, 2. estimate the overall energy efficiency of the energy conversion system, 3. identify applications of electric energy usage and apply methods that can be used to improve the energy efficiency.
Content	The course provides the student with an introduction to the significance and development potential of energy efficiency in energy production, transmission, distribution and end use. The focus is on electric energy and systems approach. The lecture topics are the efficiency of energy production processes, the efficiency of electricity transmission and distribution and the efficiency of energy end use. The course is arranged as a series of lectures delivered by experts. The lecture topics may vary from year to year. The course is related to sustainability.
Modes of Study	Lectures 12 h, individual home works, demo lectures, examination. Total workload 156 h.
Evaluation	0-5, examination 100 %, accepted individual home works.
Study materials	Lecture material, material announced by lecturers.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BL40A2401	***ELECTRICAL ENGINEERING IN WIND AND SOLAR SYSTEMS*** ***6 ECTS cr***
	Electrical Engineering in Wind and Solar Systems **Substitutes the course BL40A2400 Sähköjärjestelmät tuuli- ja aurinkoenergiasovelluksissa 5 op** **The course will be lectured every other year, next during the academic year 2015 - 2016.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Olli Pyrhönen, Postdoctoral Researcher, D.Sc. (Tech.) Katja Hynynen
Aims	Upon completion of the course the student can: 1. describe and identify electrotechnical components and system layouts in wind and solar power plants, 2. dimension the electrotechnical components in wind /solar power plants, 3. describe and analyse the control systems of wind/solar power plants, 4. describe and analyse the grid connection requirements of wind/solar power plants, 5. analyse and simulate the interaction between the grid and wind/solar power plant in different abnormal situations.
Content	Drive train technologies in wind power systems; Permanent magnet synchronous generator drive train, double-fed induction generator drive train, electric conversion in PV solar power, system topologies and power electronics solutions in small and utility scale PV solar plants. Control of a wind power plant, control of a solar power plant, technical requirements in grid connection, voltage and reactive power control in wind/solar power plants, electrical protection of wind/solar power plants. Grid codes, other international regulations and standards in wind and solar power systems. Introduction to grid connection modelling software. The course is related to sustainability.
Modes of Study	Lectures 24 h, exercises 24 h, assignments, examination. Total workload 156 h.
Evaluation	0-5, examination 50 %, assignment 50 %
Study materials	Material handed out in class.

Prerequisites	Previous knowledge of electrical engineering required. Basics of electrical machines and/or transmission of electricity recommended.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BL40A2700	*SYSTEM ENGINEERING PROJECT WORK 6 ECTS cr*
	System Engineering Project Work **Substitutes the course BL40A0901 Sulautettujen järjestelmien seminaarikurssi**
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Olli Pyrhönen, Professor, D.Sc. (Tech.) Jero Ahola, Associate Professor, D.Sc. (Tech.) Tuomo Lindh
Aims	The students will analyse and design a selected electrical energy conversion system in the field of industrial electrical drives, renewable energy conversion or motion control system. The topics are linked to an on-going research project or industrial co-operation in the above-mentioned fields. The project work includes several partly alternative system engineering tasks, such as project planning, preliminary system design, dynamic modelling and simulation, component dimensioning, electrical dimensioning, control design, automation design, control software design and project documentation. The tasks are project dependent and will be defined in the project plan.
Content	Introduction to a system engineering approach in technical projects. Project documentation, different tasks in project work, project planning and implementation, example projects, execution of system engineering tasks, project documentation and presentation. The main result of the project work is technical project documentation including an overall description and the results of agreed system engineering tasks. The course is related to sustainability.
Modes of Study	Introductory lecture, independent group working (3-5 students in one group), individual tasks within the group work, project group meetings with supervisors, writing project documentation, project presentation and demonstration. The project work topics will be defined in detail at the beginning of the course. Total workload 156 h.
Evaluation	0-5, Project work designs, documentation and presentation.
Study materials	Material handed out in class.
Prerequisites	A majority of the M.Sc. (El. Eng.) studies should be completed before participation.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BL40A2800	*ELECTRICAL MOTION CONTROL SYSTEMS 6 ECTS cr*
	Electrical Motion Control Systems **Substitutes the course BL40A1401 Automaation laite- ja järjestelmätekniikka**
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Associate Professor, D.Sc. (Tech.) Tuomo Lindh
Aims	Upon completion of the course the student will be able to: 1. apply automation and digital control theory to control of mechatronic systems, 2. apply kinematics in order to model mechanics, 3. simulate mechatronic systems, 4. use PLC technology and fieldbuses in mechatronics, 5. use the analog and digital communication techniques applied to automation, 6. construct controllers for position control and trajectory tracking,

	7. construct observers and self-tuning controllers, 8. construct dynamical system models based on tests and measurements, 9. select a proper controller structure, 10. work in a group solving automation and control problems.
Content	Basics of robot kinematics and dynamics, state-space models of mechanics, lumped models, interconnections of mechanics models, identification and parameter estimation, dynamic system models based on tests and measurements. Co-simulation of electric drives and mechanics, digital motion control.
Modes of Study	Lectures 12 h, exercises 12 h, 3rd period. Lectures 12 h, exercises 12 h, project work, laboratory exercises, 4th period. Independent study: project work 35 h, laboratory exercises 12 h, preparation for examination 40 h, examination 3 h. Examination. Total workload 156 h.
Evaluation	0-5, examination 100 %. Satisfactorily completed project work required.
Prerequisites	BL40A0110 Measurement and Automation Technology, Introduction.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BL50A0600	***ELECTROMAGNETIC COMPATIBILITY IN POWER ELECTRONICS*** ***2 ECTS cr***
	Electromagnetic compatibility in power electronics
Year and Period	M.Sc. (Tech.) 1 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	D.Sc. (Tech.) Juhamatti Korhonen, Professor, D.Sc. (Tech.) Pertti Silventoinen Person in Charge: Professor, D.Sc. (Tech.) Pertti Silventoinen
Aims	Upon completion of the course the student will be able to: 1. describe the coupling mechanisms of electromagnetic interferences in power electronics, 2. name the most significant sources of electromagnetic emissions in power electronic systems, 3. recognise and be aware of cable reflection in electrical drives, 4. list the suitable filter types for common mode filtering, du/dt filtering and harmonics filtering.
Content	Power electronics as an interference source, network harmonics, reflection phenomena of cables, conductive RF interference, interference radiation of power electronics, filtering techniques of conductive interferences.
Modes of Study	12 h of lectures, 1st period. Written examination. Independent work 40 h. Total workload 55 h.
Evaluation	0-5, written examination 100 %.
Study materials	To be announced in class.
Prerequisites	Recommended: Basic knowledge of electromagnetism and electromagnetic fields
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BL50A1300	***ADVANCED COURSE IN ELECTRONICS*** ***6 ECTS cr***
	Advanced Course in Electronics
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Pertti Silventoinen, Professor, D.Sc. (Tech.) Jero Ahola
Aims	The student prepares a seminar presentation on a new topic in electronics. Upon completion of the course the student will be able to demonstrate in-depth knowledge of a new topic in electronics.
Content	The course contents are subject related and will be specified during the introductory lectures. The course is related to sustainability.

Modes of Study	2 h of introductory lectures, 12 h of seminar presentations, 3rd period. 12 h of seminar presentations, 4th period. No written examination. Independent work 134 h. Total workload 162 h.
Evaluation	0-5, seminar presentation 100 %.
Study materials	The material will be specified in the introductory lecture.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

4.2 Master's Programme in Mechanical Engineering

In the Master's Programme in Mechanical Engineering, students may choose between two major subjects: Design and Manufacturing or Packaging Technology. The major subject in **Design and Manufacturing** corresponds to 120 ECTS credits and two years of full-time studies in which all lectures and laboratory work are conducted in English. The first three semesters include 90 ECTS credits of classroom and laboratory instruction. The Master's thesis of 30 ECTS credits is prepared in the fourth semester after all other courses have been completed.

The major subject in **Packaging Technology** is a part-time programme leading to the degree of Master of Science in Technology. Teaching is organised as intensive teaching periods (4-5 days at a time) during the academic year, and distance learning solutions are widely used. Students have two years (90 ECTS credits) of coursework in which all lectures, exercises and laboratory work are conducted in English. The Master's thesis (30 ECTS credits) will be prepared after the other courses have been completed.

Both major subjects in the programme lead to the degree of Master of Science in Technology.

The person responsible of the Master's Programme in Mechanical Engineering is Docent Harri Eskelinen, D.Sc. (Tech.).

Aims of the Master's Programme

The objective in both major subjects is to educate experts in their own areas. Design and Manufacturing particularly emphasises future product design and production technologies. The aim is to provide in-depth knowledge in design or production related areas such as machine design, steel structures, welding technology, laser technology as well as production and sheet metal technology. The subject is targeted for students who wish to pursue a career in the mechanical engineering industry using advanced engineering techniques.

In Packaging Technology, the emphasis is on packaging materials, converting and packaging technologies and the skills to work throughout the packaging chain. The subject is aimed at students already working in packaging related businesses or wishing to pursue a career in the industry dealing with packaging.

Careers for Graduates

The programme provides a foundation for both constructive design and production-oriented tasks, and a variety of tasks in the packaging field. The professional tasks may include, for example, product development and design, management of design and production projects, technical sales both in domestic and international business. The professional scope often includes educational, research and marketing tasks as well as specialist responsibilities in technical inspection and project management. The programme also provides students with knowledge and skills for scientific doctoral studies in the field of mechanical engineering.

Degree Structure of the Programme

Degree Structure		
General Studies	11-13	ECTS cr
Major Subject	40 (min.)	ECTS cr
Minor Subject	20 (min.)	ECTS cr
Elective Studies	17-19 (min.)	ECTS cr
Master's Thesis and Seminar	30	ECTS cr
Total	*120 (min.)*	*ECTS cr*

General Studies (11-13 ECTS cr):
All the students in the programme conduct the same general studies. The studies provide a brief introduction to the field of mechanical engineering as well as language skills essential for M.Sc. studies.

Major Subject in Design and Manufacturing (min 70 ECTS cr):
The person responsible for the major subject in Design and Manufacturing is Professor Aki Mikkola, D.Sc. (Tech.)

In the mechanical engineering programme, students focus on machine design and manufacturing aspects. In the machine design studies, students learn both the theory and practice of developing mechanical engineering systems for performance, strength and durability. They learn to use state-of-the-art computer tools for creating and testing virtual prototypes in such that complex mechatronic systems and structures can be designed, tested and optimised before a prototype is fabricated. In the manufacturing studies, students learn about modern production systems and production planning. Special emphasis is given to welding technology, laser processes (welding, cutting and heat treatment), high technology machining operations and sheet metal and plate forming. In addition, studies on new metallic and non-metallic materials are included in the programme.

The person responsible for the major subject in Design and Manufacturing is Professor Aki Mikkola (Virtual Design). Other professors in the major studies are Professor Timo Kärki (Fiber Composites), Professor Jukka Martikainen (Welding Technology), Professor Antti Salminen (Laser Processes), Professor Juha Varis (Production Technology), Professor Timo Björk (Steel Structures), Professor Heikki Handroos (Machine Automation) and Professor Jussi Sopanen (Machine Dynamics).

Major Subject in Packaging Technology (min. 70 ECTS cr):
The person responsible for the major subject in Packaging Technology is Professor Kaj Backfolk, D.Sc. (Tech.)

In the mechanical engineering programme, students focus on machine design and manufacturing aspects. In the packaging technology, the point of focus is the packaging machine. Students learn about packaging materials, the converting of packaging materials into packages and the interaction of the package and the content. The design part concentrates both on the design of packages and machine constructions needed to convert the packaging material into packages. The legislation influencing the packaging value chain is considered as well as the environmental impact of the various packaging materials and production methods.

The person responsible for the major subject in Packaging Technolgy is Professor Kaj Backfolk (Packaging Technology). Other professors for the major studies in the programme are Professor Juha Varis (Production Technology) and Visiting Professor Jurkka Kuusipalo (Converting Technology).

General Studies 11-13 ECTS cr

General Studies (11-13 ECTS cr)		*year*	*per.*	*ECTS cr*
BK10A0300	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1	1
BK10A1200	Research Methods and Methodologies	M.Sc. (Tech.) 1	1-2	4
FV11A6500	Presenting in English	B.Sc. (Tech.) 2-3 B.Sc. (Econ. & Bus. Adm.) 2-3	per 1/ INT 43/per 2/per 3/INT 10 /per 4	2
FV11A9800	Academic Writing in English Course 1	B.Sc. (Tech.) 2-3 M.Sc. (Tech.) 1 B.Sc. (Econ. & Bus. Adm.) 2-3 M.Sc. (Econ. & Bus. Adm.) 3	1/3	2
FV11A9900	Academic Writing in English Course 2	B.Sc. (Tech.) 3 M.Sc. (Tech.) 1 B.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 3	2/4	2
FV18A9101(*	Finnish 1		1/3	2

*) Foreign students are required to study at least one course of Finnish language.

Major in Design and Manufacturing min. 70 ECTS cr

Obligatory Studies (41 ECTS cr)		*year*	*per.*	*ECTS cr*
BK10A1500	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BK50A0701	Advanced Production Engineering	M.Sc. (Tech.) 1	1-2	6
BK50A2200	Design Methodologies and Applications of Machine Element Design	M.Sc. (Tech.) 1	1-2	5

Choose enough courses from following specialisation studies to attain 70 ECTS cr together with Obligatory courses.

Specialisation Studies in Design

List of elective courses		*year*	*per.*	*ECTS cr*
BK10A0100	Individual Project Work	M.Sc. (Tech.) 1	1-4	6
BK60A0800	Fluid Power	M.Sc. (Tech.) 1	3-4	5
BK60A1000	Control of Mechatronic Machines	M.Sc. (Tech.) 1	1-2	6
BK60A1200	Programming in Control and Mechatronics	M.Sc. (Tech.) 1	3-4	6
BK60A1300	Industrial Robotics	M.Sc. (Tech.) 2	1-2	6
BK70A0000	Simulation of a Mechatronic Machine	M.Sc. (Tech.) 1	1-2	6
BK70A0101	Simulation, Laboratory Course	M.Sc. (Tech.) 1	3-4	6
BK70A0500	Machine Dynamics	M.Sc. (Tech.) 2	1-2	6
BK80A1200	FE-analysis Course	M.Sc. (Tech.) 1	3-4	5

Specialisation Studies in Manufacturing

List of elective courses		*year*	*per.*	*ECTS cr*
BK10A0100	Individual Project Work	M.Sc. (Tech.) 1	1-4	6
BK20A0402	Modern Welding Technology	M.Sc. (Tech.) 1	1-2	6
BK30A0600	Laser Based Products and Production Technology	M.Sc. (Tech.) 1	3-4	5
BK30A0700	Laser Materials Processing	M.Sc. (Tech.) 2	1-2	5
BK30A0801	Laboratory Course of Laser Processing Technology	M.Sc. (Tech.) 1	1-2	4
BK30A0901	Additive Manufacturing - 3D Printing	M.Sc. (Tech.) 2	3-4	5
BK50A2700	Selection Criteria of Structural Materials	M.Sc. (Tech.) 1	3-4	6
BK90C1800	Green Fiber Materials	M.Sc. (Tech.) 1	4	5

Major in Packaging Technology min. 70 ECTS cr

Min. 40 ECTS cr and Master's Thesis and Seminar should be selected		*year*	*per.*	*ECTS cr*
BK10A1500(*	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BK10A1100(**	Laboratory Work Course in Mechanical Engineering			10-30
BK50A1300	Converting and Forming of Fibre Based Packaging	M.Sc. (Tech.) 2	1-2	5
BK50A1401	Packaging Lines and Machinery	M.Sc. (Tech.) 2	3-4	7
BK50A2001	Package Performance and Sustainability	M.Sc. (Tech.) 1	3	5
BK50A2100	Printing and Package Design	M.Sc. (Tech.) 2	1-2	6
BK50A2400	Packaging Materials	M.Sc. (Tech.) 1	1	5
BK50A2500	Coating and Lamination of Fibre Based Packaging Materials	M.Sc. (Tech.) 1	1-2	5

*) Obligatory for all
**) No more than 10 ECTS credits

Minor Subject (min. 20 ECTS cr):
Students may choose any minor subject taught in English at LUT if the required prerequisites are fulfilled.

Elective Studies (min. 17-19 ECTS cr):
Elective studies can include any courses offered by LUT if the required prerequisites are fulfilled. Studies in other universities may be included upon application. Elective studies may include an internship that improves professional skills, which may be worth a maximum of 10 ECTS credits. More information: BK10A1400 Work Internship in Master's Degree.

Master Thesis and Seminar (30 ECTS cr):
The Master's thesis is a research or design project which is carried out after the other courses have been completed. The thesis deals with the field of the student's major subject. In Master's degree programmes taught in English, the Master's thesis is always prepared in English.

Degree Structure for Double Degree Students

Degree Structure		
General Studies	6	ECTS cr
Major Subject	64	ECTS cr
Credit Transfer	50	ECTS cr
Total	*120 (min.)*	*ECTS cr*

General Studies (6 ECTS cr)

Obligatory Studies (6 ECTS cr)		*year*	*per.*	*ECTS cr*
FV11A6500	Presenting in English	B.Sc. (Tech.) 2-3 B.Sc. (Econ. & Bus. Adm.) 2-3	per 1/ INT 43/per 2/per 3/INT 10 /per 4	2
FV11A9800	Academic Writing in English Course 1	B.Sc. (Tech.) 2-3 M.Sc. (Tech.) 1 B.Sc. (Econ. & Bus. Adm.) 2-3 M.Sc. (Econ. & Bus. Adm.) 3	1/3	2
FV11A9900	Academic Writing in English Course 2	B.Sc. (Tech.) 3 M.Sc. (Tech.) 1 B.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 3	2/4	2

Major in Design and Manufacturing (for Double Degree Students) 64 ECTS cr

Min. 34 ECTS cr + Master's Thesis and Seminar 30 ECTS cr should be selected		*year*	*per.*	*ECTS cr*
BK10A1500(*	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BK20A0402	Modern Welding Technology	M.Sc. (Tech.) 1	1-2	6
BK30A0600	Laser Based Products and Production Technology	M.Sc. (Tech.) 1	3-4	5
BK30A0700	Laser Materials Processing	M.Sc. (Tech.) 2	1-2	5
BK30A0801	Laboratory Course of Laser Processing Technology	M.Sc. (Tech.) 1	1-2	4
BK50A0701	Advanced Production Engineering	M.Sc. (Tech.) 1	1-2	6
BK50A2200	Design Methodologies and Applications of Machine Element Design	M.Sc. (Tech.) 1	1-2	5
BK50A2700	Selection Criteria of Structural Materials	M.Sc. (Tech.) 1	3-4	6
BK70A0000	Simulation of a Mechatronic Machine	M.Sc. (Tech.) 1	1-2	6

*) Obligatory for all

Double degree students come from LUT partner universities. The student completes the Master's degree in both partnering universities and will be awarded the degree certificate of LUT and the diploma of the home university. A maximum of 50 ECTS credits may be transferred to the LUT degree from previous studies in the student's home university.

Minor Subjects of Mechanical Engineering

Minor Subject in Packaging Technology

Obligatory Studies (23 ECTS cr)		*per.*	*ECTS cr*
BK50A1401	Packaging Lines and Machinery	3-4	7
BK50A2100	Printing and Package Design	1-2	6
BK50A2400	Packaging Materials	1	5
BK50A2600	Principles of Chemistry, Paper Technology and Food Technology	1-4	5

Minor Subject in Manufacturing

Obligatory Studies (22 ECTS cr)		*per.*	*ECTS cr*
BK30A0600	Laser Based Products and Production Technology	3-4	5
BK30A0901	Additive Manufacturing - 3D Printing	3-4	5
BK50A0701	Advanced Production Engineering	1-2	6
BK50A2700	Selection Criteria of Structural Materials	3-4	6

Minor Subject in Design

Obligatory Studies (23 ECTS cr)		*per.*	*ECTS cr*
BK60A1000	Control of Mechatronic Machines	1-2	6
BK70A0000	Simulation of a Mechatronic Machine	1-2	6
BK70A0500	Machine Dynamics	1-2	6
BK80A1200	FE-analysis Course	3-4	5

Course Descriptions in Mechanical Engineering

		ECTS cr
BK10A0100	Individual Project Work	6
BK10A0300	Introduction to M.Sc. Studies	1
BK10A1100	Laboratory Work Course in Mechanical Engineering	10 - 30
BK10A1200	Research Methods and Methodologies	4
BK10A1400	Work Internship in Master’s Degree	2 - 10
BK10A1500	Master's Thesis and Seminar	30
BK20A0402	Modern Welding Technology	6
BK30A0600	Laser Based Products and Production Technology	5
BK30A0700	Laser Materials Processing	5
BK30A0801	Laboratory Course of Laser Processing Technology	4
BK30A0901	Additive Manufacturing - 3D Printing	5
BK30A1100	Laser Technology and 3D-printing	4
BK50A0701	Advanced Production Engineering	6
BK50A1300	Converting and Forming of Fibre Based Packaging	5
BK50A1401	Packaging Lines and Machinery	7
BK50A2001	Package Performance and Sustainability	5
BK50A2100	Printing and Package Design	6
BK50A2200	Design Methodologies and Applications of Machine Element Design	5
BK50A2400	Packaging Materials	5
BK50A2500	Coating and Lamination of Fibre Based Packaging Materials	5
BK50A2600	Principles of Chemistry, Paper Technology and Food Technology	5
BK50A2700	Selection Criteria of Structural Materials	6
BK60A0800	Fluid Power	5
BK60A1000	Control of Mechatronic Machines	6
BK60A1200	Programming in Control and Mechatronics	6
BK60A1300	Industrial Robotics	6
BK70A0000	Simulation of a Mechatronic Machine	6
BK70A0101	Simulation, Laboratory Course	6
BK70A0500	Machine Dynamics	6
BK80A1200	FE-analysis Course	5
BK80A1401	Fatigue Design	6
BK90C1800	Green Fiber Materials	5

BK10A0100	INDIVIDUAL PROJECT WORK 6 ECTS cr
	Individual Project Work **Only for students of the Master's Programme in Mechanical Engineering.**
Year and Period	M.Sc. (Tech.) 1 Period 1-4
Teacher(s)	Professors of the Degree Programme of Mechanical Engineering
Aims	The aim of this course is to prepare the student for a scientific approach tp the M.Sc. thesis work. After having passed this course, the student will be able to apply scientific research methods and carry out research work.
Content	The student will apply methods of engineering and/or research work to a design or production technology related project supervised by a professor, industrial representative or researcher/instructor. The work will be reported and presented. The course is related to sustainability.
Modes of Study	10 h of lectures, Periods 1-4. 146 h of tutorials and independent projects, Periods 1-4. Total workload 156 h.
Evaluation	Pass/Fail, based on written report and oral presentation.
Prerequisites	Consent of supervising professor.

BK10A0300	INTRODUCTION TO M.SC. STUDIES 1 ECTS cr
	Introduction to M.Sc. Studies
Year and Period	M.Sc. (Tech.) 1 Period 1
Teacher(s)	Information Specialist, M.Sc. (Tech.) Marja Talikka Person in Charge: Doctoral Student, M.Sc. (Tech.) John Bruzzo Escalante
Aims	A) The course provides the student with basic knowledge of studying at LUT in general and particularly in his/her degree programme. The course helps the student to plan and follow the progress of his/her studies at LUT with a help of a personal study plan. B) Students will learn to use different distance learning applications. Students will learn how to find electronic material from the Academic Library collections and databases.
Content	The Orientation Days activities. Degree requirements. Planning of Master’s studies. Preparing an electronic personal study plan in the ePSP workshop. Use of the Moodle learning environment. The Academic Library collections and databases. The course is related to sustainability.
Modes of Study	Participation in the Orientation Days activities 15 h, Period 1. Library tour 1 h, Period 1. Assignments on information retrieval, library use and databases in Moodle. Information sources and information retrieval, lecture and exercises 2 h, Period 1. ePSP workshop 2 h, Period 1. Independent study 6 h. Total workload 26 h. Moodle is used in this course.
Evaluation	Pass/Fail
Study materials	Orientation Days, Study Guide, Information retrieval course in Moodle, the Academic Library collections and databases.

BK10A1100	*LABORATORY WORK COURSE IN MECHANICAL ENGINEERING*	*10 - 30 ECTS cr*
	Laboratory Work Course in Mechanical Engineering **The course is mainly intended for foreign visiting students. The students register for the course by contacting the supervisor. If the course is selected for major studies in packaging technology, the maximum number of ECTS credits is 10.**	
Year and Period		
Teacher(s)	N. N. Person in Charge: Head of the Laboratory	
Aims	To give the student a deeper understanding of mechanical engineering in a specialised area.	
Content	A project which is done in one of the laboratories of the department. The project is planned together with the supervisor(s) and consists mainly of laboratory work, literature work and report writing. The course may contain lectures and seminars. The project may also be planned together with industry and then carried out at some industrial location.	
Modes of Study	The number of hours spent on the project will determine the number of credits, e.g. three months of work equals 15 ECTS cr. Credits will be granted when the final report is delivered. Extra credits can be received based on separate examinations.	
Evaluation	0-5 or pass/fail, depending on the project carried out.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BK10A1200	*RESEARCH METHODS AND METHODOLOGIES*	*4 ECTS cr*
	Research Methods and Methodologies	
Year and Period	M.Sc. (Tech.) 1 Period 1-2	
Teacher(s)	Associate Professor, Docent, D.Sc. (Tech.) Harri Eskelinen	
Aims	After having passed this course, the student will be able to: - plan, lead and organise a research project according to established scientific practices and procedures - compare, choose and utilise proper scientific practices to carry out research projects in industrial environments - write and present a scientific research plan and research report.	
Content	Learning outcomes: Criteria to evaluate the scientific contribution of research. Scientific research projects in engineering science. Principles of qualitative and quantitative analysis. Viewpoints on how to illustrate the results of quantitative analysis. Different means to carry out literature reviews, interviews and surveys. Utilisation of silent knowledge. Contents and structures of research plans and research structures based on the IMRAD principle. Viewpoints of writing scientific articles and conference papers. Practical advice about giving a conference presentation. Guidelines for acting as an opponent in a scientific conference or seminar. The course is related to sustainability.	
Modes of Study	Lectures 12 h, Period 1. Exercises and individual guidance 24 h, Periods 1-2. Independent study 48 h, Periods 1-2. Seminar 20 h, Period 2. Total workload 104 h.	
Evaluation	0-5, exercises 30%, seminar 70%.	
Study materials	Lectures in the Noppa portal.	

Further Information	For Finnish students: Eskelinen & Karsikas, Tutkimusmetodiikan perusteet - Tekniikan alan oppikirja, Tammertekniikka, 2014. This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK10A1400 *WORK INTERNSHIP IN MASTER'S DEGREE* *2 - 10 ECTS cr*

DI-tutkinnon työharjoittelu

No course registration (replaced by submitting the application for approval of the internship coordinator).

Year and Period	M.Sc. (Tech.) 1-2
Teacher(s)	Laboratory Engineer, M.Sc. (Tech.) Jari Selesvuo
Aims	After the work environment internship, the student has obtained a basic knowledge of the work, work environment and working community in his/her own field. The student is able to apply and generalize knowledge and skills acquired during the course of studies to work in his/her own field.
Content	The student obtains a (summer) job from the company, works as a paid employee, requests a certificate of employment and applies for the approval of the work as an internship for the Master's degree. Full-time employment relationships of at least four weeks can be approved as internships. The completion of the Master's thesis is not accepted as an internship. An employment relationship that took place before the studies can be approved as an internship providing that it has not been accepted and included in any other previous degree. The course is related to sustainability.
Modes of Study	First 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to starting an employment relationship (e.g. orientation, the rules of the employment relationship and the work place) 15 h, observing (while working) how the working community operates (e.g. how work/production is organized, supervision, the working manners of the working community/teams, the social environment of the work place) 22 h, a written internship report 5 h (2-3 pages), total 52 h. 3-10 ECTS credits: having different tasks in a company 26-208 h (1 ECTS credit/26 h). The number of ECTS credits of compulsory internship is 6 ECTS cr.
Evaluation	Pass/Fail, internship report 100%.

BK10A1500 *MASTER'S THESIS AND SEMINAR* *30 ECTS cr*

Master's Thesis and Seminar, Diplomityö ja seminaari

In Master's degree programmes taught in English, the Master's thesis is always prepared in English.

Year and Period	M.Sc. (Tech.) 2 Period 1-4
Teacher(s)	Professors and associate professors of the major subject Person in Charge: Project Researcher, D.Sc. (Tech.) Merja Peltokoski
Aims	The Master's thesis is the final project of the Master's degree, which demonstrates the student's knowledge of a topic of scientific or societal importance in the professional field in question. The student will be able to combine theory and practice: he/she will be able to exploit theory in solving problems in scientific research. The student will be capable of independent and target-oriented work, set personal goals concerning results and schedules. The student will be capable of extensive and versatile data acquisition.
Content	The Master's thesis is a research project which requires approximately 6 months of work. It is related to the student's major subject and its topic is agreed on by the supervisor and the student together. During the work, the

	student must show capability to work independently according to defined plans and goals. The course includes seminars. The course is related to sustainability.
Modes of Study	The Master's thesis is a written report on the research work involved, presenting the stages of the work, the methods, results and explanations. The thesis includes a seminar for students who are starting to write their Master's thesis, students who are about to graduate, and their supervisors. In the final stages, each student briefly presents the goals, content and results of his/her work. Students must attend other seminar sessions (audit at least three) before starting their own thesis, and finally give a seminar presentation of their own when the work is finished. Seminars 2 h, Periods 1-4. Independent study 778 h. Total workload 780 h. Seminar listening points are valid till the student will graduate. Moodle is used in this course.
Evaluation	0-5, Master's thesis 100%. Seminar sessions: students have to attend at least three sessions and give their own presentation (possibility for online presentation and auditing). Press release accepted/fail.
Study materials	LUT Master's thesis instructions. Seminar instructions in Moodle.

BK20A0402	***MODERN WELDING TECHNOLOGY*** ***6 ECTS cr***
	Modern Welding Technology **Replaces the courses BK20A0401 Modern Welding Technology and BK20A0301 Hitsaustekniikan jatkokurssi. Cannot be included in the same degree as BK20A2200 Basics of Welding Technology.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	University Lecturer, Lic.Sc. (Tech.) Raimo Suoranta Associate Professor, D.Sc. (Tech.) Paul Kah
Aims	After having passed this course, the student will be able to: - identify and define the special features of welding in production and product design - select proper processes and welding procedures for different materials - utilise standards like SFS-EN-ISO in welding production, quality management, etc. - make plans for cost-effective production.
Content	Productivity, economy and quality in welding. Welding costs. Productive and efficient new welding processes. Basics of welding metallurgy. Mechanisation and robotisation of welding. Basics of design of welded structures. Beveling methods. Quality, environmental and safety aspects in a welding workshop.
Modes of Study	Lectures 24 h, Periods 1-2. Tutorials 16 h, seminar, Periods 1-2. Independent study 160 h. Total workload 240 h. Moodle is used in this course.
Evaluation	0-5, oral examination 80%, seminar 20%.
Study materials	Lecture notes. Kou: Welding metallurgy. Howard & Gray: Modern Welding Technology, 6th edition. AWS Welding handbook, 9th edition.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction. Enrolment to tutorial groups in WebOodi

BK30A0600	***LASER BASED PRODUCTS AND PRODUCTION TECHNOLOGY*** ***5 ECTS cr***
	Laser Based Products and Production Technology
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Antti Salminen Researcher, D.Sc. (Tech.) Heidi Piili Project Engineer, M.Sc. (Tech.) Tuomas Purtonen Person in Charge: Professor, D.Sc. (Tech.) Antti Salminen
Aims	After having passed the course, the student will: - understand how laser beams are generated in a laser resonator and what optical arrangements are required for a laser materials processing system - be able to compare and generalise the special features of laser processing systems in production and the impact and utilisation of special features of these processes on product design - understand how and what kind of process monitoring equipment can be used for quality assurance.
Content	Knowledge on different laser equipment, resonator types, accessories and processing systems and requirements of different ways to process material with a laser beam. The principles of systems used for production. Optical components used for laser processing, safety and quality assurance. Tools for beam forming, guiding and modification. The possibilities and limitations of laser processing in product design. Practical case examples. Economic aspects of laser materials processing.
Modes of Study	Lectures 28 h, Periods 3-4. Group work for seminars, 60 h, Periods 3-4. Seminar presentations 6 h, Period 4. Individual work 36 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, written exam 20%, seminar 80%. The exam is not necessary for course completion.
Study materials	Study materials, including the lecture material, will be listed in Moodle.
Prerequisites	BK30A0000 Sädetyöstö or BK30A0801 Laboratory Course of Laser Processing Technology or BK30A1100 Laser Technology and 3D-printing are recommended.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK30A0700	***LASER MATERIALS PROCESSING*** ***5 ECTS cr***
	Laser Materials Processing **Replaces the course BK30A0300 Lasertekniikan jatkokurssi.**
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Antti Salminen Researcher, D.Sc. (Tech.) Heidi Piili Project Engineer, M.Sc. (Tech.) Tuomas Purtonen Person in Charge: Professor, D.Sc. (Tech.) Antti Salminen
Aims	After having passed the course, the student will: - be familiar with the basic features of laser beam-material interaction and the process parameters affecting it - know how a laser beam interacts with different materials during different laser processes - know how to select process parameters for different materials.
Content	Basic phenomena of laser beam-material interaction in different laser processes. The effect of process parameters on the nature of beam-material interaction. Formation of a keyhole and behaviour of molten material. Detailed

	knowledge on the beam-material interaction in the most common laser processes. Practical cases and application examples. The course is related to sustainability.
Modes of Study	Lectures 28 h, Periods 1-2. Seminar 14 h, Periods 1-2. Individual work 88 h. Total workload 130 h . Moodle is used in this course.
Evaluation	0-5, written exam 20%, seminar 80%.
Study materials	Steen, W., Laser Material Processing. Ion, J., Laser Processing of Engineering Materials. Material given in lectures and in Moodle.
Prerequisites	Either BK30A0000 Sädetyöstö or BK30A1100 Laser Technology and 3D-printing has to be passed before attending this course. If neither of these are completed, a test on preliminary knowledge has to be taken at the beginning of the course.
Further Information	Completion of BK30A0600 Laser Based Products and Production Technology can be useful for course completion. This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK30A0801	***LABORATORY COURSE OF LASER PROCESSING TECHNOLOGY*** ***4 ECTS cr***
	Laboratory Course of Laser Processing Technology
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Antti Salminen Project Engineer, M.Sc. (Tech.) Tuomas Purtonen Person in Charge: Professor, D.Sc. (Tech.) Antti Salminen
Aims	After having passed the course, the student will: - have practical experience about laser materials processing - understand the importance of process parameter selection for different laser processes - understand the practical aspects of laser materials processing of different materials - possess skills needed in the world of work.
Content	Introduction to various laser materials processing systems. Work safety in laser processing. Laser marking, cutting, welding and surface treatment processes. Practical use of laser processes. Participation in laser processing demonstrations. Manufacturing of a demonstration piece, which includes work phases with different laser processes. Writing reports and a seminar paper about the laboratory demonstrations.
Modes of Study	Lectures and guided group work 12 h, Periods 1-2. Laboratory exercises 12 h, Periods 1-2. Reporting 12 h. Individual work 68 h. Total workload 104 h. Moodle is used in this course.
Evaluation	0-5, written exam 20%, seminar 80%.
Study materials	Study materials, including the lecture material, will be listed in Moodle.

BK30A0901	***ADDITIVE MANUFACTURING - 3D PRINTING*** ***5 ECTS cr***
	Additive Manufacturing - 3D Printing **Replaces the course BK30A0900 Additive Manufacturing.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Antti Salminen

	Researcher, D.Sc. (Tech.) Heidi Piili N. N. Acknowledged invited lecturers Person in Charge: Professor, D.Sc. (Tech.) Antti Salminen
Aims	After having passed the course, the student will: - know all of the different technologies of additive manufacturing (AM, aka 3D printing) - be able to compare different AM processes and select suitable processes for different applications - know the basics about product design for additive manufacturing - be familiar with the possibilities of additive manufacturing in product development, prototyping and part manufacturing - have the latest knowledge of additive manufacturing technologies and processes.
Content	Additive manufacturing (AM, aka 3D printing) processes, materials and equipment. Utilisation of the potential of additive manufacturing in product design. Practical cases and applications. Future trends and potential of additive manufacturing. First-hand demonstrations on how to design parts for additive manufacturing. Practical demonstrations on manufacturing of parts with AM processes. Economic aspects of additive manufacturing. The course is related to sustainability.
Modes of Study	Lectures 28 h, Periods 3-4. Tutorials 14 h, Periods 3-4. Individual work 88 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, written exam 80%, seminar 20%.
Study materials	Gibson, I., Rosen, D. W., Stucker, B.: Additive Manufacturing Technologies. Other study material will be listed in Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK30A1100	***LASER TECHNOLOGY AND 3D-PRINTING 4 ECTS cr***
	Laser Technology and 3D-printing
Year and Period	B.Sc. (Tech.) 3 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Antti Salminen N. N.
Aims	After having completed this course, the student should be able to: - realise the wide range of laser based manufacturing technologies, 3D printing processes and their applications - understand the possibilities of laser based manufacturing technologies and 3D printing in modern manufacturing and product development - evaluate the applicability of laser based manufacturing technologies and 3D printing for manufacturing purposes.
Content	A laser beam as a tool for materials processing. Classification of lasers and laser materials processing technologies. Basics of applications and technical solutions of laser technology in R&D&I and in industrial scale manufacturing. The basics of 3D printing, e.g. adding material in layers. Classification of 3D printing (additive manufacturing) technologies. A brief overview of materials suitable for 3D printing. Applications of 3D printing in R&D&I and in industrial scale manufacturing.
Modes of Study	Lectures 20 h, Periods 3-4. Seminar presentations 4 h, Period 4. Seminar work and related tasks 45 h, Periods 3-4. Independent studying 37 h. Total workload 106 h. Moodle is used in this course.
Evaluation	0-5, examination 50%, seminar 50%.

Study materials	All of the material, such as lectures and guidelines related to the course, will be uploaded to Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK50A0701	***ADVANCED PRODUCTION ENGINEERING 6 ECTS cr***
	Advanced Production Engineering
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor(s) and associate professor(s) of the major subject Person in Charge: Project Researcher, D.Sc. (Tech.) Merja Peltokoski
Aims	After having completed this course, the student should be able to: - compare and evaluate the most advanced design and production methods, equipment, equipment systems and modern product facilities used especially in the manufacture of sheet and plate metal products particularly in the manufacturing of solid parts and sheet metal products - justify the role of manufacturing as a part of the company's strategy - understand the duties of factory management and development as well as in research in the field.
Content	The most common and relevant manufacturing methods for modern metal cutting, sheet metal production and basics of paperboard forming. Advanced production methods for various basic manufacturing processes. Principals of modern production systems such as flexible manufacturing systems (FMS, IMS). The significance and technologies of product design as well as of production (CAD, CAP, PPS, CAM). DFMA and cost functions of products, production control and simulation. The operation of a factory as part of a principal-supplier network. The technology and methods for improving production. Material handling, production and information systems of a workshop. Novel manufacturing processes. Development of workshop operations and quality control. The course is related to sustainability.
Modes of Study	Lectures 28 h, Periods 1-2. Seminar lecture 2 h, Period 1. Seminars 18 h, Period 2. Seminar work (pair work) and working as an opponent 65 h, Periods 1-2. Independent study 30 h. Industry visit 12 h in Period 1 or 2. Total workload 155 h. Moodle is used in this course.
Evaluation	0-5, examination 65%, seminar 35%. Intermediate seminar presentation, final presentation and working as an opponent. Participation in industrial visit. Adequate participation in seminars.
Study materials	Course material on Moodle. Other literature to be announced during lectures.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK50A1300	***CONVERTING AND FORMING OF FIBRE BASED PACKAGING 5 ECTS cr***
	Converting and Forming of Fibre Based Packaging
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk Professor, D.Sc. (Tech.) Juha Varis Researcher, M.Sc. (Tech.) Panu Tanninen Laboratory Engineer, M.Sc. (Tech.) Jari Selesvuo
Aims	After having passed this course, the student will be able to: -choose and evaluate paper and board converting technologies -compare and analyse their development in package production.

Content	The main technologies of carton forming: die cutting, scoring, folding of blanks and other forming technologies. Tool design (3D systems) and tool manufacturing technologies in modern workshops. Machines and equipment for listed converting processes, and their integration into effective production systems. Sealing, gluing and closing technologies of fibre based packaging materials. Special requirements of various paper based materials for converting processes. Features to be considered in multimaterial converting. Knowledge of the main paper package forming technologies. The requirements of various paper and board grades set for the processes. The course is related to sustainability.
Modes of Study	Lectures and laboratory exercises total 28 h. Independent study 102 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, examination 100%.
Study materials	Handouts.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A1401	***PACKAGING LINES AND MACHINERY*** ***7 ECTS cr***
	Packaging Lines and Machinery
Year and Period	M.Sc. (Tech.) 2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk Researcher, D.Sc. (Tech.) Jari Varis University Lecturer, D.Sc. (Tech.) Kimmo Kerkkänen Researcher, D. Sc. (Tech.) Huapeng Wu Doctoral Student, M. Sc. (Tech.) Ville Leminen Visiting lecturer, M.Sc. (Tech.) Tapani Sarin Person in Charge: Professor, D.Sc. (Tech.) Kaj Backfolk
Aims	After having passed this course, the student will be able to: -explain and categorise operations and functions of packaging lines -construct and develop packaging line solutions -act as a project member or manager in a packaging line investment project.
Content	The unit processes in a packaging line, the main components of a packaging line. The main filling technologies in food packaging, for example liquid packaging, aseptic packaging, MAP packaging, autoclave packaging. The main filling technologies in non-food packaging, like pharma, electronics, industrial packaging. Technologies used in carton packaging and flexible packaging, pouch, wrapping, form-fill-seal. The focus is on fibre based packaging. Instrumentation, automation, robotics in packaging lines. The course is related to sustainability.
Modes of Study	Lectures 20 h. Team work and seminars 30 h. Independent study 132 h. Total workload 182 h. Moodle is used in this course.
Evaluation	0-5, seminar work 100%.
Study materials	Handouts.
Further Information	The demands of the seminar work can be tailored to fit doctoral studies. This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A2001	***PACKAGE PERFORMANCE AND SUSTAINA-BILITY*** ***5 ECTS cr***
	Package Performance and Sustainability **Replaces the course BK50A2000 Legislation on Packaging, Interaction of Package and the Content, Environmental Issues and Sustainability.**
Year and Period	M.Sc. (Tech.) 1 Period 3
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk N. N. (visiting lecturer from industry) Person in Charge: Professor, D.Sc. (Tech.) Kaj Backfolk
Aims	After having passed this course, the student will be able to: -describe the EU legislation on packaging -understand and describe the regulations related to forestry and wood handling -understand and describe the chemical pulping process -understand and describe the recycling of renewable fibres -understand the interaction of the package and content.
Content	The main content of EU legislation on food contact material and environmental issues. Fundamentals related to the chemical pulping process. Environmental issues of packaging and packaging waste. The environmental standardisation of packages in the EU. Sustainability concerning packaging legislation on product safety aspects and traceability. Testing of packages. Interaction of the package and content. The course is related to sustainability.
Modes of Study	Lectures total 24 h, Periods 3-4. Seminar and exercises 12 h. Independent study 90 h. Total workload 126 h. Moodle is used in this course.
Evaluation	0-5, examination 50%, seminar work 50%.
Study materials	Handouts.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A2100	***PRINTING AND PACKAGE DESIGN*** ***6 ECTS cr***
	Printing and Package Design
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk N.N. (visiting lecturer from industry) Person in Charge: Professor, D.Sc. (Tech.) Kaj Backfolk
Aims	After having passed this course, the student will be able to: -understand and evaluate the influence of the substrate on the print quality -compare and analyse different printing methods used in the packaging industry -choose proper printing methods for a certain package solution -solve printing problems and to control print quality -justify the importance of the graphic design process in packaging -communicate with the various partners involved in a design process -to act as a producer for a dedicated product.
Content	Pre-press operations. The main printing technologies and their use in the packaging industry. Printing on various substrates. Composition of printing inks. Emerging printing technologies and their potential use in the packaging industry. Future trends of printing technologies. Aspects of the role of packages in the value chain. Demands set on the lay-out of a package. Various ways for idea generation of package lay-out. The course is related to sustainability.

Modes of Study	Lectures total 26 h, Periods 2-3. Seminar and exercises 12 h. Independent study 100 h. Total work load 138 h. Moodle is used in this course.
Evaluation	A. Printing and varnishing 0-5, examination 50%, 0-5 seminar work 50%. B. Design project 0-5, outcome of the work 100%. C. The total evaluation is 50% A and 50% B.
Study materials	Handouts. Saarelma, H., Oittinen, P., Printing. In series of books: Papermaking Science and Technology, Book 13, Fapet, Helsinki 1989.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A2200	***DESIGN METHODOLOGIES AND APPLICATIONS OF MACHINE ELEMENT DESIGN*** 5 ECTS cr
	Design Methodologies and Applications of Machine Element Design **Replaces the course BK50A1201 Machine Design for Packaging Technology.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Associate Professor, Docent, D.Sc. (Tech.) Harri Eskelinen
Aims	After having passed the course, the student will know: - how to dimension the most essential machine elements according to the requirements of their strength, reliability, lifetime and wear - how to carry out mechanism synthesis and analysis for typical engineering applications - how to handle the design process of a simple machine or mechanism and means to estimate functional aspects of applied technology.
Content	Basic mechanism types, mechanism analysis and synthesis, reliability-based machine design, wear phenomena and lifetime analysis of selected machine parts and elements. Different methodologies of DFM(A) and means to apply them in mechanical engineering. Knowledge about how to design a simple machine or mechanisms for special application areas of mechanical engineering and means to estimate functional aspects of applied technology. During project work, students will obtain experience in how to work as engineering experts in a design team and what is required from efficient leadership and management in engineering design.
Modes of Study	Lectures total 12 h, Period 1. Exercises total 12 h, Period 1. Project work 86 h, Period 2. Independent study 20 h. Total workload 130 h.
Evaluation	0-5, project work 80%, exercises 20%.
Study materials	Erdman, A.G., Mechanism Design. Norton, R.L., Design of Machinery. Lectures in the Noppa portal.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A2400	***PACKAGING MATERIALS*** 5 ECTS cr
	Packaging Materials
Year and Period	M.Sc. (Tech.) 1 Period 1
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk Docent Ali Harlin, D.Sc. (Tech.) Person in Charge: Professor, D.Sc. (Tech.) Kaj Backfolk

Aims	After having passed this course, the student will be able to: -compare the packaging related properties of various packaging materials -choose the appropriate packaging material for typical packaging applications.
Content	The manufacture, physical and chemical properties (relevant for packaging) of the major packaging materials: paper, paperboard, corrugated board, polymers including biopolymers, adhesives, glass and metal. The foreseeable future development of each material. Material composite possibilities and their use. The course is related to sustainability.
Modes of Study	Lectures total 24 h, Period 1. Seminar 8 h, Period 1. Independent study 90 h. Total workload 122 h. Moodle is used in this course.
Evaluation	0-5, examination 70%, seminar 30%.
Study materials	Handouts.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A2500	***COATING AND LAMINATION OF FIBRE BASED PACKAGING MATERIALS*** ***5 ECTS cr***
	Coating and Lamination of Fibre Based Packaging Materials
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Visiting lecturer, Professor, Jurkka Kuusipalo Professor, D.Sc. (Tech.) Kaj Backfolk Person in Charge: Professor, D.Sc. (Tech.) Kaj Backfolk
Aims	After having passed this course, the student will be able to: -compare various ways to combine materials with paper and board -compare and evaluate their properties in different packaging and choose the appropriate packaging material for typical packaging applications.
Content	Raw materials for the main coating and laminating methods. The main properties (including printing) of the finished products. Focus on the extrusion coating process. The main applications of polymer coated paper based packaging materials in the packaging sector. Combined packaging structures and their manufacturing techniques. The course is related to sustainability.
Modes of Study	Lectures total 28 h, Period 2. Independent study 90 h. Total workload 118 h. Moodle is used in this course.
Evaluation	0-5, examination 100%.
Study materials	Handouts. Kuusipalo, J. ed., Paper and Paperboard Converting. In series of books: Papermaking Science and Technology, part 12, 2nd edition, Fapet, Helsinki.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A2600	***PRINCIPLES OF CHEMISTRY, PAPER TECHNOLOGY AND FOOD TECHNOLOGY*** ***5 ECTS cr***
	Principles of Chemistry, Paper Technology and Food Technology
Year and Period	M.Sc. (Tech.) 1 Period 1-4
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk
Aims	After having passed this course, the student will be able to: -explain basic general, organic and biochemical phenomena -explain and categorise the basics of paper technology and products

	-define packaging related features of processed food.
Content	Basic phenomena of general, organic and biochemistry. The main fibre grades and other raw materials and their role in paper products, the main part processes of paper production, typical properties of the main paper and board grades. The basic principles of foods and processing theory, the main food processes and their effect on foods considering packaging. The course is related to sustainability.
Modes of Study	Introduction lecture and essay writing with specific instructions. Independent study 130 h. Total workload 130 h. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Smook, G.A., Handbook for Pulp & Paper Technologists, 2nd edition, pp. 1-7, 36-44, 194-324 or Smook, G.A., Handbook for Pulp & Paper Technologists, 3rd edition, pp. 1-9, 37-45, 190-324 or Holik, H., Handbook of Paper and Board, Wiley-VCH Verlag GmbH & Co KgaA, Wennheim, Germany Bettelheim & March, Introduction to General, Organic and Biochemistry, Saunders College Publishing Fellows, P., Food Processing Technology – Principles and Practice, 2nd edition, Part I, pp. 7-62, III and IV, pp. 229-452.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK50A2700	***SELECTION CRITERIA OF STRUCTURAL MATERIALS 6 ECTS cr***
	Selection Criteria of Structural Materials
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Associate Professor, Docent, D.Sc. (Tech.) Harri Eskelinen
Aims	After having passed this course, the student will be able to: - apply and develop systematic and analytical means and tools of systematic material selection approaches for solving cross-technological material selection tasks - define and analyse the properties, strengths, weaknesses and application areas of the main groups of constructional materials for different types of applications - justify and build generalised models to take into account both the functionality and the manufacturability aspects in addition to the total costs and environmental aspects of the product in solving the material selection task - evaluate and utilise recent results and documents of material science - derive analytical models based on the principles of LCCs, LCAs and MIPS factors in material selection.
Content	During the course the student will become familiar with the properties and application areas of different constructional materials. The recent scientific results dealing with materials science and technology will be discussed. Aspects of selecting and comparing different materials are discussed from the viewpoints of functionality, manufacturing, costs and environmental aspects of the product. Future trends in materials science are discussed briefly. Metals and their alloys, polymers, ceramics, composites, wood materials, adaptive materials, nanomaterials. Environmental aspects of material selection from the viewpoint of LCC and LCA and the basics of MIPS calculations. Innovative solutions of material selection tasks will be discussed. Principles to formulate and solve materials solution tasks based on analytical and systematic approaches and means to develop models to support the selection process starting from the product’s requirement list will be discussed in detail. A multi-language teaching environment will be utilised during the project work. The course is related to sustainability.

Modes of Study	Lectures 12 h, Period 3. Lectures 12 h, Period 4. Exercises in small teams 24 h, Periods 3-4. Project work 88 h. Independent study 20 h. Total workload 156 h.
Evaluation	0-5, project work 60%, exercises 40%.
Study materials	Mangohon, P., The Principles of Materials Selection for Engineering Design. Strong, A. B., Plastics, Materials and Processing. Kalpakjan, S. & Schmid, S., Manufacturing Engineering and Technology. Lectures and exercises in the Noppa portal. For Finnish students: Eskelinen & Karsikas, Vihreän teknologian näkökulmat konstruktiomateriaalien valinnassa, ISBN 978-952-265-457-1.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK60A0800	***FLUID POWER 5 ECTS cr***
	Fluid Power
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Heikki Handroos
Aims	To understand the structure and behaviour of fluid power transmission components and systems. Skills for dimensioning hydraulic components for various systems. Skills for designing fluid power transmissions for industrial and mobile machines. Ability to analyse hydraulic components and systems through modelling and simulation.
Content	Fluid power system structures, hydraulic fluids, hydraulic transmission lines, pumps, motors, cylinders, basic control valves, servo valves, accessories, hydraulic servo systems, modelling and simulation of hydraulic components and circuits.
Modes of Study	Lectures 36 h, Periods 3-4. Tutorials 36 h, Periods 3-4. Laboratory work 16 h. Independent study 42 h. Total loading 130 h.
Evaluation	0-5, examination 75%, laboratory work 25%.
Study materials	Lecture notes in Noppa. Rabie, M. Galal: Fluid Power Engineering, McGraw-Hill, 2009.
Prerequisites	Recommended BK60A0200 Mekatroniikka (not required from students of the Master's Programme in Mechanical Engineering).
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK60A1000	***CONTROL OF MECHATRONIC MACHINES 6 ECTS cr***
	Control of Mechatronic Machines
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Doctoral Student, M.Sc. (Tech.) Hamid Roozbahani Person in Charge: Doctoral Student, M.Sc. (Tech.) Hamid Roozbahani
Aims	The aim of this course is to develop theoretical and practical expertise in the analysis and design of control systems as well as the programming and control of robotic machines. The application of control system strategies covers a wide area and the course provides a sound basis for the study of both classical and modern techniques. After having passed this course module, the student will be able to: - model and simulate the control of mechatronic machines - design servo control systems for hydraulic, pneumatic and electro-machines e.g. by utilising the frequency and time domain methods

	- programming and control of mechatronic machines e.g. a robotic machine.
Content	This course introduces common industrial servo control systems: hydraulic, pneumatic, and electro-mechanic systems. The dynamic analysis of these servo systems is studied in both the time and frequency domain. Different control strategies are introduced, mainly classical with some concepts of modern control. The design and analysis of digital control will be introduced. During this course, design, analysis and simulation are conducted using Matlab/Simulink.
Modes of Study	Lectures 36 h, Periods 1-2. Tutorials 36 h, Periods 1-2. Exercises 36 h, Period 2. Laboratory work 16 h. Independent study 50 h. Total workload 174 h.
Evaluation	0-5, final exam 40%, tutorials 30%, final project 30%.
Study materials	Lecture notes. Selected chapters from the following textbooks: 1) Modern Control Engineering (5th Edition): Katsuhiko Ogata 2) Jelali Mohieddine: "Hydraulic servo-systems, modeling, identification and control".
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK60A1200	***PROGRAMMING IN CONTROL AND MECHATRONICS*** ***6 ECTS cr***
	Programming in Control and Mechatronics, Ohjelmointi mekatroniikassa ja säädössä
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Doctoral Student, M.Sc. (Tech.) Hamid Roozbahani Person in Charge: Doctoral Student, M.Sc. (Tech.) Hamid Roozbahani
Aims	Mechatronics is a design process that includes a combination of mechanical, electrical, control and computer engineering. Control is the engineering discipline that applies control theory to design systems with desired behaviors. In this course, advanced modelling, programming and simulation tools and methods are introduced to students of mechanical engineering and other departments with a related background in control engineering and mechatronics. Students will learn how related software such as MATLAB, SIMULINK, C++ and LabVIEW can be used to solve and analyse control and mechatronic problems using control theory. This course provides a mathematical basis for problem formulation, and coding/solving using the above-mentioned computational software. Students will learn how to solve simple control problems using their own codes, algorithms and designs. Then more complex problems will be solved using SIMULINK. After this course, students will be able to start working on various topics in mechatronics for advanced designs or analysis.
Content	Introduction to control and mechatronics and related problems such as: - theoretical and practical expertise in the analysis and design of control systems - programming and control of mechatronic machines, e.g. a robotic machine - application of control system strategies in a wide area of both classical and modern techniques - modelling and simulation of the control of mechatronic machines - design control systems for hydraulic, pneumatic and electro-machines e.g. by utilising the frequency and time domain methods - application of computational software (such as MATLAB, SIMULINK, LabVIEW, C++, etc.) in solving control problems - PLC and Micro controller programming.

	This course introduces common industrial servo control systems: hydraulic, pneumatic, and electro-mechanic systems. The dynamic analysis of these systems is studied in both the time and frequency domain. Different control strategies are introduced, mainly classical with some concepts of modern control. The design and analysis of digital control will be introduced.
Modes of Study	Lectures 36 h, Periods 3-4. Tutorials 36 h, Periods 3-4. Exercises 36 h, Periods 3-4. Laboratory work 16 h. Independent study 50 h. Total loading 174 h.
Evaluation	0-5, final exam 40%, tutorials 30%, final project 30%.
Study materials	Lecture notes. Selected chapters from the following textbooks: 1) Modern Control Engineering (5th Edition): Katsuhiko Ogata 2)Matlab & SIMULINK user manual based on Mathworks database 3) LabVIEW user manual based on NI database 4) C++
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK60A1300	***INDUSTRIAL ROBOTICS 6 ECTS cr***
	Industrial Robotics
Year and Period	M.Sc. (Tech.) 2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Huapeng Wu
Aims	The goal of this course is to introduce the theory of industrial robotics. The course enables the student to carry out advanced kinematic and dynamic analysis of various robot structures including stiffness and singularities. The course also deals with motion and force control methods proposed for actuator, joint and Cartesian space control. In addition, the student obtains an overview of upper level control problems such as axis interpolation.
Content	Overview of kinematic structures of robots. Direct kinematics, inverse kinematics, trajectory planning, robot dynamics, joint and actuator space control methods. Force control methods. The course is related to sustainability.
Modes of Study	42 h of lectures, exercises, seminar, Period 1. 42 h of tutorials, exercises, project work, Period 2. Independent study 72 h. Total workload 156 h. Moodle is used in this course.
Evaluation	0-5, exercise 20%, project report 20%, written examination 60%.
Study materials	Lecture notes. Selected chapter from the following text books: 1. John J. Craig ”Introduction to robotics : Mechanics and control” 2. Phillip J.M. ”Introduction to Robotics” 3. Lung-Wen Tsai ”Robot Analysis: The mechanics serial and parallel manipulator” 4. Huapeng Wu ”Parallel Manipulator: Towards New Applications”
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BK70A0000	***SIMULATION OF A MECHATRONIC MACHINE 6 ECTS cr***
	Simulation of a Mechatronic Machine
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Aki Mikkola

Aims	The student will learn the theories and practices of the mathematical modelling and computer simulation of machine systems, which are either hydraulically or pneumatically actuated. The student will be able to utilise simulations as an integrated tool of product design and utilise his/her skills to generalise the theories of engineering design to solve multidisciplinary design tasks. The student will be able to compare and justify the use of different constructional solutions for linear and rotating motion mechanisms based on their static, kinematic and dynamic analysis. The student will be able to conduct individual scientific work to simulate mechatronic machines.
Content	Principles of multibody dynamics, modelling of actuators, coupled simulation. Use of the concept of virtual work. Constraint equations and Lagrangian multipliers. Inertia of rigid bodies. Modelling of hydraulic components. Numerical integration of the equation of motion. Individual utilisation of simulation software, including the principles of how to apply previously mentioned mathematical theories to handling and solving abstract and multidisciplinary problems. The course is related to sustainability.
Modes of Study	Lectures 24 h, Periods 1-2. Teamwork in multi-cultural working environment 30 h, Periods 1-2. Supervised tutorials 24 h, Periods 1-2. Independent study 78 h, Periods 1-2. Total workload 156 h. Moodle is used in this course.
Evaluation	0-5, examination or mid-course examinations 80%, simulation work 20%.
Study materials	Lecture notes. Shabana, A. A.: Computational Dynamics, John Wiley & Sons, Inc., 1st edition, 1994. ISBN 0-471-30551-0.
Prerequisites	Students are recommended to have completed BK80A2600 Mekaniikka and BK60A0200 Mekatroniikka (not required from students of the Master's Programme in Mechanical Engineering).
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction. Enrolment to tutorial groups in WebOodi

BK70A0101	***SIMULATION, LABORATORY COURSE 6 ECTS cr***
	Simulation, Laboratory Course **Replaces the course BK70A0100 Koneen simuloinnin työkurssi.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Aki Mikkola
Aims	The student will learn the advanced theories and practices of the mathematical modelling and computer simulation of machine systems. The student will be able to utilise advanced simulations to solve a practical design assignment. The student will be able to verify and evaluate the accuracy of simulation models. The student will be able to conduct individual scientific work to analyse the dynamics of machine systems.
Content	Spatial kinematics, modelling of flexible bodies in multibody applications, modal reduction methods, real-time simulation, embedded systems, contact modelling, multibody dynamics on failure analysis, vehicle modelling, model verifications, practical measurements. The course is related to sustainability.
Modes of Study	Lectures 24 h, Periods 3-4. Teamwork in a multi-cultural working environment 30 h, Periods 3-4. Supervised tutorials 36 h, Periods 3-4. Independent study 66 h, Periods 3-4.

	Total workload 156 h. Moodle is used in this course.
Evaluation	0-5, examination or mid-course examinations 50%, simulation work 50%.
Study materials	Lecture notes. Shabana, A. A.: Dynamics of Multibody Systems, Cambridge University Press, 3rd edition, 2005. ISBN 0-521-85011-8. Shabana, A. A.: Computational Dynamics, John Wiley & Sons, Inc., 1st edition,1994. ISBN 0-471-30551-0.
Prerequisites	Recommended: BK70A0000 Simulation of a Mechatronic Machine completed.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BK70A0500	***MACHINE DYNAMICS 6 ECTS cr***
	Machine Dynamics
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Jussi Sopanen
Aims	After having passed the course, the student will know: - the theory of structural dynamics design and how to apply the knowledge in the design of machine systems (especially electromechanical systems) - how to model dynamic machine systems, solve the equations of motion in frequency and time domains and analyse the results - the basics of vibration measurements and experimental modal analysis.
Content	Multiple degree-of-freedom vibrations, solution and interpretation of natural frequencies and modes. Response to the harmonic and general force excitation. Derivation of the equations of motion of the system and solution in the frequency and time domain. Vibration measurements and experimental modal analysis. Introduction to rotor dynamics. Torsion vibrations. Vibrations of electromechanical systems.
Modes of Study	Lectures 28 h, Periods 1-2. Supervised tutorials 20 h, Periods 1-2. Laboratory work 4 h. Independent study 76 h, Periods 1-2. Teamwork in a multi-cultural working environment 32 h, Periods 1-2. Total workload 160 h. Moodle is used in this course.
Evaluation	0-5, examination or mid-course examinations 70%, homework assignments 20%, laboratory exercises 10%.
Study materials	Lecture notes. Inman, D. J.: Engineering vibration, 3rd ed., Pearson Education Inc., New Jersey, 2007. ISBN 0-13-228173-2.
Prerequisites	Students are recommended to have completed BK80A2600 Mekaniikka (not required from students of the Master's Programme in Mechanical Engineering) and BK80A1200 FE-analysis Course or BK80A2800 FE-analyysin sovellukset konetekniikassa.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BK80A1200	***FE-ANALYSIS COURSE 5 ECTS cr***
	FE-analysis Course
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	M.Sc. (Tech.) Ilkka Pöllänen Professor, D.Sc. (Tech.) Timo Björk N. N.
Aims	Students will understand the mathematical foundations of finite element analysis and will be able to use a commercial finite element programme to analyse simple statically loaded mechanical structures.

Content	The student will be acquainted with the procedure of static linear-elastic FE analysis with the aim of providing the student with a basic knowledge of the derivation of element stiffness matrices of elements, the assembly of a global stiffness matrix, the handling of boundary conditions and loading as well as problem solving. In the tutorials the student will be acquainted with FE modelling using commercial software.
Modes of Study	24 h of lectures, Periods 3-4. 24 h of tutorials, Periods 3-4. Independent study 74 h. Overall 130 h. Moodle is used in this course.
Evaluation	0-5, examination 50%, exercises 50%.
Study materials	The material will be specified during lectures.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BK80A1401	***FATIGUE DESIGN*** ***6 ECTS cr***
	Väsymiskestävyys **The course will be lectured in Finnish. The foreign students read the course book (the particular chapters), carry out the home exercises and finally participate the exam in order to pass the course.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Senior Assistant, D.Sc. (Tech.) Timo Nykänen Professor, D.Sc. (Tech.) Timo Björk
Aims	The aim of this course is for the student to learn how to design fatigue loaded structures and how to avoid fatigue failure.
Content	Principals of design to avoid fatigue failure of mechanical engineering components and structures. Introduction to fatigue, dynamic loading of structures, deformation of structural materials, stress concentrations, introduction to fracture mechanics. Design of structures based on stress-life approach, strain life approach and linear elastic fracture mechanics. Introduction to design and to the fatigue assessment of welded joints. Suitable also for postgraduate studies. The course is related to sustainability.
Modes of Study	Lectures 42 h, 1st-2nd period. Tutorials 40 h, 1st-2nd period. Moodle is used in this course.
Evaluation	0-5, examination 60%, home exercises 40%.
Study materials	Material prepared for the course in Moodle. Dowling N.E., Mechanical Behavior of Materials 2nd ed., Prentice Hall.
Prerequisites	BK80A0501 Lujuusoppi II or BK50A2700 Selection Criteria of Structural Materials.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BK90C1800	***GREEN FIBER MATERIALS*** ***5 ECTS cr***
	Green Fiber Materials **Replaces the courses BK90C0000 Puuraaka-aineoppi and BK90C1700 Metsätalous.**
Year and Period	M.Sc. (Tech.) 1 Period 4
Teacher(s)	D.Sc. (Agr. & For.) Veikko Möttönen Laboratory Engineer, D.Sc. (Tech.) Marko Hyvärinen Person in Charge: Professor, D.Sc. (Tech.), D.Sc. (Agr. & For.) Timo Kärki
Aims	After having passed this course, the student will be able to:

	- estimate different fiber resources available - define concepts and entities related to fiber usage - determine and explain what properties fibers have in relation to the growth and functions of fiber cells - compare structures and properties of fiber materials and their effects on the most important practical applications.
Content	Fiber resources. Practical principles of managing fiber resources. Fiber procurement. Macroscopial and microscopial structure of fiber materials and functions of fiber cells. Analysis of fibers with the Franklin method. Physical and mechanical properties. Empirical methods for defining strength properties. Modelling of relations between physical/mechanical/end use properties. Introduction to fiber based composites. The course is related to sustainability.
Modes of Study	Lectures 24 h, Period 4. Exercises 42 h, Period 4. Independent study 60 h. Total workload 126 h. Moodle is used in this course.
Evaluation	0-5, examination 100%.
Study materials	Course material. Handouts. Lecturer's comments. Wood Handbook, Wood as an Engineering Material. Forest Products Laboratory, 2010. (www.fpl.fs.fed.us)
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

5. LUT SCHOOL OF ENGINEERING SCIENCE

5.1 Master's Programme in Chemical and Process Engineering

Two-year Master's Programme in Chemical and Process Engineering

The Master's degree programme in Chemical and Process Engineering takes two years, corresponds to 120 ECTS credits and leads to the degree of Master of Science in Technology. Three semesters include lectures and exercises, as well as laboratory and project work. The fourth semester is devoted to the Master's thesis. The language of tuition in the programme is English.

Aims of the Master's Programme

The general objective of the programme is to give students sufficient scientific and technological knowledge for the career of chemical and process engineers in different fields of process industry. Moreover, the students will attain the basis for doctoral/Ph.D. studies and for continuous education in the field.

A specific goal is to promote and develop students' abilities to create innovations and new technology. This is realized by offering interdisciplinary education and special courses focusing on the development of innovation-related skills. The programme also emphasizes internationality and communication skills needed in the modern working environment.

Careers for Graduates

The programme gives students capabilities to work in different kind of assignments in process industry, most typically in R&D, design and operation of plants. Most graduates will find their placement in chemical, pulp and paper, metallurgical or food industry. However, nowadays the skills of chemical engineers have more and more demand also outside the traditional process industry.

Major and Minor Subjects

Chemical Process R&D (major)

Chemical Process R&D major focuses on production processes and plant design as well as on research and development with the aim of developing new products and manufacturing processes. In teaching the focus is on the methodology of both planning and research and development, especially on the necessary skills for developing new technologies. Educational content is suitable for all types of process industries where chemical engineering skill are needed.

Separation Technology (minor)

Separation Technology minor focuses extensively on separation methods used in industrial and environmental technology, such as filtrsation and membrane technology, precipitation, crystallization, liquid-liquid extraction, adsorption and chromatography, and ion exchange. Methods are described theoretically so that the student will be able to choose the appropriate separation method for the given separation problem. In addition, the student will be able to describe and size the separation devices using mathematical models. Students will also be introduced to hydrometallurgy, which has become an important part of modern high-tech mining and metals processing.

Green Process Technology (minor)

Green Process Technology minor focuses on the application of green chemistry's principles and utilization of renewable natural resources, especially wood biomass, in the process industry. Teaching in water treatment processes focuses on unit operations and separation materials that can be used for cleaning process or drinking water. Biomaterials' process engineering focuses on forest biorefinery industry and in a variety of process solutions. Courses give students the understanding of products that can be produced from wood or forest industry by-products.

Sustainability (minor)

In sustainability minor the students learn to identify, observe and make use of the challenges related to sustainability in technology industry. Courses offered range from sustainable business and technology related courses offered by other degree programmes to courses related to chemical engineering methods and unit operations. Sustainability minor courses are mainly taught in English, but there are also some courses taught in Finnish.

Degree Structure

A General studies	7	ECTS cr
B Major subject	70	ECTS cr
C Minor subject	25	ECTS cr
D Elective studies	18	ECTS cr
Total	*120 (min.)*	*ECTS cr*

General Studies

Obligatory studies (7 ECTS cr)		*year*	*per.*	*ECTS cr*
BK10A0300	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1	1
FV10A 6EC(*	Language and Communication Studies			6

*) 6 ECTS credits from same language

Major Subject

Obligatory studies (70 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A2010	Modeling of Unit Operations	M.Sc. (Tech.) 1	1-2	6
BJ02A2020	Process Control	M.Sc. (Tech.) 1	4	5
BJ02A2030	Fluid Dynamics in Chemical Engineering	M.Sc. (Tech.) 1	3	5
BJ02A2040	Advanced Process Design	M.Sc. (Tech.) 1	2	6
BJ02A2050	Process Intensification	M.Sc. (Tech.) 1	4	4
BJ02A2060	Product Design	M.Sc. (Tech.) 2	1	4
BJ02A2070	Project on Process and Plant Design	M.Sc. (Tech.) 2	1-2	10
BJ02A0040	Master's Thesis and Seminar	M.Sc. (Tech.) 2	3-4	30

Minor Subject

1. Separation Technology

Obligatory studies (25 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1	2	6
BJ02A3030	Solid-Liquid Separation	M.Sc. (Tech.) 1	3	5
BJ02A3040	Crystallization	M.Sc. (Tech.) 2	1	5
BJ02A3050	Hydrometallurgy	M.Sc. (Tech.) 1	4	4

2. Green Process Technology

Obligatory studies (25 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4020	Methods in Green Chemistry	M.Sc. (Tech.) 1	4	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5
BJ02A4040	Processing of Biomaterials	M.Sc. (Tech.) 2	1-2	7
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1	3	3

3. Sustainability

Obligatory studies (8 ECTS cr)		*year*	*per.*	*ECTS cr*
BH60A1600	Basic Course on Environmental Management and Economics	B.Sc. (Tech.) 2	2	5
BH60A4400	Introduction to Sustainability	M.Sc. (Tech.) 1	1	3

Min. 17 ECTS credits should be selected from below to attain 25 ECTS credits for the minor.

Vaihtoehtoiset opinnot		*year*	*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	DI 1-2	2	3
BH61A0600	Bioenergy	DI 1-2	1	3
BJ02A1050	Biopolymeerit	DI 1-2	4	5
BJ02A1060	Prosessi- ja ympäristöanalytiikka	DI 1-2	per 1-INT 43	5
BJ02A1070	Bioprosessitekniikan perusteet	DI 1-2	INT 17	4
BJ02A2050	Process Intensification	DI 1-2	4	4
BJ02A3010	Membrane Technology	DI 1-2	1	5
BJ02A3020	Chemical Separation Methods	DI 1-2	2	6
BJ02A4010	Industrial Water Treatment	DI 1-2	2	5
BJ02A4030	Green Chemistry	DI 1-2	1	5
BJ02A4040	Processing of Biomaterials	DI 1-2	1-2	7
BK90C1800	Green Fiber Materials	DI 1-2	4	5
CS10A0770	Cleaner Technologies and Markets	DI 1-2	3-4	5
CS30A1690	Social Sustainability	DI 1-2	4	5

Elective Studies

Elective studies can include any courses offered by LUT if the required prerequisites are fulfilled. Studies in other universities may be included upon application. Elective studies may include an internship that improves professional skills, which may be worth a maximum of 10 ECTS credits. More information: BJ02A0030 Work Internship in Master's Degree.

Master's Programme for Double Degree Students of Chemical and Process Engineering

Double degree students come from the LUT partner universities. The student takes his Master's degree from both partnering universities, and will be awarded the degree certificate of LUT and the diploma of the home university. The maximum credit transfer to be accepted to the LUT degree from the previous studies in the student's home university is 50 ECTS cr.

Degree Structure for Double Degree Students

A Major Subject	70	ECTS cr
B Credit transfer from studies at home university, a max. of 50 ECTS cr	50	ECTS cr
Total	*120 (min.)*	*ECTS cr*

Major Subject for Double Degree Students

Chemical and Metallurgical Engineering

Obligatory studies (49 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A2030	Fluid Dynamics in Chemical Engineering	M.Sc. (Tech.) 1	3	5
BJ02A2040	Advanced Process Design	M.Sc. (Tech.) 1	2	6
BJ02A2060	Product Design	M.Sc. (Tech.) 1	1	4
BJ02A3050	Hydrometallurgy	M.Sc. (Tech.) 1	4	4
BJ02A0040	Master's Thesis and Seminar	M.Sc. (Tech.) 2	3-4	30

Min. 21 ECTS credits should be selected to attain 70 ECTS credits.

List of elective courses		*year*	*per.*	*ECTS cr*
BJ02A2010	Modeling of Unit Operations	M.Sc. (Tech.) 1	1-2	6
BJ02A2020	Process Control	M.Sc. (Tech.) 1	4	5
BJ02A2050	Process Intensification	M.Sc. (Tech.) 1	4	4
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1	2	6
BJ02A3030	Solid-Liquid Separation	M.Sc. (Tech.) 1	3	5
BJ02A3040	Crystallization	M.Sc. (Tech.) 1	1	5
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5

Additional Information

Personal Study Plan
A personal study plan (PSP) is the student's tool for planning and monitoring university studies. The PSP is based on the degree structure described in the Study Guide. There are three official check-points of the PSP:
- at the beginning of the M.Sc. studies during the 1st period
- upon approval of topic application for a Master's thesis
- upon graduation.

The students of the LUT School of Engineering Science make the PSP in an electronic form by using the ePSP
tool in WebOodi.

Credit Transfer
ECTS credits can be transferred from the student's previous university level studies or higher university degrees from Finnish or foreign universities. For more information and application forms please see Uni-portal.

Complementary Studies
The student with a Finnish degree from the University of Applied Sciences or equivalent may have to study complementary studies. The extent of these studies depends on the content of the previous degree. For more information please see Uni-portal.

Internship
The Internship in the Master’s degree can be worth 10 ECTS credits. Employment prior to the studies at LUT may be accepted, if it has not been included in any previous degrees. The traineeship is approved by internship coordinators.

Maturity Test
Students must complete a maturity test in the Master's degree to prove that they know the topic of their Master's thesis. LUT accepts the public-access abstract of the thesis as the maturity test in terms of content. The abstract is a one-page introduction of the thesis that can be understood independently. It includes the identification data, objectives, key content and key results of the work.

In addition to the abstract, Master's level students take a separate maturity test only if they need to prove their Finnish or Swedish skills. In such cases, the guidelines for Bachelor's level maturity tests are applied. The maturity test is graded passed//failed.

Course Descriptions in Chemical and Process Engineering

		ECTS cr
BJ02A0010	Laboratory Work Course in Chemical Technology	10 - 30
BJ02A0020	Master's Thesis and Seminar	30
BJ02A0030	Work Internship in Master's Degree	2 - 10
BJ02A0040	Master's Thesis and Seminar	30
BJ02A2010	Modeling of Unit Operations	6
BJ02A2020	Process Control	5
BJ02A2030	Fluid Dynamics in Chemical Engineering	5
BJ02A2040	Advanced Process Design	6
BJ02A2050	Process Intensification	4
BJ02A2060	Product Design	4
BJ02A2070	Project on Process and Plant Design	10
BJ02A3010	Membrane Technology	5
BJ02A3020	Chemical Separation Methods	6
BJ02A3030	Solid-Liquid Separation	5
BJ02A3040	Crystallization	5
BJ02A3050	Hydrometallurgy	4
BJ02A4010	Industrial Water Treatment	5
BJ02A4020	Methods in Green Chemistry	5
BJ02A4030	Green Chemistry	5
BJ02A4040	Processing of Biomaterials	7
BJ02A4050	Biomaterials Design and Application	3

BJ02A0010	***LABORATORY WORK COURSE IN CHEMICAL TECHNOLOGY*** ***10 - 30 ECTS cr***
	Laboratory Work Course in Chemical Technology
Year and Period	M.Sc. (Tech.) 1-2
Teacher(s)	N. N. Person in Charge: Head of the Laboratory
Aims	Upon completion of the module, the student will be able to: - carry out independently a small research project (the contents of the module varies substantially).
Content	A specific project which is done in one of the laboratories of the department. The project is planned together with the supervisor(s) and consists mainly of laboratory work, literature work and report writing. The course may contain lectures and seminars. The project may also be planned together with industry and then carried out at some industrial location.
Modes of Study	The amount of work hours in the project will determine the amount of credits, e.g. three months of work would give 15 ECTS cr. Credits will be granted when the final report is delivered. Extra credits can be received if specific examinations are made. Hours of self-study varies.
Evaluation	0-5 or pass/fail, depending on the project carried out.
Study materials	Literature related to the project.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A0020	***MASTER'S THESIS AND SEMINAR*** ***30 ECTS cr***
	Diplomityö ja seminaari **In Master's degree programmes taught in English, the Master's thesis is always prepared in English.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4
Teacher(s)	Examiner of the thesis N.N.
Aims	Upon completion of the module, the student will be able to: - define a research problem or design task - select appropriate methods for a restricted research problem or design task in the field - can find and use critically data, information and knowledge in the field, and estimate their reliability - apply his/her chemical engineering knowledge to solve a restricted research problem or carry out a design task - apply his creativity to find new solutions or in best case to generate new technology - report the results orally and participate in a scientific discussion - write a report from the task according to scientific principles.
Content	The thesis is a research or design project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the instructions for the Master's thesis.
Modes of Study	The thesis is connected to a seminar with other thesis students and their instructors. Each student gives a brief presentation on the results of his/her project. The presentations are then discussed, and teachers pose questions on them to the entire group. The student attends at least twice the seminar organized by the competence area of the School of Engineering Science to which the work is related to. See the course Moodle page for more details. Moodle is used in this course.
Evaluation	0-5, Master's thesis 100%.

BJ02A0030	***WORK INTERNSHIP IN MASTER'S DEGREE***	***2 - 10 ECTS cr***
	DI-tutkinnon työharjoittelu **No course registration (replaced by submitting the application for approval of the internship coordinator).**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Ritva Tuunila	
Aims	After the module a student - has become acquainted with an industrial working environment in the field of chemical or process industry - has obtained experience in practical application of his/her knowledge and skills - has seen operation of production processes and equipment of his field in practice - can analyze the practical role of knowledge and skills he/she has learned in his/her studies	
Content	Practical operating, research, design or quality control work in chemical or process industry, laboratory or engineering company.	
Modes of Study	Practical training of eight weeks in industry. Written report including a description of working environment, tasks of the student and their contribution to the goals and operation of the company. First 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to starting an employment relationship (e.g. orientation, the rules of the employment relationship and the work place) 15 h, observing (while working) how the working community operates (e.g. how work/production is organized, supervision, the working manners of the working community/teams, the social environment of the work place) 22 h, a written internship report 5 h (2-3 pages), total 52 h. 3-10 ECTS credits: having different tasks in a company 26-208 h (1 ECTS credit/26 h).	
Evaluation	Pass/Fail, internship report 100%.	

BJ02A0040	***MASTER'S THESIS AND SEMINAR***	***30 ECTS cr***
	Master's Thesis and Seminar, Diplomityö ja seminaari	
Year and Period	M.Sc. (Tech.) 2 Period 3-4	
Teacher(s)	Professor of the chosen subject area N. N.	
Aims	Upon completion of the module, the student will be able to: - define a research problem or design task - select appropriate methods for a restricted research problem or design task in the field - can find and use critically data, information and knowledge in the field, and estimate their reliability - apply his/her chemical engineering knowledge to solve a restricted research problem or carry out a design task - apply his creativity to find new solutions or in best case to generate new technology - report the results orally and participate in a scientific discussion	
Content	The thesis is a research or design project. Students must demonstrate the ability to complete the project independently and following a plan. A report is prepared following the instructions for the Master's thesis.	
Modes of Study	The thesis is connected to a seminar with other thesis students and their instructors. Each student gives a brief presentation on the results of his/her project. The presentations are then discussed, and teachers pose questions on them to the entire group. The student attends at least twice the seminar organized by the competence area of the School of Engineering Science to which	

	the work is related to. See the course BJ02A0020 Moodle page for more details. Seminar is the same for both BJ02A0020 and BJ02A0040.
Evaluation	0-5, Master's thesis 100%.

BJ02A2010	***MODELING OF UNIT OPERATIONS 6 ECTS cr***
	Modeling of Unit Operations **Replaces the course BJ30A0600 Yksikköprosessien mallinnus**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	N.N. Person in Charge: Associate Professor, Ph.D. Tuomo Kauranne Professor, Ph.D. Heikki Haario
Aims	After completing the module the student - can describe steady-state and transient unit operations with mathematical models - can validate models and estimate parameters from experimental data - can apply phenomenon based models in process development and design tasks, such as sizing, optimization, and scale-up - can use mathematical and simulation software
Content	Mechanistic mathematical models in research and design. Steady-state and transient models. Models in different stages of process life cycle. Parameter estimation. Simulation. Optimization. Scale-up. Modern modeling and simulation software.
Modes of Study	Lectures 24 h, exercises 14 h, 1st period. Home assignments 70 h, self-study 46 h. Home assignments passed, no exam. Total workload 154 h. Moodle is used in this course.
Evaluation	1-5.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BJ02A2020	***PROCESS CONTROL 5 ECTS cr***
	Process Control
Year and Period	M.Sc. (Tech.) 1 Period 4
Teacher(s)	Associate Professor, Docent, D.Sc. (Tech.) Satu-Pia Reinikainen N. N. Person in Charge: Associate Professor, Docent, D.Sc. (Tech.) Satu-Pia Reinikainen
Aims	After completing the module the student can - construct dynamic models for simple processes - explain the degrees of freedom in a given system - explain the principles of different process control strategies - apply different process control strategies for simple systems - explain the principles of statistical process control
Content	Mathematics for control systems. Degrees of freedom. Feed-forward and feedback control. PID control. Basics of statistical process control methods for dynamic processes. Introduction to control charts for quality and process control. Multivariate extensions of statistical process control.
Modes of Study	Lectures and exercises 30 h, 4th period. Homework 50 h. Self Study 50 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, written exam 100%. Homework passed.
Study materials	To be announced.

Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A2030	***FLUID DYNAMICS IN CHEMICAL ENGINEERING 5 ECTS cr***
	Fluid Dynamics in Chemical Engineering, Virtaustekniikka kemiantekniikan sovelluksissa **Replaces the course BJ30A0700 Computational Fluid Dynamics in Chemical Engineering**
Year and Period	M.Sc. (Tech.) 1 Period 3
Teacher(s)	Professor, D.Sc. (Tech.) Tuomas Koiranen N.N. (laboratory demonstrations) Person in Charge: Professor, D.Sc. (Tech.) Tuomas Koiranen
Aims	A student can: - Select, size and scale-up different mixing devices (stirred tanks, in-line mixers) for blending and multiphase mixing (solid-liquid mixing, liquid and gas dispersions) based on short-cut design methods. - Understand basics of fluid rheology and adapt the information to mixing design. - Understand computational fluid dynamics (CFD) calculations and is able to solve basic fluid mixing problems with CFD programs.
Content	Design methods and scale-up of fluid mixers, rheology, mixing effects in chemical reactions. Theoretical basis of CFD and chemical engineering aspects.
Modes of Study	Exercise based lecturing 18 h, home exercises 32 h (in Moodle), fluid mixing demonstration 4 h, mixing case study (literature review) 24 h, seminar 8 h, 3rd period. Self-study 44 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, 75% home exercises for passing course, 100% home exercises increases grade 20%. Mixing case study report (failed/satisfactory/good). Good report increases grade 20%. Examination 60% (exam grade at least 1 for passing course).
Study materials	Additional material will be informed at lectures. Material in Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A2040	***ADVANCED PROCESS DESIGN 6 ECTS cr***
	Advanced Process Design, Prosessisuunnittelun jatkokurssi
Year and Period	M.Sc. (Tech.) 1 Period 2
Teacher(s)	Lic.Sc. (Tech.) Esko Lahdenperä
Aims	Upon completion of the module, the student will be able to - estimate physical and chemical properties of substances for initial design information - carry out process synthesis (determination of process structure, selection of unit operations and equipment type, arrangement of process flows, process integration..) - carry out process analysis (computer-aided investigation of the operation of the selected process structure, computation of material and energy balances, simulation…) - optimize the process (structure and conditions)
Content	The students will learn to use modern simulation tool (ASPEN) in advanced and realistic process design and development tasks.
Modes of Study	Lectures 24 h, exercises 24 h, 2nd period. Assignments 50 h.

	Self-study 58 h. Total workload 156 h. Moodle is used in this course.
Evaluation	0-5, written examination 100%, assignments passed.
Study materials	To be announced later.
Prerequisites	BJ01A5030 Prosessisimuloinnin perusteet passed.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A2050	***PROCESS INTENSIFICATION 4 ECTS cr***
	Process Intensification, Prosessien intensifiointi
Year and Period	M.Sc. (Tech.) 1 Period 4
Teacher(s)	Docent, D.Sc. (Tech.) Arto Laari Person in Charge: Docent, D.Sc. (Tech.) Arto Laari
Aims	Upon completion of the module, the student will be able to - explain goals of process intensification, describe advantages reached by it as well as typical methods of intensification - explain and use following applications of process intensification: intensified reactors and separation equipment, combination of reaction and separation, hybrid separation, alternative energy sources, transforming a batch process to continuous one - recognize possibilities to intensify an apply novel technology in existing processes
Content	Teaching will include lectures and seminars. In the seminars there will be discussion and problem solving about various topics and problems given by the lecturer. The course is related to sustainability.
Modes of Study	Lectures and seminars 24 h, 4th period. Self-study and preparation for seminars 80 h. Total workload 104 h. Moodle is used in this course.
Evaluation	0-5, written examination 100%.
Study materials	Lecture material, Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A2060	***PRODUCT DESIGN 4 ECTS cr***
	Product Design, Tuotekehitys **Replaces the course BJ40A0100 Product Design**
Year and Period	M.Sc. (Tech.) 2 Period 1
Teacher(s)	Docent, D.Sc. (Tech.) Arto Laari Person in Charge: Docent, D.Sc. (Tech.) Arto Laari
Aims	Upon completion of the module, the student will be able to - nominate and classify chemical products - analyze customers' needs - create and develop ideas for chemical products - compare product ideas and make selections - apply his/her chemical engineering knowledge in product design - nominate and describe computer-aided methods for chemical product design
Content	The lectures concern theory of chemical product design. Also several examples of product development projects will be described. The exercises include small tasks in the field of idea generation and product design. These will be performed as teamwork.
Modes of Study	Lectures 12 h, exercises 12 h, 1st period. Self-study and preparation for exercises 80 h. Total workload 104 h. Moodle is used in this course.
Evaluation	0-5, written examination 100%.
Study materials	Lecture material, Moodle.

Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A2070	*PROJECT ON PROCESS AND PLANT DESIGN 10 ECTS cr*
	Project on Process and Plant Design, Prosessisuunnittelun suunnitteluprojekti **Replaces the course BJ30A0500 Project on Process and Plant Design**
Year and Period	M.Sc. (Tech.) 2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	N. N. Person in Charge: N. N.
Aims	Upon completion of the module, the student will be able to - apply his/her chemical engineering knowledge to real industrial process design project - perform technical and economical design calculations - solve real design problems starting sometimes from limited and incomplete initial information - seek and create novel solutions to design problems
Content	The projects are carried out in the groups of five students. The topics are from industry. A typical topic is a feasibility study of a process covering a brief market survey, comparison of process alternatives, preliminary process design (process flow diagram, mass and energy balances, sizing of main equipment), lay-out, cost and profitability estimation. Different aspects are emphasized in different projects, depending on the topic.
Modes of Study	Lectures 5 h, project meetings, 1st period. Lectures 5 h, project meetings, 2nd period. Design and project work about 250 h, 1st-2nd period. Total workload 260 h. Moodle is used in this course.
Evaluation	0-5, design reports 100%.
Study materials	Lecture material, Moodle.
Prerequisites	BJ01A5020 Prosessi- ja tehdassuunnittelu passed.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A3010	*MEMBRANE TECHNOLOGY 5 ECTS cr*
	Membrane Technology **Replaces the course BJ50A0001 Membraanitekniikka**
Year and Period	M.Sc. (Tech.) 1 Period 1
Teacher(s)	Professor, D.Sc. (Tech.) Mika Mänttäri Associate Professor, D.Sc. (Tech.) Arto Pihlajamäki Associate Professor, D.Sc. (Tech.) Mari Kallioinen Person in Charge: Professor, D.Sc. (Tech.) Mika Mänttäri
Aims	At the end of the course a student is expected to know how to: - explain the basic terms and membrane processes - interpret observed phenomena in the separation process and their influence to the separation process - compare the feasibility of membrane materials, modules and manufacturing processes - choose the most appropriate membrane and membrane process for a separation process - identify the possibilities, benefits and limits of membrane processes
Content	Membrane processes (micro-, ultra- and nanofiltration, reverse osmosis, pervaporation, etc.). Manufacturing membranes, membrane materials and structures Phenomena in membrane processes (fouling, concentration polarisation,

	etc.). Modules. Separation mechanisms. Characterisation of membranes. Applications. The course is related to sustainability.
Modes of Study	Lectures 24 h, self-study (Moodle) 30 h, seminar presentations 18 h, laboratory works and their reporting 24 h, preparation for exam and exam 24 h, 1st period. Total workload 120 h. Moodle is used in this course.
Evaluation	0-5, written examination 70%, seminar and laboratory works 30%. Possible extrapoints from Moodle-assessments (0-10).
Study materials	Lecture presentations and additional material (Moodle): book chapters and articles. Mulder, M., Basic Principles of Membrane Technology, 2nd ed., Kluwer, 1996/2003.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A3020	***CHEMICAL SEPARATION METHODS 6 ECTS cr***
	Chemical Separation Methods, Kemialliset erotustekniikat **Replaces the course BJ90A0720 Chemical Separation Methods**
Year and Period	M.Sc. (Tech.) 1 Period 2
Teacher(s)	Professor, D.Sc. (Tech.) Tuomo Sainio
Aims	After the module the student - can describe the principles of main chemical separation methods - can describe industrial uses of the chemical separation methods - understands the dynamic behavior of periodically operated separation processes - can select methods and materials for separation and purification of complex mixtures
Content	Fundamentals of adsorption and ion exchange; separation materials; dynamics of adsorption and ion exchange columns; industrial liquid-solid and gas-solid adsorption processes. Industrial scale chromatography; batch and continuous operation modes; process performance; application examples. Liquid-liquid chromatography. Liquid-liquid extraction; application in separation of organic compounds. The course is related to sustainability.
Modes of Study	Lectures 20 h, 2nd period. Simulations, exercises and seminars 20 h, 2nd period. Reports, home assignments and self-study 110 h. Total workload 150 h. Moodle is used in this course.
Evaluation	0-5, oral examination 70%, reports, assignments and presentations 30%.
Study materials	Lecture material will be distributed via Moodle.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BJ02A3030	***SOLID-LIQUID SEPARATION 5 ECTS cr***
	Solid-Liquid Separation, Kiintoaineen ja nesteen erotus **Replaces the course BJ20A2300 Solid-Liquid Separation**
Year and Period	M.Sc. (Tech.) 1 Period 3
Teacher(s)	Professor, D.Sc. (Tech.) Antti Häkkinen Associate Professor, D.Sc. (Tech.) Ritva Tuunila Post-Doctoral Researcher, D.Sc. (Tech.) Riina Salmimies Person in Charge: Professor, D.Sc. (Tech.) Antti Häkkinen
Aims	After completing the module the student can:

	- know the fundamental phenomena in solid-liquid separation - name different methods and equipment used for solid-liquid separation - select and size suitable equipment for separation processes based on suspension properties and data from laboratory tests - explain the effects of the characteristics of the solid material and the liquid on the separation and post treatment processes - define different filter media used in filtration and make a preliminary selection of a medium for different cases - perform an experimental test in laboratory scale - write a scientific report.
Content	The topics are as follows: Fundamentals of solid-liquid separation, filtration methods, operation of filters, cake formation and washing, deliquoring, design and modeling of filters and scale-up. Filter media and blinding. Experimental design in filtration test work.
Modes of Study	Lectures 18 h, exercises 18 h, filtration laboratory work 20 h, literature review 20 h, 3rd period. Self-study 54 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, written examination 60%, laboratory work 20%, literature review 20%.
Study materials	Additional material will be informed at lectures.
Prerequisites	Knowledge of the fundamentals of particle characterization and mechanical separation methods. Recommended literature: Fundamentals of Particle Technology by Richard Holdich, Chapters 1–8.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BJ02A3040	***CRYSTALLIZATION*** ***5 ECTS cr***
	Crystallization, Kiteytys
Year and Period	M.Sc. (Tech.) 2 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Marjatta Louhi-Kultanen Doctoral Student, M.Sc. (Tech.) Bing Han Doctoral Student, M.Sc. (Tech.) Mehdi Hasan Doctoral Student, M.Sc. (Tech.) Alexander Sokolov Person in Charge: Professor, D.Sc. (Tech.) Marjatta Louhi-Kultanen
Aims	After completing the module the student can: - explain the fundamentals of industrial crystallization and precipitation (solid-liquid equilibrium, supersaturation as driving force, crystallization methods, kinetics, population density, crystal size distributions, polymorphism, solvate and hydrate formation, mass transfer in crystallization and dissolution, realtime process monitoring and process control) - explain crystallization as purification, separation and concentration unit operation, recovery method of chemicals from side streams - predict solubility of electrolyte solutions (multi-component solutions, Pitzer model) - explain principles of nanocrystallization - list and describe the operation of the most important industrial crystallizers - sizing of industrial crystallizers (batch process, continuous process by Mixed Suspension Mixed Product Removal (MSMPR) theory) - estimate process conditions for batch processes (cooling policy, seeding policy) - calculate heat balances for cooling and evaporative crystallization processes (Aspen Plus) - characterization methods of crystalline end-products
Content	Theory, operation and design of crystallizers. Crystallization as purification, separation and concentration method. Crystallization from solution and melt. Solid-liquid and solid-gas- liquid precipitation processes. Mass transfer of reactant dissolution and absorption. Process Analytical Technology (PAT) in crystallization processes.

Modes of Study	Lectures 12 h, exercises 18 h, crystallization equipment demonstrations and seminar 20 h, 1st period. Assignments and self-study 80 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, assignments and seminar 100%.
Study materials	Davey, R. J., Garside, J., From Molecules to Crystallizers, Oxford, Oxford University Press, 2000. Lecture materials.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BJ02A3050	***HYDROMETALLURGY***	***4 ECTS cr***
	Hydrometallurgy	
Year and Period	M.Sc. (Tech.) 1 Period 4	
Teacher(s)	Research Engineer, D.Sc. (Tech.) Markku Laatikainen Post-Doctoral Researcher, D.Sc. (Tech.) Sami Virolainen N. N. Person in Charge: Research Engineer, D.Sc. (Tech.) Markku Laatikainen	
Aims	After the course, the students - understand the fundamentals of hydrometallurgy - are familiar with methods and equipment used in hydrometallurgical processes - have perspective on industrial utilization of hydrometallurgy.	
Content	Minerals and ores. Mining and mineral processing. Solution chemistry of hydrometallurgical solutions. Leaching. Treatment of leach solutions by solvent extraction, ion exchange and adsorption. Metal recovery by precipitation and by electrochemical methods. Hydrometallurgy of secondary raw materials.	
Modes of Study	Lectures and exercises 24 h. Home exercise 4 h. Laboratory work 10 h. Self-study 75 h. Total workload 113 h. Moodle is used in this course.	
Evaluation	0-5, written examination 100%, exercises passed.	
Study materials	Lectures. Supporting material: Fathi Habashi, Textbook of Hydrometallurgy, Metallurgie Extractive Quebec, 2nd edition, 1999.	

BJ02A4010	***INDUSTRIAL WATER TREATMENT***	***5 ECTS cr***
	Industrial Water Treatment, Teollisten vesien käsittely	
Year and Period	M.Sc. (Tech.) 1 Period 2	
Teacher(s)	Professor, D.Sc. (Tech.) Mika Sillanpää Researcher, D.Sc. (Tech.) Eveliina Repo Person in Charge: Professor, D.Sc. (Tech.) Mika Sillanpää	
Aims	By the end of the course, the student is expected to have knowledge about: - Treatment of water emissions, - Solid waste disposal - Environmental regulations and trends - Case studies	
Content	Learning the methods of industrial wastewater treatment such as coagulation, flocculation, adsorption, advanced oxidation processes (AOPs), and electrochemical methods as well as environmental analytics. Students also will be familiarized with novel techniques such as nanotechnology in water treatment and environmental analytics. Comparison of different industrial wastewater treatment techniques will be considered in the course from economical, environmental and technical sides. Case exercises will be conducted as a group	

	work using Moodle discussion forums and group meetings. Weekly homework exercises related to the topic of each week are returned via Moodle. The course is related to sustainability.
Modes of Study	Lectures 12 h, exercises 28 h, case studies, 2nd period. Independent workload: literature work and homework, altogether approx. 106 h. Total workload approx. 130 h. Moodle is used in this course.
Evaluation	0-5, literature work 50%, case studies 30% and homework 20%.
Study materials	Lecture notes. Moodle.
Prerequisites	BJ02A4030 Green Chemistry
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A4020	***METHODS IN GREEN CHEMISTRY*** ***5 ECTS cr***
	Methods in Green Chemistry, Vihreän kemian menetelmät
Year and Period	M.Sc. (Tech.) 1 Period 4
Teacher(s)	Professor, D.Sc. (Tech.) Mika Sillanpää Researcher, D.Sc. (Tech.) Eveliina Repo Person in Charge: Professor, D.Sc. (Tech.) Mika Sillanpää
Aims	By the end of the course, the student is expected to be able to - compare the basic water treatment methods as well as novel technology - apply the basic environmental analytics and evaluate how the novel technology can be used to improve the analysis - evaluate and justify the advantages of green chemistry in different applications of environmental technology as well as in organic synthesis - compare critically the green chemistry methods to traditional methods
Content	Learning the methods of environmental analytics and water treatment such as adsorption, photocatalysis, and electrochemical methods. Learning to interpret experimental results by modeling using for example kinetic models and theoretical adsorption isotherms. Especially, familiarizing novel techniques such as nanotechnology in water treatment and environmental analytics. Utilization of green chemistry in environmental technology as well as in organic synthesis i.e. solvent free synthesis or solvent substitution. The course is related to sustainability.
Modes of Study	Lectures 3 h, 4th period. Laboratory exercises 20 h, 4th period. Preparation for the exam, exercise reports, independent workload about 106 h. Total workload about 130 h. Moodle is used in this course.
Evaluation	0-5, exam 50%, reports from laboratory exercises 50%.
Study materials	Lecture notes. Moodle.
Prerequisites	BJ02A4030 Green Chemistry
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A4030	***GREEN CHEMISTRY*** ***5 ECTS cr***
	Green Chemistry, Johdatus vihreään kemiaan
Year and Period	M.Sc. (Tech.) 1 Period 1
Teacher(s)	Professor, D.Sc. (Tech.) Mika Sillanpää Researcher, D.Sc. (Tech.) Eveliina Repo Person in Charge: Professor, D.Sc. (Tech.) Mika Sillanpää
Aims	Principles of green chemistry and green engineering - Industrial ecology - Typical hazardous compounds, national and global trends - Safe chemicals, safe processes - Surface reactions - Catalysis as a means to improve materials efficiency

	- Case studies
Content	Learning the principles of green chemistry and their practical applications as well as the concepts of green chemistry such as industrial ecology. Learning to recognize the methods, processes, and the parts of the processes that follow the principles of green chemistry. Getting to know how to prevent pollution with the aid of green chemistry. Also course include learning the principles of green chemistry in depth using case-studies. These include finding green solutions for the problems arising in different processes of environmental technology. Case exercises will be conducted as a group work and each group will present the results. Each student will give a seminar presentation of the topic related to the principles of green chemistry. Weekly homework exercises related to the topic of each week are returned via Moodle. The course is related to sustainability.
Modes of Study	Lectures 14 h, 1st period. Case studies 16 h, final seminar 12 h, 1st period. Independent workload: Literature work and homework, altogether about 90 h. Total workload: 130 h. Moodle is used in this course.
Evaluation	0-5, seminar and literature work 40%, homework 20%, case studies 40%.
Study materials	Stanley E. Manahan, Green Chemistry and the Ten Commandments of Sustainability, ChemChar Research, Inc., 2006, manahans@missouri.edu. Lecture notes. Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A4040	***PROCESSING OF BIOMATERIALS 7 ECTS cr***
	Processing of Biomaterials
Year and Period	M.Sc. (Tech.) 2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk Doctoral Student, M.Sc. (Tech.) Katriina Mielonen Various invited lectures from industry Person in Charge: Professor, D.Sc. (Tech.) Kaj Backfolk
Aims	After completing the module, the student ought to - Understand modern forest biorefinery processes and modern pulp industry - Describe process integration concepts, energy and source efficient solutions and development trends. - Get insight into current state and development potential, and role of economy and policy aspects.
Content	Raw materials resources, pre-treatment methods, biochemical and chemical conversion, thermochemical conversion, pulping methods (cooking, bleaching), dissolving pulp manufacturing, carbohydrate production, lignin removal and purification, fuel from lignocellulosics (1st generation, 2nd generation, 3rd generation), competing resources and processes to forest biorefinery, future outlook and R&D trends. The course is related to sustainability.
Modes of Study	Lectures 40 h, 1st-2nd period. Self-studies 60 h. Project works (case studies or mill problem solving): 60 h. Excursion (optional). Total workload 160 h. Moodle is used in this course.
Evaluation	0-5, written examination 70%, project work 30%.
Study materials	Selected chapters in Biorefining of Forest Resources (R. Alén) and/or Integrated Forest Biorefineries. Challenges and Opportunities (L. P. Christopher). Lecture material will be distributed via Moodle.
Prerequisites	BJ01A5050 Biojalostamot BJ02A4050 Biomaterials Design and Application

Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BJ02A4050	***BIOMATERIALS DESIGN AND APPLICATION 3 ECTS cr***
	Biomaterials Design and Application
Year and Period	M.Sc. (Tech.) 1 Period 3 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Kaj Backfolk Doctoral Student, M.Sc. (Tech.) Katriina Mielonen Doctoral Student, D.Sc. (Tech.) Esa Saukkonen Person in Charge: Professor, D.Sc. (Tech.) Kaj Backfolk
Aims	After the completing the module, the student ought to: - describe how various renewable resources is utilized in various applications. - have an insight into material and molecular design and its role for the end product performance - describe how biomaterials, and in particular wood derived, are used for example in food, pharmaceuticals, composites, and smart materials.
Content	Fundamentals about biomaterial design, modification, synthesis and use in in various products. Application and properties of wood derived materials such as lignin, hemicellulose, cellulose and nanofibers is presented. Chemical and mechanical modification, separation methods, mixing and drying methods. Product specification requirements and characterization methods. The course is related to sustainability.
Modes of Study	Lectures 20 h, 3rd period. Project work 20 h, 3rd period. Self-studies 30 h. Excursion (optional). Total workload 70 h. Moodle is used in this course.
Evaluation	0-5, written examination 70%, project work 30%.
Study materials	Lecture material will be distributed via Moodle. Selected chapters in Biorefining of Forest Resources (R. Alén).
Prerequisites	BJ01A5050 Biojalostamot
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

5.2 Master's Programme in Computational Engineering and Physics

The Master's Degree Programme in Computational Engineering and Physics takes two years, corresponds to 120 ECTS credits and leads to the degree of Master of Science in Technology. The language of tuition in the programme is English. The programme has three alternative major subjects: Technomathematics, Technical Physics and Intelligent Computing**.**

Degree Structure

General Studies	7-14	ECTS cr
Major Subject	70-74	ECTS cr
Minor Subject	20 (min.)	ECTS cr
Elective Studies	12-23	ECTS cr
Total	*120 (min.)*	*ECTS cr*

Technomathematics

Programme Coordinator in Technomathematics is University Lecturer Jouni Sampo, D.Sc. (Tech.)

Technomathematics is the art and science of applying mathematics and computational models into real life problems in industrial research and applied science, such as

- measurements, experiments and intelligent data-analysis
- modelling and simulation of systems and processes
- production management and process monitoring/control
- financial models, risk analysis and decision support systems.

The professional scope is wide-ranging and growing rapidly, and therefore the aim is to develop the student's mathematical and computational skills for industry and other research and development tasks. The graduate is able to combine modeling, computational skills, advanced theory and data analysis in innovative ways and to provide solutions to questions of industrial R&D. The programme also provides the graduate with capabilities for scientific doctoral studies and independent research.

Education in applied mathematics at LUT is international. The most important fields of education and research are inverse problems, computational material science and statistical/soft modeling. Some examples of applications and research areas: inverse problems, stochastic methods, Bayesian methods with MCMC, fuzzy logic and data analysis, computational fluid dynamics, wavelets and image/signal analysis.

ECMI Masters in Industrial Mathematics

The department is a member of ECMI (www.ecmi-indmath.org) which represent a European network of Master's programmes in mathematics oriented towards applications in real world, industry and society. The network has agreed on a European Model Curriculum, which will facilitate mobility at the European scale. LUT students of Technomathematics have a possibility of studying as exchange students in another ECMI partner university abroad. For more information: www.ecmi-indmath.org/

Master's Thesis and Seminar 30 ECTS cr

Thesis topics arise from various application areas, research projects and contacts with industry. Typically, the thesis contains a theoretical study, as well as the use of up-to-date mathematical and computational methods for solving an application practical problem.

Technical Physics

Programme Coordinator in Technical Physics is Professor Erkki Lähderanta, Ph.D

The student majoring in Technical Physics should have a Bachelor's degree from a related field. Each student will make a personal study plan, the contents of which will depend on the student's previous degree/studies and his field of interest and specialization.

The aim of the major subject in Technical Physics is to prepare the student professionally and academically in physics and other technical science skills in industry and R&D tasks. The most important fields of education and research are material physics, applied optics and microelectronics. The programme also provides the graduate with capabilities for scientific doctoral studies and independent research.

Master's Thesis and Seminar 30 ECTS cr
Thesis topics arise from various application areas, research projects and contacts with different universities. Typically, the thesis contains a theoretical study, experimental part and analysis of the experimental results.

Intelligent Computing

Programme Coordinator in Intelligent Computing is Associate Professor Arto Kaarna, D.Sc. (Tech.)

The masters graduating from Intelligent Computing are able to apply their capabilities, scientific knowledge, and scientific methods in practice, they are able to participate in challenging product development projects and also software projects in the role of an expert or as a leader. The graduates are able to communicate both orally and in written form, including the ability and skills as a public performer, and they are able to participate in a project group also in a multi-cultural environment. The education is given in English language and as such, the graduates can communicate both orally and in written form using English language. The programme provides the graduate with the capabilities for doctoral studies and life-long learning in working life. Furthermore, the graduates

- are able to analyze and find solutions for challenging problems in information processing through transforming them into algorithmic form
- are able to apply mathematical methods in algorithms
- are able to apply intelligent and learning approaches of information processing to solve problems in information technology
- are able to use and rationally select solutions and methods in digital imaging, computer vision, computer graphics, machine learning and artificial intelligence.

Master's Thesis and Seminar 30 ECTS cr
The topics for the thesis are related to the research performed in the laboratory of Machine Vision and Pattern Recognition. The topic may also originate from the cooperation with industry, both in product development e.g. in machine vision problems, information processing, or software projects. Most often the thesis includes thorough studies utilizing the computational methods, approaches and applications from computer vision, pattern recognition, and machine learning. The thesis contains the problem setting, the modeling and proposal for the solution for the problem, and the implementation of the solution and finally the estimation of the quality for the proposed solution.

General Studies 7-14 ECTS cr

Obligatory Studies (7-14 ECTS cr)		*year*	*per.*	*ECTS cr*
BM10A0500	Research Methods	M.Sc. (Tech.) 1	INT 43-per 2	3
BM20A5001*)	Principles of Technical Computing	B.Sc. (Tech.) 2 M.Sc. (Tech.) 1	1	4
BK10A0300**)	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1	1
FV10A4EC***)	Language Studies			4
FV18A9101****)	Finnish 1		1/3	2

*) Only for students who have no Matlab programming courses in earlier studies
**) Only for students coming outside of LUT
***) 4 ECTS cr from the same language. Students are recommended to study FV11A9800 Academic Writing in English Course 1 2 ECTS cr and FV11A9900 Academic Writing in English Course 2 2 ECTS cr
****) Foreign students are required to study at least one course of Finnish language.

Major in Technomathematics, obligatory studies 38 + 32 ECTS cr

Obligatory Studies (38 ECTS cr)		*year*	*per.*	*ECTS cr*
BM10A0000	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BM20A2500	Linear Algebra and Normed Spaces	M.Sc. (Tech.) 1-2	1	3
BM20A4000	Case Study Seminar	M.Sc. (Tech.) 1	1-4	5

Major Subject, elective modules 32 ECTS cr
The student chooses a minimum of 32 ECTS cr of courses from the modules a-e. Its´s recommended, that the extent of at least one of the modules should be at least 15 ECTS cr, the rest of the courses can freely be selected from the other modules.

a) Process Modelling and Ecomathematics

List of elective courses		*year*	*per.*	*ECTS cr*
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A2000	Simulation	M.Sc. (Tech.) 1	1	4
BM20A3301	Stochastic Theory and Models	M.Sc. (Tech.) 1-2	4	3-5
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A6000	Ecomathematics	M.Sc. (Tech.) 1	3-4	5
BJ02A2010	Modeling of Unit Operations	M.Sc. (Tech.) 1	1-2	6

b) Data Driven Modelling

List of elective courses		*year*	*per.*	*ECTS cr*
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A2000	Simulation	M.Sc. (Tech.) 1	1	4
BM20A3001	Statistical Analysis in Modelling	M.Sc. (Tech.) 1	2	5
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1-2	4	4
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A6100	Advanced Data Analysis and Machine Learning	M.Sc. (Tech.) 2	1-2	6
BJ02A2010	Modeling of Unit Operations	M.Sc. (Tech.) 1	1-2	6

c) Numerical Methods, Optimization and Scientific Computing

List of elective courses		*year*	*per.*	*ECTS cr*
BM20A2701	Numerical Methods II	M.Sc. (Tech.) 1	3	3
BM20A2800	Nonlinear Optimization	M.Sc. (Tech.) 1-2	3	4
BM20A2901	Discrete Optimization	M.Sc. (Tech.) 1-2	4	5
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A4701	Modelling with Partial Differential Equations	M.Sc. (Tech.) 2	2	4
BM20A5100	Scientific Computing and Numerics for PDEs	M.Sc. (Tech.) 2	4	6
BM20A5600	Inverse Problems and Sparse Transforms	M.Sc. (Tech.) 1-2	2-3	6

d) Fuzzy Methods and Soft Computing

List of elective courses		*year*	*per.*	*ECTS cr*
BM20A3101	Fuzzy Sets and Fuzzy Logic	M.Sc. (Tech.) 1-2	1-2	6
BM20A3203	Fuzzy Engineering and Decision Making	M.Sc. (Tech.) 1-2	3-4	6
BM20A3602	Fuzzy Data Analysis	M.Sc. (Tech.) 1-2	3-4	6
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A4500	Evolutionary Computation	M.Sc. (Tech.) 1-2	2-3	5

e) Computational Materials Science

List of elective courses		*year*	*per.*	*ECTS cr*
BM20A2701	Numerical Methods II	M.Sc. (Tech.) 1	3	3
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A4500	Evolutionary Computation	M.Sc. (Tech.) 1-2	2-3	5
BM20A5100	Scientific Computing and Numerics for PDEs	M.Sc. (Tech.) 2	4	6
BM20A5400	Computational Modeling of Materials	M.Sc. (Tech.) 1	1-2	6

Minor Subject (a min. of. 20 ECTS cr)
The student can choose any minor subject taught at LUT if the required prerequisites are completed.

Major in Technical Physics 74 ECTS cr

Obligatory Studies (74 ECTS cr)		*year*	*per.*	*ECTS cr*
BM10A0000	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BM30A0500	Applied Optics	M.Sc. (Tech.) 1	2	6
BM30A0601	Optoelectronics	M.Sc. (Tech.) 1	1	6
BM30A1500	Advanced Topics in Material Science	M.Sc. (Tech.) 1-2	2	6
BM30A1600	Microelectronics	M.Sc. (Tech.) 1	1	6
BM30A1701	Physics of Semiconductor Devices	M.Sc. (Tech.) 1-2	1-2	6
BM30A2200	Semiconductor and Superconductor Physics	M.Sc. (Tech.) 1	1-2	6
BM30A2500	Nanophysics	M.Sc. (Tech.) 1-2	1-2	6
BL50A0600	Electromagnetic Compatibility in Power Electronics	M.Sc. (Tech.) 1	1	2

Major in Intelligent Computing 70 ECTS cr

Obligatory Studies (60 ECTS cr)		*year*	*per.*	*ECTS cr*
BM10A0000	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BM40A0600	Introduction to Computer Graphics	M.Sc. (Tech.) 1	2	5
BM40A0700	Pattern Recognition	M.Sc. (Tech.) 1	1-2	7
BM40A0800[1]	Machine Vision and Digital Image Analysis	M.Sc. (Tech.) 1-2	3-4	7
BM40A0900[1]	Computer Vision	M.Sc. (Tech.) 1-2	3-4	7
BM40A1000	Seminar on Intelligent Computing	M.Sc. (Tech.) 2	2-3	4
BM40A1200	Digital Imaging and Image Preprocessing	M.Sc. (Tech.) 1	1-2	7

1) Exchangeable

The student chooses a minimum of 10 ECTS cr to attain 70 ECTS cr of major subject studies

List of elective courses		*year*	*per.*	*ECTS cr*
BL40A1000	Real-time Operating Systems and Programs	M.Sc. (Tech.) 2	1-2	5
BL40A1100	Embedded System Programming	M.Sc. (Tech.) 1	1-2	4
BM10A0600	Research Methods, Laboratory Project	M.Sc. (Tech.) 1	1-4	1-5
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A2500	Linear Algebra and Normed Spaces	M.Sc. (Tech.) 1-2	1	3
BM20A2701	Numerical Methods II	M.Sc. (Tech.) 1	3	3
BM20A2800	Nonlinear Optimization	M.Sc. (Tech.) 1-2	3	4
BM20A2901	Discrete Optimization	M.Sc. (Tech.) 1-2	4	5
BM20A3001	Statistical Analysis in Modelling	M.Sc. (Tech.) 1	2	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	M.Sc. (Tech.) 1-2	1-2	6
BM20A3301	Stochastic Theory and Models	M.Sc. (Tech.) 1-2	4	3-5
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1-2	4	4
BM20A3602	Fuzzy Data Analysis	M.Sc. (Tech.) 1-2	3-4	6
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A4500	Evolutionary Computation	M.Sc. (Tech.) 1-2	2-3	5
BM20A5600	Inverse Problems and Sparse Transforms	M.Sc. (Tech.) 1-2	2-3	6
BM20A6100	Advanced Data Analysis and Machine Learning	M.Sc. (Tech.) 2	1-2	6
BM30A0500	Applied Optics	M.Sc. (Tech.) 1	2	6
BM30A0601	Optoelectronics	M.Sc. (Tech.) 1	1	6
BM40A0000	International Summer School in Novel Computing	M.Sc. (Tech.) 2	INT	1-3
BM40A0800	Machine Vision and Digital Image Analysis	M.Sc. (Tech.) 1-2	3-4	7
BM40A0900	Computer Vision	M.Sc. (Tech.) 1-2	3-4	7

Minor Subject (min. of 20 ECTS cr)
The student can choose any minor subject taught at LUT if the required prerequisites are completed.

Elective Studies (12-23 ECTS cr)
Elective studies can include any courses offered by LUT if the required prerequisites are completed. The students majoring in Intelligent Computing are recommended to choose elective studies from the selectable courses of the major subject. Studies in other universities may be included upon application.

Elective studies may include a maximum of 10 ECTS credits of internship improving expertise. More information: BM10A0100 Work Internship in Master´s Degree.

Degree Structure for Double Degree Students of Technical Physics

General Studies	5	ECTS cr
Major Subject	66	ECTS cr
Credit Transfer	50	ECTS cr
Total	*121 (min.)*	*ECTS cr*

General Studies

Obligatory Studies (5 ECTS cr)		*year*	*per.*	*ECTS cr*
BK10A0300	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1	1
FV10A4EC(*	Language Studies			4

*) 4 ECTS cr from the same language. Students are recommended to study FV11A9800 Academic Writing in English Course 1 2 ECTS cr and FV11A9900 Academic Writing in English Course 2 2 ECTS cr

Major in Technical Physics (for Double Degree Students) 66 ECTS cr

Obligatory Studies (66 ECTS cr)		*year*	*per.*	*ECTS cr*
BM10A0000	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BM30A0500	Applied Optics	M.Sc. (Tech.) 1	2	6
BM30A0601	Optoelectronics	M.Sc. (Tech.) 1	1	6
BM30A1500	Advanced Topics in Material Science	M.Sc. (Tech.) 1-2	2	6
BM30A1600	Microelectronics	M.Sc. (Tech.) 1	1	6
BM30A2200	Semiconductor and Superconductor Physics	M.Sc. (Tech.) 1	1-2	6
BM30A2500	Nanophysics	M.Sc. (Tech.) 1-2	1-2	6

Students are recommented to study at least one course of Finnish, FV18A9101 Finnish 1 2 ECTS cr.

Double degree students come from the LUT partner universities. The student takes his Master's degree from both partnering universities, and will be awarded the degree certificate of LUT and the diploma of the home university. The maximum credit transfer to be accepted to the LUT degree from the previous studies in the student's home university is 50 ECTS cr.

Degree Structure for Double Degree Students of Intelligent Computing

The programme is a master's degree programme specializing in computational science and intelligent computing. Students will study the first two semesters at their home university and the last two semesters at LUT. The maximum credit transfer to be accepted to the LUT degree from the previous studies in the student's home university is 50 ECTS cr.

The master thesis is allocated for the second year of the studies and it is supervised by the supervisors from the two universities. The successful completion of the programme after all the requirements have been fulfilled shall be resulted in the awarding the double degree: the Master's degree at LUT, Computational Engineering and Physics, and the degree from the home university.

Degree Structure		
General Studies	4	ECTS cr
Major Subject	66	ECTS cr
Credit Transfer	50	ECTS cr
Total	*120 (min.)*	*ECTS cr*

General Studies

Obligatory Studies (4 ECTS cr)		*year*	*per.*	*ECTS cr*
FV10A4EC[*]	Language Studies			4

[*)] 4 ECTS cr from the same language. Students are recommended to study FV11A9800 Academic Writing in English Course 1 2 ECTS cr and FV11A9900 Academic Writing in English Course 2 2 ECTS cr

Major in Intelligent Computing (for Double Degree Students) 66 ECTS cr

Obligatory Studies (60 ECTS cr)		*year*	*per.*	*ECTS cr*
BM10A0000	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30
BM40A0600	Introduction to Computer Graphics	M.Sc. (Tech.) 1	2	5
BM40A0700	Pattern Recognition	M.Sc. (Tech.) 1	1-2	7
BM40A0800[1]	Machine Vision and Digital Image Analysis	M.Sc. (Tech.) 1-2	3-4	7
BM40A0900[1]	Computer Vision	M.Sc. (Tech.) 1-2	3-4	7
BM40A1000	Seminar on Intelligent Computing	M.Sc. (Tech.) 2	2-3	4
BM40A1200	Digital Imaging and Image Preprocessing	M.Sc. (Tech.) 1	1-2	7

[1)] Exchangeable

Choose a minimun of 6 ECTS cr to attain 66 ECTS cr of major subject studies.

List of elective courses		*year*	*per.*	*ECTS cr*
BL40A1000	Real-time Operating Systems and Programs	M.Sc. (Tech.) 2	1-2	5
BL40A1601	Embedded System Design	M.Sc. (Tech.) 1	1-2	6
BM10A0500	Research Methods	M.Sc. (Tech.) 1	INT 43- per 2	3
BM10A0600	Research Methods, Laboratory Project	M.Sc. (Tech.) 1	1-4	1-5
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A2500	Linear Algebra and Normed Spaces	M.Sc. (Tech.) 1-2	1	3
BM20A2701	Numerical Methods II	M.Sc. (Tech.) 1	3	3
BM20A2800	Nonlinear Optimization	M.Sc. (Tech.) 1-2	3	4
BM20A2901	Discrete Optimization	M.Sc. (Tech.) 1-2	4	5
BM20A3001	Statistical Analysis in Modelling	M.Sc. (Tech.) 1	2	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	M.Sc. (Tech.) 1-2	1-2	6
BM20A3301	Stochastic Theory and Models	M.Sc. (Tech.) 1-2	4	3-5
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1-2	4	4
BM20A3602	Fuzzy Data Analysis	M.Sc. (Tech.) 1-2	3-4	6
BM20A3801	Advanced Mathematical Methods	M.Sc. (Tech.) 1	1-4	3-6
BM20A4500	Evolutionary Computation	M.Sc. (Tech.) 1-2	2-3	5
BM20A4701	Modelling with Partial Differential Equations	M.Sc. (Tech.) 2	2	4
BM20A5600	Inverse Problems and Sparse Transforms	M.Sc. (Tech.) 1-2	2-3	6
BM20A6100	Advanced Data Analysis and Machine Learning	M.Sc. (Tech.) 2	1-2	6
BM30A0500	Applied Optics	M.Sc. (Tech.) 1	2	6
BM30A0601	Optoelectronics	M.Sc. (Tech.) 1	1	6
BM40A0000	International Summer School in Novel Computing	M.Sc. (Tech.) 2	INT	1-3
BM40A0800	Machine Vision and Digital Image Analysis	M.Sc. (Tech.) 1-2	3-4	7
BM40A0900	Computer Vision	M.Sc. (Tech.) 1-2	3-4	7

Minor Subjects of Computational Engineering

Minor Subject in Technomathematics

Minor in Technomathematics can be studied by students of other Master’s degree programmes. However, suitable background knowledge is needed. This means basic knowledge about matrix calculation, optimization, statistics, numerical analysis and especially mathematical programming with some procedural language (preferably Matlab/Octave).

A minimum of 20 ECTS credits should be selected from the courses below:

Minor Studies min. 20 ECTS cr		*per.*	*ECTS cr*
BM20A1901	Statistics II	2	4
BM20A2000	Simulation	1	4
BM20A2500	Linear Algebra and Normed Spaces	1	3
BM20A2701	Numerical Methods II	3	3
BM20A2800	Nonlinear Optimization	3	4
BM20A2901	Discrete Optimization	4	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	1-2	6
BM20A3203	Fuzzy Engineering and Decision Making	3-4	6
BM20A3401	Design of Experiments	4	4
BM20A3602	Fuzzy Data Analysis	3-4	6
BM20A3801	Advanced Mathematical Methods	1-4	3-6
BM20A4500	Evolutionary Computation	2-3	5
BM20A5001	Principles of Technical Computing	1	4
BM20A5100	Scientific Computing and Numerics for PDEs	4	6
BM20A5400	Computational Modeling of Materials	1-2	6
BM20A5600	Inverse Problems and Sparse Transforms	2-3	6

Minor Subject in Technical Physics

Minor in Technical Physics can be studied by students of other Master's degree programmes.

Minimum 20 ECTS credits should be selected.

Minor Studies min. 20 ECTS cr		*per.*	*ECTS cr*
BM30A0500	Applied Optics	2	6
BM30A1500	Advanced Topics in Material Science	2	6
BM30A1600	Microelectronics	1	6
BM30A1701	Physics of Semiconductor Devices	1-2	6
BM30A2100	Microelectronics Processing Technology	1-2	2
BM30A2200	Semiconductor and Superconductor Physics	1-2	6
BM30A2500	Nanophysics	1-2	6

Minor Subject in Intelligent Computing

Obligatory Studies		*per.*	*ECTS cr*
BM40A0700	Pattern Recognition	1-2	7
BM40A1200	Digital Imaging and Image Preprocessing	1-2	7

Select enough courses to attain 20 ECTS cr together with obligatory courses. If some obligatory course is included in the degree somewhere else, select enough courses from the following studies to attain enough minor studies.

List of elective courses		*per.*	*ECTS cr*
BM20A1901	Statistics II	2	4
BM20A2500	Linear Algebra and Normed Spaces	1	3
BM20A2701	Numerical Methods II	3	3
BM20A2800	Nonlinear Optimization	3	4
BM20A3001	Statistical Analysis in Modelling	2	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	1-2	6
BM20A3203	Fuzzy Engineering and Decision Making	3-4	6
BM20A3401	Design of Experiments	4	4
BM20A3602	Fuzzy Data Analysis	3-4	6
BM20A3801	Advanced Mathematical Methods	1-4	3-6
BM20A4500	Evolutionary Computation	2-3	5
BM20A5001	Principles of Technical Computing	1	4
BM20A5600	Inverse Problems and Sparse Transforms	2-3	6
BM40A0600	Introduction to Computer Graphics	2	5
BM40A0800	Machine Vision and Digital Image Analysis	3-4	7
BM40A0900	Computer Vision	3-4	7

Course Descriptions in Computational Engineering and Physics

		ECTS cr
BM10A0000	Master's Thesis and Seminar	30
BM10A0100	Work Internship in Master's Degree	2 - 10
BM10A0500	Research Methods	3
BM10A0600	Research Methods, Laboratory Project	1 - 5
BM10A0800	Computational Science and Physics: Advanced Topics in Material Science	3
BM20A1901	Statistics II	4
BM20A2000	Simulation	4
BM20A2500	Linear Algebra and Normed Spaces	3
BM20A2701	Numerical Methods II	3
BM20A2800	Nonlinear Optimization	4
BM20A2901	Discrete Optimization	5
BM20A3001	Statistical Analysis in Modelling	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	6
BM20A3203	Fuzzy Engineering and Decision Making	6
BM20A3301	Stochastic Theory and Models	3 - 5
BM20A3401	Design of Experiments	4
BM20A3602	Fuzzy Data Analysis	6
BM20A3801	Advanced Mathematical Methods	3 - 6
BM20A4000	Case Study Seminar	5
BM20A4500	Evolutionary Computation	5
BM20A4701	Modelling with Partial Differential Equations	4
BM20A4800	Project Work in Applied Mathematics	10 - 30
BM20A5001	Principles of Technical Computing	4
BM20A5100	Scientific Computing and Numerics for PDEs	6
BM20A5200	Modeling Workshop and Summer School	3 - 6
BM20A5300	Special Course on Industrial Mathematics	2 - 5
BM20A5400	Computational Modeling of Materials	6
BM20A5600	Inverse Problems and Sparse Transforms	6
BM20A6000	Ecomathematics	5
BM30A0500	Applied Optics	6
BM30A0601	Optoelectronics	6
BM30A1500	Advanced Topics in Material Science	6
BM30A1600	Microelectronics	6
BM30A1701	Physics of Semiconductor Devices	6
BM30A2100	Microelectronics Processing Technology	2
BM30A2200	Semiconductor and Superconductor Physics	6
BM30A2300	Project Work in Technical Physics	10 - 30
BM30A2500	Nanophysics	6
BM40A0000	International Summer School in Novel Computing	1 - 3
BM40A0600	Introduction to Computer Graphics	5
BM40A0700	Pattern Recognition	7
BM40A0800	Machine Vision and Digital Image Analysis	7
BM40A0900	Computer Vision	7
BM40A1000	Seminar on Intelligent Computing	4
BM40A1200	Digital Imaging and Image Preprocessing	7
BM40A1300	Project Work in Intelligent Computing	10 - 30

BM10A0000	*MASTER'S THESIS AND SEMINAR*	*30 ECTS cr*
	Master's Thesis and Seminar, Diplomityö ja seminaari **In Master's degree programmes taught in English, the Master's thesis is always prepared in English.**	
Year and Period	M.Sc. (Tech.) 2 Period 1-4	
Teacher(s)	Professor responsible for the major subject Person in Charge: Professor, D.Sc. (Tech.) Lasse Lensu	
Aims	Student has general knowledge about a specific field of engineering and applied science in society and is able to apply scientific knowledge and methods in this area. The student is able to work independently, prepare a research plan and operate in a disciplined way.	
Content	The Master's thesis is the final project of the Master's degree, which demonstrates the student's knowledge of a topic of scientific or societal importance. The thesis is a research or planning project. A report is prepared following the instructions for the Master's thesis. The report contains description of the problem and the context, the used methods, describes the actual analysis and acts of implementation, gives the results and evaluates the outcome and conclusions.	
Modes of Study	The student works independently and keeps contact with the supervisor informing about the progress. The thesis work is presented in a seminar with other thesis students and their instructors. The student gives a brief presentation on the results of his/her project. The presentations are discussed and reviewed by asking questions. Research work 300 h, independent study 200 h, report preparation 200 h.	
Evaluation	0-5, Master's thesis 100%.	

BM10A0100	*WORK INTERNSHIP IN MASTER’S DEGREE*	*2 - 10 ECTS cr*
	Work Internship in Master’s Degree **Internship coordinator in mathematics Ph.D. Tuomo Kauranne, physics Ph.D. Kirsi Ikonen, intelligent computing D.Sc. (Tech.) Arto Kaarna. No course registration (replaced by submitting the application for approval of the internship coordinator).**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Internship coordinator in mathematics: Associate Professor, Ph.D. Tuomo Kauranne Internship coordinator in physics: University Lecturer, Ph.D. Kirsi Ikonen Internship coordinator in intelligent computing: Associate Professor, D.Sc. (Tech.) Arto Kaarna	
Aims	After the work environment internship, the student has obtained a basic knowledge of the work, work environment and working community in his/her own field. The student is able to apply and generalize knowledge and skills acquired during the course of studies to work in his/her own field.	
Content	The student obtains a (summer) job from the company, works as a paid employee, requests a certificate of employment and applies for the approval of the work as an internship for the Master’s degree. Full-time employment relationships of at least four weeks can be approved as internships. The completion of the Master’s thesis is not accepted as an internship. An employment relationship that took place before the studies can be approved as an internship providing that it has not been accepted and included in any other previous degree.	
Modes of Study	First 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to starting an employment relationship (e.g. orientation, the rules of the employment relationship and the work place) 15 h, observing (while working) how the	

	working community operates (e.g. how work/production is organized, supervision, the working manners of the working community/teams, the social environment of the work place) 22 h, a written internship report 5 h (2-3 pages), total 52 h. 3-10 ECTS credits: having different tasks in a company 26-208 h (1 ECTS credit/26 h). There is no compulsory internship in the degree programme, but a maximum of 10 ECTS credits of internship can be included in elective studies.
Evaluation	Pass/Fail, internship report 100%.

BM10A0500	***RESEARCH METHODS***	***3 ECTS cr***
	Research Methods, Tutkimusmenetelmät	
Year and Period	M.Sc. (Tech.) 1 INT 43-per 2	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Arto Kaarna	
Aims	Student is able to describe concepts and methods in research. Student knows what is required in scientific reporting and is able to evaluate the structure and contents of a scientific report. Student is able to prepare a research plan.	
Content	Categorization of science, scientific work. Philosophies behind research. Research process, designing research, research questions and hypothesis. Information retrieval, literature review. Qualitative and quantitative research methods, data collection. Reporting scientific work.	
Modes of Study	Lectures 12 h, exercises and assignments 8 h, intensive week 43. Practical assignment 35 h, 2nd period. Self-study 20 h, exam 3 h. Total 78 h. Moodle is used in this course.	
Evaluation	0-5, exam 60%, practical assignments 40%.	
Study materials	Creswell, J.W.: Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, SAGE, 2009. Hirsjärvi, S., Remes, P., Sajavaara, P.: Tutki ja kirjoita, 15.-16. painos, Tammi, 2010. Research reports.	
Prerequisites	B.Sc. studies finished.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BM10A0600	***RESEARCH METHODS, LABORATORY PROJECT***	***1 - 5 ECTS cr***
	Research Methods, Laboratory Project, Tutkimusmenetelmät, laboratorioprojekti	
Year and Period	M.Sc. (Tech.) 1 Period 1-4	
Teacher(s)	Technomathematics: Post-Doctoral Researcher, D.Sc. (Tech.) Virpi Junttila Technical Physics: Professor, Ph.D. Erkki Lähderanta Intelligent Computing: Associate Professor, D.Sc. (Tech.) Arto Kaarna	
Aims	Student is able to execute a well-defined research task in Technical Physics, Technomathematics, or Intelligent Computing.	
Content	Research work in the topic defined by the laboratory. When starting the course contact one of the professors according to your major subject: Technical Physics, Erkki Lähderanta; Technomathematics, Jouni Sampo; Intelligent Computing, Arto Kaarna. Reporting and a seminar presentation of the work implemented.	
Modes of Study	Participation in the work of the research group, 1st-4th period. Total 26-130 h.	
Evaluation	Passed/failed. Research report and seminar presentation.	
Study materials	Scientific articles related to the research topic, agreed with the supervisor of the project.	
Prerequisites	BM10A0500 Research Methods.	

BM10A0800	COMPUTATIONAL SCIENCE AND PHYSICS: ADVANCED TOPICS IN MATERIAL SCIENCE 3 ECTS cr
	Computational Science and Physics: Advanced Topics in Material Science **LUT Summer School intensive course 20.-24.7.2015.**
Year and Period	M.Sc. (Tech.) 2 INT The course is suitable also for doctoral studies.
Teacher(s)	Visiting lecturers Person in Charge: Professor, Ph.D. Erkki Lähderanta
Aims	The aim of the course is to introduce students to selected topics of advanced physics, especially in the area of nanophysics.
Content	Nanophysics, applied superconductivity, ferroelectrics, other advanced topics in material science connected to nanophysics.
Modes of Study	Lectures 18 h, homework 60 h (3 essays á 20 h). Total work load 78 h.
Evaluation	Pass/Fail. Written assignment 100%.
Study materials	To be given at lectures.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A1901	STATISTICS II 4 ECTS cr
	Statistics II, Tilastomatematiikka II **Replaces the course BM20A1900 Statistics II.**
Year and Period	M.Sc. (Tech.) 1-2 Period 2 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Matylda Jablonska-Sabuka
Aims	The student acquires understanding of basic and some advanced statistical methods, is able to formulate models and apply these methods to various areas in technology, economics and science. The student is able to perform two-sample tests, analysis of variance, analyze time series data, formulate decision problems using decision tree. The student understands multivariate distributions and is able to perform PCA analysis and factor analysis on multivariate data sets.
Content	Statistical inference: hypothesis testing, two sample tests. Nonparametric tests. Basics of analysis of variance, time series analysis and multiple regression models. Introduction to nonlinear regression. Elements of decision theory. Introduction to multivariate methods. Principal component analysis.
Modes of Study	Lectures 24 h, exercises 12 h, independent study and homework 20 h, project work 24 h, exam and preparation 20 h, 2nd period. Total 100 h.
Evaluation	0-5, examination 70%, home assignments 30%.
Study materials	Lectures published in Noppa.
Prerequisites	Recommended BM20A1401 Tilastomatematiikka I or equivalent knowledge.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BM20A2000	SIMULATION 4 ECTS cr
	Simulation, Simulointi
Year and Period	M.Sc. (Tech.) 1 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Virpi Junttila

Aims	The course gives an introduction to the concepts of discrete simulation models and methods together with numerical examples. After the course, the student is able numerically simulate basic queuing, server, scheduling and storage size problems.
Content	Basic concepts, discrete and continuous systems. Random numbers, discrete event generation by random numbers. Statistical and empirical distributions for event generation. Application examples: queuing systems, storage size optimization. Building numerical simulation examples with Matlab.
Modes of Study	Lectures 18 h, exercises 12 h, homework 18 h, practical assignment 34 h, preparation for examination and the examination 22 h, 1st period. Total 104 h.
Evaluation	0-5, examination 80%, homework 20%. Practical assignment.
Prerequisites	Recommended BM20A1401 Tilastomatematiikka I.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A2500	***LINEAR ALGEBRA AND NORMED SPACES 3 ECTS cr***
	Linear Algebra and Normed Spaces, Lineaarialgebra ja normiavaruudet
Year and Period	M.Sc. (Tech.) 1-2 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	University Lecturer, D.Sc. (Tech.) Jouni Sampo
Aims	The student knows the concepts of function spaces, norms, metric and convergence, linear operators, orthogonality, eigenvalues, singular values and decomposition. He/she is able to use these concepts in modeling and analysis of technical systems. Student understands essential principles in various methods of applied mathematics and is able to apply these methods in analysis of functions and signals in areas of differential equations, image analysis, numerical methods and optimization.
Content	Vector spaces and linear operators. Linear subspaces and projection. Norms, metric and convergence. Function spaces. Banach spaces, Lp-spaces. Inner product and orthogonality. Hilbert spaces. Theory of linear operators, eigenvalues and spectral decomposition. Introduction to wavelet analysis. Applications in systems and signal analysis, numerical methods, optimization.
Modes of Study	Lectures 24 h, exercises 12 h, independent study and homework 28 h, exam and preparation 10 h, 1st period. Total 74 h.
Evaluation	0-5, examination 100%.
Study materials	Will be distributed on Noppa/lectures. Suitable supporting literature: Lay, D.: Linear Algebra and its Applications, Addison-Wesley, 2000. Kreyszig, E.: Introductory Functional Analysis with Applications, Wiley, 1989. Reddy, B.D.: Introductory Functional Analysis, with applications to Boundary Value Problems and Finite Elements, Springer, 1998.
Prerequisites	Recommended BM20A1601 Matriisilaskenta.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A2701	***NUMERICAL METHODS II 3 ECTS cr***
	Numerical Methods II, Numeeriset menetelmät II
Year and Period	M.Sc. (Tech.) 1 Period 3
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Virpi Junttila Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Virpi Junttila
Aims	An introduction to numerical methods for differentiation, integration, interpolation and differential equations. Numerical methods for linear systems. After the course the student understands the basic concepts of numerical analysis, and is able to independently use numerical software (Matlab solvers).

Content	Numerical differentiation and integration. Interpolation methods in 1D and 2D. Numerical matrix calculations with applications. Over- and underdetermined linear systems, singular values of a matrix, principal components. Il-posed linear problems and regularized solutions.
Modes of Study	Lectures 18 h, exercises 12 h, homework 26 h, preparation for the examination 22 h, 3rd period. Total 78 h.
Evaluation	0-5, examination 100%.
Study materials	Will be announced at lectures.
Prerequisites	Preliminary online exercises. Recommended BM20A1501 Numeeriset menetelmät I.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A2800	*NONLINEAR OPTIMIZATION* *4 ECTS cr*
	Nonlinear Optimization, Epälineaarinen optimointi **The course will be lectured every other year, next during the academic year 2015 - 2016.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3 The course is suitable also for doctoral studies.
Teacher(s)	Lecturer, Lic.Phil. Sirkku Parviainen
Aims	After the course the student should - know how formulate and classify nonlinear optimization models - recognize optimum solutions using optimality criteria - be able to understand the principles of optimization algorithms and solve problems of line search, multivariate unconstrained and constrained optimization - know how to use optimization software.
Content	Formulation of optimization models. Classification of optimization problems. Optimality criteria in unconstrained and constrained optimization. Line search methods, unconstrained multivariate optimization methods. Methods for constrained optimization. Methods for global optimization. Principles of evolutionary algorithms. Optimization software tools, examples with Matlab.
Modes of Study	Lectures 28 h, exercises 14 h, homework 42 h, 3rd period. Study and exam 20 h. Total work load 104 h.
Evaluation	0-5, examination 100%. Exercises.
Study materials	Nocedal, J. and Wright, S. J.: Numerical Optimization, Springer, 2006.
Prerequisites	Experience in programming or using mathematical software required. BM20A1501 Numeeriset menetelmät I and BM20A4301 Johdatus tekniseen laskentaan or BM20A5001 Principles of Technical Computing.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BM20A2901	*DISCRETE OPTIMIZATION* *5 ECTS cr*
	Discrete Optimization, Diskreetti optimointi **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	M.Sc. (Tech.) 1-2 Period 4 The course is suitable also for doctoral studies.
Teacher(s)	Lecturer, Lic.Phil. Sirkku Parviainen
Aims	After the course the student should - understand the nature of discrete and combinatorial optimization problems - know the classes of computational complexity and be able to classify problems and algorithms according to their complexity

	- be able to solve various discrete optimization problems with exact methods and heuristics.
Content	Discrete optimization problems. Algorithms and computational complexity. Polynomial-time problems and NP-complete problems. Integer linear programming. Assignment problem. Traveling salesman problem: solution with branch&bound and heuristic methods. Routing and packing problems: solution with heuristics and dynamic programming. Principles of genetic algorithms and simulated annealing methods in discrete optimization.
Modes of Study	Lectures 28 h, exercises 26 h, homework 54 h, 4th period. Study and exam 22 h. Total work load 130 h.
Evaluation	0-5, examination 100%. Exercises.
Study materials	Will be announced at lectures.
Prerequisites	Experience in programming or using mathematical software required. BM20A4301 Johdatus tekniseen laskentaan or BM20A5001 Principles of Technical Computing Recommended BM20A1801 Lineaarinen optimointi.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BM20A3001	***STATISTICAL ANALYSIS IN MODELLING 5 ECTS cr***
	Statistical Analysis in Modelling, Mallien tilastollinen analyysi
Year and Period	M.Sc. (Tech.) 1 Period 2 The course is suitable also for doctoral studies.
Teacher(s)	N. N. Person in Charge: Professor, Ph.D. Heikki Haario
Aims	Introduction to modern computational methods of estimating reliability of modeling and simulation results. After the course, the student is able to estimate parameters of nonlinear models by measured data and to create posterior distributions for parameters and model predictions by MCMC (Markov chain Monte Carlo) methods.
Content	Introduction to the methods of estimating reliability of modelling. Errors and uncertainty in experimental data. Uncertainty in model parameters and prediction results. Bayesian approach for parameter estimation and inverse problems, various Monte Carlo (MCMC) methods for nonlinear models.
Modes of Study	Lectures 21 h, exercises 14 h, homework 35 h, practical assignment 38 h, preparation for examination and the examination 22 h, 2nd period. Total 130 h.
Evaluation	0-5, examination 100%.
Study materials	To be given at the lectures.
Prerequisites	First year university calculus, BM20A1401 Tilastomatematiikka I. Recommended BM20A2000 Simulation.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A3101	***FUZZY SETS AND FUZZY LOGIC 6 ECTS cr***
	Fuzzy Sets and Fuzzy Logic, Sumeat joukot ja sumea logiikka
Year and Period	M.Sc. (Tech.) 1-2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Pasi Luukka
Aims	In the end of the course student is expected to be able to - understand the basic mathematics of fuzzy systems. - understand relations between crisp and fuzzy sets. - understand basic operations on fuzzy sets. - understand fuzzy arithmetics - understand fuzzy relations. - understand basics on possibility theory.

	- understand basics on fuzzy logic. - understand basics from uncertainty based information.
Content	The course consists of concept of fuzziness, some algebras of fuzzy sets, fuzzy quantities, logical aspects of fuzzy sets, operations of fuzzy sets, fuzzy relations, universal approximation, fuzzy compositional calculus, aggregation operators, possibility theory, information uncertainty.
Modes of Study	Lectures 24 h, exercises 12 h, 1st period. Lectures 24 h, exercises 12 h, practical assignment 30 h, 2nd period. Preparation for exam and the exam 50 h. Altogether 152 h from which independent work 80 h.
Evaluation	0-5, examination 100%.
Study materials	Nguyen, H.T., Walker, E.A.: A First Course in Fuzzy Logic, 2nd Ed., Chapman & Hall/CRC, 2000. Klir, G., Yuan, B.:Fuzzy Sets and Fuzzy Logic. Theory and Applications, Prentice Hall, 1995. Fullér, R.: Introduction to Neuro-Fuzzy Systems, Physica-Verlag, 2000. Carlsson C. and Fullér, R.: Fuzzy Reasoning in Decision Making and Optimization, Physica-Verlag, 2002.
Prerequisites	Bachelor level basic math courses.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BM20A3203	***FUZZY ENGINEERING AND DECISION MAKING*** ***6 ECTS cr***
	Fuzzy Engineering and Decision Making, Sumea teknologia **Replaces the course BM20A3202 Fuzzy Engineering.** **The course will be lectured every other year, next during the academic year 2015 - 2016.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Pasi Luukka
Aims	In the end of the course student is expected to be able to - apply fuzzy systems in engineering environment. - apply function approximation methods with fuzzy systems - model and solve control problems. - apply fuzzy decision making methods.
Content	Fuzzy sets and relations, fuzzy functions and rule-based systems, mamdani fuzzy system and Sugeno-Tagaki fuzzy system, universal approximators, fuzzy modelling, fuzzy control, fuzzy controllers in applications. Fuzzy decision making methods.
Modes of Study	Lectures 24 h, exercises 12 h, 3rd period. Project work 100 h, 4th period. Preparation for exam and the exam 30 h. Overall 154 h.
Evaluation	0-5, examination 100%. Project work.
Study materials	Fullér, R.: Introduction to Neuro-Fuzzy Systems, Physica-Verlag, 2000. Kosko, B.: Fuzzy Engineering, Prentice-Hall, 1996. Passino, K.M., Yurkovich, S.: Fuzzy Control, Addison-Wesley, 1998.
Prerequisites	Recommended BM20A3101 Fuzzy Sets and Fuzzy Logic.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BM20A3301	***STOCHASTIC THEORY AND MODELS*** ***3 - 5 ECTS cr***
	Stochastic Theory and Models, Stokastiikan teoriaa ja malleja
Year and Period	M.Sc. (Tech.) 1-2 Period 4 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Matylda Jablonska-Sabuka
Aims	Student knows the theory of stochastic models and advanced statistical methods and is able to apply them in analyzing and understanding systems and phenomena containing randomness and uncertainty. Student is able to formulate and analyse reliability models, Markov chain and poisson processes, birth/death models, ARMA models for time series. The student knows the principles of estimation parameters of stochastic models and nonlinear regression. The student learns basics of stochastic calculus and stochastic differential equations.
Content	Theory of stochastics applicable to modelling and analysing systems where randomness is inherent in a non-trivial way. Stochastic processes, conditional expectations and martingales. Brownian motion, introduction to Ito-integral and stochastic differential equations. Time series and ARMA-models. Regression and linear statistical models. Analysis and identification of nonlinear statistical models. Bayesian methods.
Modes of Study	Supervised self-study course. Lectures 10 h, exercises 10 h, project assignment 20-40 h, self-study material 20-50 h, exam and preparation 14 h, 4th period. Total 74-124 h.
Evaluation	0-5, examination 50%, project assignment 50%.
Study materials	Will be announced at lectures.
Prerequisites	BM20A1401 Tilastomatematiikka I. Recommended BM20A1901 Statistics II, BM20A2500 Linear Algebra and Normed Spaces.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A3401	***DESIGN OF EXPERIMENTS*** ***4 ECTS cr***
	Design of Experiments, Koesuunnittelu **The course is organized jointly with the Department of Mathematics and Physics and with the Department of Chemical Technology. It covers the design of experiment modules of the courses BJ70A0701 Teollisuus- ja ympäristöanalytiikka I and BJ70AJ110 Design of Experiments and Sampling (postgraduate course).**
Year and Period	M.Sc. (Tech.) 1-2 Period 4 The course is suitable also for doctoral studies.
Teacher(s)	N. N. Associate Professor, Docent, D.Sc. (Tech.) Satu-Pia Reinikainen Person in Charge: Professor, Ph.D. Heikki Haario
Aims	After the course, the student is expected to master the basic skills for effective experimentation, together with regression analysis of data: - understanding of the importance of designed experiments - ability to apply the basic experimental plans, and regression techniques to analyse the results - skills to optimize an engineering process using design of experiments and data analysis.
Content	Importance of experimental design, minimization of prediction uncertainty of regression models. Basic factorial designs: 2N, Central Composite designs for regression analysis. The Taguchi principles. Experimental optimisation of engineering processes.

Modes of Study	Lectures 21 h, exercises 14 h, homework 21 h, experimental work in laboratory 26 h, preparation for examination and the examination 22 h, 4th period. Total 104 h.
Evaluation	0-5, examination 70%, project work 30%.
Study materials	Box, G., Hunter, S., Hunter, W. G.: Statistics for Experimenters, Wiley 2005, 2nd Edition.
Prerequisites	First year university calculus, BM20A1401 Tilastomatematiikka I/basic statistics. Basic (Matlab) skills for technical computing with PC.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A3602	***FUZZY DATA ANALYSIS***	***6 ECTS cr***
	Fuzzy Data Analysis, Data-analyysiä sumeassa ympäristössä **The course will be lectured every other year, next during the academic year 2016 - 2017.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Pasi Luukka	
Aims	In the end of the course student is expected to be able to - understand theoretical aspects of data analysis. - understand the principles of multicriteria decision making and is capable of applying them. - model and analyze uncertainty in different problem settings. - apply fuzzy principal component analysis, fuzzy clustering and classification methods to data analysis problems. - apply fuzzy regression analysis.	
Content	Fuzzy sets and relations. Uncertainty measures. Qualitative and quantitative analysis of fuzzy data. Introduction to possibility theory and generalized measure theory. Principles of individual multiperson, multicriteria and multidecision making, fuzzy interpolation, fuzzy principle component analysis, fuzzy clustering and classification, fuzzy regression analysis. Evaluation of methods.	
Modes of Study	Lectures 24 h, exercises 24 h, 3rd period. Project work 80 h, 4th period. Preparation for exam and the exam 30 h. Overall 158 h.	
Evaluation	0-5, examination 100%. Project work.	
Study materials	Bandemer, H., Näther, W.: Fuzzy Data Analysis, Kluwer Academic Publ., 1992.	
Prerequisites	Recommended BM20A3101 Fuzzy Sets and Fuzzy Logic.	
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.	

BM20A3801	***ADVANCED MATHEMATICAL METHODS***	***3 - 6 ECTS cr***
	Advanced Mathematical Methods, Matemaattisten menetelmien erikoiskurssi	
Year and Period	M.Sc. (Tech.) 1 Period 1-4 The course is suitable also for doctoral studies.	
Teacher(s)	N.N. Person in Charge: University Lecturer, D.Sc. (Tech.) Jouni Sampo	
Aims	The student will obtain theoretical and operational skills in some specific area of applied mathematics. He understands the methods and knows how to apply the methods to modeling problems in science and engineering.	
Content	The course will demand reading literature, working on exercises and practical projects. Material will be individually chosen according to the focus of the	

	study module, students' interests and research task. The topic may be for example optimization, numerical methods, PDE:s, stochastics, theory of algorithms, wavelets, filtering, systems analysis, mathematics of finance etc. The course with the same title can be included in the study programme twice when two distinct areas are covered.
Modes of Study	Self-study of learning material 40-60 h, exercises 20-40 h, project assignment and report writing 20-40 h, 1st-4th period. Total 80-140 h.
Evaluation	0-5, report 100%.
Prerequisites	Recommended BM20A1501 Numeeriset menetelmät I, BM20A1601 Matriisilaskenta.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A4000	***CASE STUDY SEMINAR*** ***5 ECTS cr***
	Case Study Seminar, Sovelletun matematiikan erikoistyöt
Year and Period	M.Sc. (Tech.) 1 Period 1-4 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, Ph.D. Tuomo Kauranne
Aims	The course gives an introduction to independent scientific work by presenting seminar works from different fields of applied mathematics. After the course, the student is able to prepare and give scientific presentations.
Content	The course works in a seminar form. Each student receives a project work topic and presents the problem as well as the work plan in the beginning. For example, the topics cover modelling problems from different engineering fields, together with numerical solutions. Solution methods for the project work problems are discussed during the course. At conclusion, the participants present their project works. The project work typically is an introduction to the diploma work topic of the student.
Modes of Study	Lectures 42 h, exercises 14 h, homework 38 h, preparation of the presentation 36 h, 1st-4th period. Total 130 h.
Evaluation	Pass/fail. To pass the course student must attend 7 weeks and present his/her project work.
Prerequisites	First year university calculus. Recommended BM20A1501 Numeeriset menetelmät I, BM20A1601 Matriisilaskenta, BM20A3900 Modelling Methodology in Process Engineering.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A4500	***EVOLUTIONARY COMPUTATION*** ***5 ECTS cr***
	Evolutionary Computation, Evoluutiolaskenta **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	M.Sc. (Tech.) 1-2 Period 2-3 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Saku Kukkonen
Aims	Upon completion of the course the student will: 1. Understand what evolutionary computation is and what its possibilities/limitations are. 2. Know major types of evolutionary algorithms. 3. Be able to apply evolutionary computation in order to solve practical problems.
Content	Introduction to evolutionary computation and its applications. Structure, components, and characteristics of evolutionary algorithms. Evolutionary problem solving, searching, and optimization. Different evolutionary algorithms, practical problem solving, and multiobjective optimization using evolutionary algorithms.

Modes of Study	Lectures 24 h, exercises 12 h, project work 54 h and seminars 10 h, preparation for the exercises and exam 30 h, 2nd-3rd period. Total 130 h.
Evaluation	0-5, examination 100%. Project work.
Study materials	Eiben, A. E., Smith, J. E.: Introduction to Evolutionary Computing, Springer-Verlag, 2003. Haupt, R. L., Haupt, S. E.: Practical Genetic Algorithms, Wiley, 1998. Other material given at lectures.
Prerequisites	Good programming skill using some programming language is needed. The following courses might be helpful: CT60A0200 Ohjelmoinnin perusteet, CT60A0210 Käytännön ohjelmointi and BM40A0300 Tietorakenteet ja algoritmit.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BM20A4701	*MODELLING WITH PARTIAL DIFFERENTIAL EQUATIONS* 4 ECTS cr
	Modelling with Partial Differential Equations, Osittaisdifferentiaaliyhtälöt matemaattisessa mallinnuksessa **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	M.Sc. (Tech.) 2 Period 2 The course is suitable also for doctoral studies.
Teacher(s)	N.N. Person in Charge: Associate Professor, Ph.D. Tuomo Kauranne
Aims	The student is able to formulate PDE-models, knows fundaments of theory, basic model types and most common numerical schemes, and is able to perform numerical solution using mathematical software tools. The student familiar with a number of application areas. He/she is able to analyze PDE models in multiphysical phenomena, examples are acoustics, solidification and free-boundary computations, crystal growth and impedance tomography.
Content	Introduction to PDE:s, basics of finite element method, multiphysics and modeling, examples of applications in acoustics, solidification and free-boundary computation, crystal growth, parameter estimation in impedance tomography.
Modes of Study	Supervised self study course: supervision 4 h, exercises 12 h, self study 55 h, project assignment 30 h, exam and preparation 10 h, 2nd period. Total 111 h. The course is available in Finnish language as web-course http://hlab.ee.tut.fi/mallinnus/kurssit.
Evaluation	0-5, exam 40%, project assignment 60%.
Study materials	Haberman, R.: Elementary Applied Partial Differential Equations with Fourier Series and Boundary Value Problems, Prentice Hall 1983. O'Neil, P.: Beginning Partial Differential Equations, John Wiley 1999. Kevorkian, J.: Partial Differential Equations. Analytical solution techniques, Chapman & Hall 1996. Tveito, A., Winther, R.: Introduction to Partial Differential Equations: A Computational Approach (edited by J.E. Marsden, L. Sirovich, M. Golubitsky, W. Jäger), Springer 2005.
Prerequisites	BM20A5500 Differentiaaliyhtälöt ja dynaamiset systeemit Recommended BM20A5700 Integraalimuunnokset.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A4800	***PROJECT WORK IN APPLIED MATHEMATICS 10 - 30 ECTS cr***
	Project Work in Applied Mathematics, Soveltavan matematiikan projektityö
Year and Period	M.Sc. (Tech.) 1-2
Teacher(s)	N. N. Person in Charge: Associate Professor, Ph.D. Tuomo Kauranne
Aims	The student obtains practical skills on research methods and practices and obtains advanced knowledge in a specific application area. The student gains experience in project work, team work skills, self-management and work discipline.
Content	A specific project which is done in one of the research groups of applied mathematics. The project is planned together with the supervisor(s) and consists of computational research work, model building, literature surveys and report writing. The course may contain lectures and seminars. The project may also be planned together with industry and partly carried out in the environment of the company.
Modes of Study	Research work 100-300 h, independent study 100 h, report preparation 100-200 h.
Evaluation	0-5 or pass/fail, depending on the work performance and project report.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A5001	***PRINCIPLES OF TECHNICAL COMPUTING 4 ECTS cr***
	Principles of Technical Computing, Teknisen laskennan ja julkaisemisen perusteet
Year and Period	B.Sc. (Tech.) 2, M.Sc. (Tech.) 1 Period 1
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Matylda Jablonska-Sabuka
Aims	Students get a good understanding of Matlab syntax and programming, gain fluency in principles of technical computing and are able to apply the skills to basic mathematical and engineering problems (the skills are applicable in big part to Octave and R programming, too).
Content	Working with various data structures (multidimensional arrays, cell arrays, etc.), Matlab symbolic functionality, using built-in functions, handling external data, plotting, writing user-defined functions.
Modes of Study	Lectures 12 h, computer class exercises 24 h, independent study 30 h, preparation for exam 34 h, 1st period. Total 100 h.
Evaluation	0-5, examination 100%.
Study materials	Gilat, A.: An Introduction to Matlab with Applications. Lectures published in Noppa.
Prerequisites	Basic University Calculus required. Recommended first year university calculus.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BM20A5100	***SCIENTIFIC COMPUTING AND NUMERICS FOR PDES 6 ECTS cr***
	Scientific Computing and Numerics for PDEs, Tieteellinen laskenta ja ODY-numeriikka **The course will be lectured every other year, next during the academic year 2015 - 2016.**
Year and Period	M.Sc. (Tech.) 2 Period 4

	The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, Ph.D. Joonas Sorvari
Aims	The student knows basic equations of mass and heat flow and is able of use physical principles and conservation laws to model multiphysical systems and behaviour of materials. The student is able to implement advanced numerical algorithms for the solutions and work with professional software tools.
Content	The course is connected to the projects in CEID institute and presents the methods of scientific computing and software tools used in CEID-projects.
Modes of Study	Lectures 14 h, exercises 28 h, self-study 40 h, project assignment 40 h, exam and preparation 10 h, 4th period. Total 132 h.
Evaluation	0-5, project work 50%, exam 50%.
Prerequisites	BM20A2701 Numerical Methods II BM20A5500 Differentiaaliyhtälöt ja dynaamiset systeemit Recommended BM20A4100 Vektorianalyysi teknillisessä laskennassa.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A5200	***MODELING WORKSHOP AND SUMMER SCHOOL***	***3 - 6 ECTS cr***
	Modeling Workshop and Summer School, Matemaattisen mallinnuksen työpaja ja kesäkoulu **Will be organized during summer months in different European universities. LUT can send 1-3 participants based on academic merits. See http://www.ecmi-indmath.org/. Participation in another equivalent summer school will be accepted.**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	N. N. Person in Charge: Associate Professor, Ph.D. Tuomo Kauranne	
Aims	Student will obtain skills in formulating mathematical models of problems coming for industrial R&D, analyse the model, derive numerical solutions and report the results. Student will obtain skills in group work and communication.	
Content	The course consists of 6-10 problems from industry or various applied fields. Students are expected to analyze the problem, formulate mathematical models, evaluate and select appropriate theoretical and numeric methods and derive solutions. Lectures presenting the problems and required methods will be delivered.	
Modes of Study	Lectures 15 h, project work and research 40-90 h, studying literature and report writing 20-40 h. Seminar presentation and its preparation 20 h. Total 70-165 h.	
Evaluation	Pass/Fail.	
Study materials	Problem specific literature will be given during the workshop.	
Prerequisites	Recommended background: BSc degree or equivalent in applied mathematics or engineering. One year of master’s level studies (minimum 40 ECTS cr) in mathematics, physics and IT. Attendance on Case Study Seminar.	

BM20A5300	***SPECIAL COURSE ON INDUSTRIAL MATHEMATICS***	***2 - 5 ECTS cr***
	Special Course on Industrial Mathematics, Teollisuusmatematiikan vaihtuva-alainen erikoiskurssi **Intensive lecture course by visiting professor. Will be announced when a visit is confirmed.**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Visiting professor	

	Person in Charge: Docent, Ph.D. Matti Heiliö
Aims	Intensive lecture course is based on special expertise of visiting professors and extends the area of expertise covered by LUT staff. Students will achieve knowledge on the theory, methods and applications. Students achieve recent knowledge and skills on mathematical technology.
Content	The content depends on the speciality of the visitor. Possible themes include stochastic differential equations, tensor calculus, mathematical physics, CFD-methods, mathematical epidemiology, finance, Bayesian methods, inverse problems, signals and wavelet theory.
Modes of Study	Lectures 10-28 h, exercises 7-21 h, project work 0-20 h, exam and preparation 20 h. Total 37-89 h.
Evaluation	0-5, exam 60%, exercises/project work 40%.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A5400	***COMPUTATIONAL MODELING OF MATERIALS*** ***6 ECTS cr***
	Computational Modeling of Materials, Materiaalien laskennallinen mallinnus **The course is lectured for the first time during the academic year 2015-2016.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Postdoctoral Researcher, Ph.D. Katariina Pussi
Aims	The student knows the basic principles of computational modeling of materials and can write simple modeling programs.
Content	Core material: molecular dynamics, Monte Carlo, ab initio methods. Additional material: multiscale modeling, tight binding methods, theory of LEED.
Modes of Study	Lectures 24 h, exercises 20 h, practical assignments 60 h, exam and preparation for the exam 50 h, 1st-2nd period. Total 154 h.
Evaluation	0-5, exam 100%.
Study materials	Lecture notes.
Prerequisites	Basic physics and mathematics courses, basic programming skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

BM20A5600	***INVERSE PROBLEMS AND SPARSE TRANSFORMS*** ***6 ECTS cr***
	Inverse Problems and Sparse Transforms, Käänteisongelmat ja harvoihin muunnokset
Year and Period	M.Sc. (Tech.) 1-2 Period 2-3 The course is suitable also for doctoral studies.
Teacher(s)	University Lecturer, D.Sc. (Tech.) Jouni Sampo
Aims	Student understands and is able to use classical methods for solving inverse problem of estimation of signal from incomplete or corrupted measurements. Student understands concept of sparse transforms and is able to apply those for signal analysis, estimation, recovery and compression.
Content	Formulation of inverse problems with additive noise. Ill-posedness and inverse crimes. Truncated singular value decomposition, Tikhonov and total variation regularization. Concept of sparse transforms. Fourier-, wavelet and curvelet transforms. Compressed sensing. Applications to signal enhancement, de-noising, de-convolution, compression and analysis.
Modes of Study	Lectures 24 h, exercises 12 h, homeworks 24 h, 2nd period.

	Lectures 24 h, exercises 12 h, homeworks 24 h, 3rd period. Exam and preparation for exam 27 h. Total 147 h.
Evaluation	0-5, examination 50%, exercises and homeworks 50%.
Study materials	Material will be distributed on lectures/Noppa.
Prerequisites	Basic Matlab skills are required. Recommended: BM20A2500 Linear Algebra and Normed Spaces
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM20A6000	***ECOMATHEMATICS*** ***5 ECTS cr***
	Ecomathematics, Ekomatematiikka
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Virpi Junttila
Aims	The course gives introduction to concepts and mathematical methods used in current environmental modeling tasks such as forest inventory needed for carbon monitoring in REDD+, waste water treatment, bio-economics and mathematical epidemiology. After the course, student is able to explore new areas of environmental modeling tasks and build needed mathematical models independently.
Content	Introduction to concepts of 4-5 current environmental modeling cases and mathematical tools used. This course is related to sustainability. The course is related to sustainability.
Modes of Study	Lectures 24 h, exercises 24 h, homework 24 h, practical assignments 50 h, 3rd-4th period. Total 122 h.
Evaluation	0-5, practical assignments 100%.
Study materials	Will be announced at lectures.
Prerequisites	Recommended: BM20A1901 Statistics II and BM20A3900 Modelling Methodology in Process Engineering. Basic (Matlab) skills for technical computing with OC.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM30A0500	***APPLIED OPTICS*** ***6 ECTS cr***
	Applied Optics, Sovellettu optiikka
Year and Period	M.Sc. (Tech.) 1 Period 2
Teacher(s)	Docent, Ph.D. Erik Vartiainen
Aims	After the course a student 1. knows the basic properties of waves and wave motion; 2. understands the material polarization phenomenon as the ultimate source of light; 3. knows the basic properties and physics of laser action; 4. knows the ideas and applications of ultrafast optics; 5. knows the basic physics and applications of nonlinear optics; 6. knows the Fresnel-equations, and understand accordingly the physics of light reflection and refraction; 7. knows the basics of light polarization, the corresponding applications and the Jones matrix formulation; 8. understands the meaning of spatial and temporal coherence of light, and their implications for the technical applications, such as FTIR spectroscopy; 9. knows the ABCD-matrix formulation for geometrical optics; 10. knows the basics of laser imaging: one- and two-photon confocal microscopy, spectral imaging, and fluorescence nanoscopy; 11. understands the physics of producing slow and fast light, and knows their applications;

	12. understands diffraction of light, and its applications.
Content	1. Wave motion and wave equations; 2. Maxwell equations and electromagnetic spectrum; 3. Lasers; 4. Ultrafast lasers; 5. Fresnell equations; 6. Polarization and optical activity; 7. Geometrical optics; 8. Coherence; 9. Interference and diffraction; 10. Nonlinear optics; 11. Optical microscopy and nanoscopy; 12. Slow and fast light; THz-optics; 13. Attosecond optics; 14. Coherent control.
Modes of Study	Lectures 36 h, exercises 12 h, homework 78 h, preparation for the exam 26 h and the exam 4 h, 2nd period. Total 156 h.
Evaluation	0-5, examination 100%.
Study materials	1. Eugene Hecht, Optics, 4th edition (Addison-Wesley, 2002). 2. G. R. Fowles, Introduction to Modern Optics, 2nd edition, (Holt, Rinehart and Winston, New York, 1976). 3. R. W. Boyd, Nonlinear Optics (Academic Press, San Diego, 1992). 4. Y. R. Shen, The Princples of Nonlinear Optics (Wiley, New York, 1984).
Prerequisites	Students are recommended to have completed Physics or Physics L.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

BM30A0601	***OPTOELECTRONICS*** ***6 ECTS cr***
	Optoelectronics, Optoelektroniikka
Year and Period	M.Sc. (Tech.) 1 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D. Tuure Tuuva
Aims	To understand the basics of optical data communication. Construction of wave guides using total internal reflection and working principals of light emitting diodes and photodetectors.
Content	Optical waveguides, light emitting devices and photodetectors.
Modes of Study	Lectures 35 h, exercises 14 h, preparation for exam 107 h, 1st period. Examination.
Evaluation	0-5, examination 100%.
Study materials	Kasap, S. O.: Optoelectronics and Photonics P. Silfsten & E. Vartiainen: Optoelektroniikka,
Prerequisites	Physics or Physics L.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM30A1500	***ADVANCED TOPICS IN MATERIAL SCIENCE*** ***6 ECTS cr***
	Advanced Topics in Material Science, Moderni materiaalitiede
Year and Period	M.Sc. (Tech.) 1-2 Period 2 The course is suitable also for doctoral studies.
Teacher(s)	Visiting lecturers Person in Charge: Professor, Ph.D. Erkki Lähderanta
Aims	The aim of the course is to introduce students to selected topics of advanced physics, especially in the area of nanophysics.
Content	Nanophysics, applied superconductivity, ferroelectrics, other advanced topics in material science connected to nanophysics.
Modes of Study	Lectures 30 h, homework 126 h (5 essays á 25 h 12 min), 2nd period. Total work load 156 h.
Evaluation	Pass/Fail. Written assignment 100%.
Study materials	To be given at lectures.
Prerequisites	BM30A2200 Semiconductor and Superconductor Physics
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM30A1600	***MICROELECTRONICS*** ***6 ECTS cr***
	Microelectronics, Mikroelektroniikka
Year and Period	M.Sc. (Tech.) 1 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, Ph.D. Tuure Tuuva
Aims	To acquaint students with integrated circuit technology and provide them with skills for analog IC design. The students will learn the most important variables and functions related to the components of integrated circuits. Components will be modelled with simulation programs. The assignment of IC design will be carried out with a suitable design program.
Content	Semiconductor physics for the analysis of the operation of components. The geometry and design rules of IC components. PN junctions, MOS, BJT, and passive components in IC.
Modes of Study	Lectures 24 h, tutorials 24 h, preparation for exam 46 h, assignment 54 h, 1st period. Assignment and its presentation. Written examination.
Evaluation	0-5, examination 100%. Satisfactorily completed assignment required.
Study materials	Roger T. Howe, Charles G. Sodini: Microelectronics An Integrated Approach.
Prerequisites	Recommended BL40A1711 Johdanto digitaalielektroniikkaan and BL50A1400 Analogiaelektroniikka.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM30A1701	***PHYSICS OF SEMICONDUCTOR DEVICES*** ***6 ECTS cr***
	Physics of Semiconductor Devices, Puolijohdekomponenttien fysiikka
Year and Period	M.Sc. (Tech.) 1-2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, Ph.D. Tuure Tuuva
Aims	To provide the student with an in-depth knowledge of semiconductor diode, CCD, MOSFET, LED and photodiode and their operation.
Content	Structure, operation and physics of semiconductor devices.
Modes of Study	Special assignment 128 h, seminars 24 h, 1st-2nd period.
Evaluation	Pass/fail, special assignment 100%.
Study materials	Sze, Physics of Semiconductor Devices.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM30A2100	***MICROELECTRONICS PROCESSING TECHNOLOGY*** ***2 ECTS cr***
	Microelectronics Processing Technology, Mikropiirien valmistustekniikka
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, Ph.D. Tuure Tuuva
Aims	To provide the student with a basic knowledge of microelectronics processing technology and components. Oxidation, diffusion and metallization.
Content	Purification of semiconductor materials. Growth of semiconductor crystals and wafer preparation. Epitaxial layers, diffusion, ion implantation, oxidation, etching and photolithography. Semiconductor manufacturing and development.
Modes of Study	Special assignment 52 h.
Evaluation	0-5, seminar and/or written assignment 100%.
Study materials	Plummer, J. D., Deal, M. D., Griffin, P. B., Silicon VLSI Technology: Fundamentals, Practice and Modeling.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM30A2200	***SEMICONDUCTOR AND SUPERCONDUCTOR PHYSICS***	***6 ECTS cr***
	Semiconductor and Superconductor Physics, Puolijohde- ja suprajohdefysiikka	
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.	
Teacher(s)	Professor, Ph.D. Erkki Lähderanta	
Aims	The course gives the student the skills to understand the basic behaviour of semiconductors and superconductors.	
Content	Classical conductor, free-electron model of metals, energy bands, doped semiconductors, spintronics, basic properties of superconductivity, London equations, thermodynamics of the superconducting transition, the intermediate state, coherence length, current in superconductor, thin films, BCS-theory, type-II superconductors.	
Modes of Study	Lectures 42 h, exercises 28 h, preparing for exercises 56 h, preparing for the exam 30 h, 1st-2nd period. Total work load 156 h.	
Evaluation	0-5, examination 100%.	
Study materials	Juha Sinkkonen: Puolijohdeteknologian perusteet. A. C. Rose-Innes and E. H. Rhoderick: Introduction to Superconductivity, 2nd edition (Pergamon).	
Prerequisites	A knowledge of the fundamentals of material physics, a knowledge of the electric and physical properties of materials.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BM30A2300	***PROJECT WORK IN TECHNICAL PHYSICS***	***10 - 30 ECTS cr***
	Project Work in Technical Physics, Teknillisen fysiikan projektityö **The course is mainly intended for foreign visiting students.**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	N. N. Person in Charge: Professor, Ph.D. Erkki Lähderanta Professor, Ph.D. Tuure Tuuva Docent, Ph.D. Erik Vartiainen	
Aims	The student obtains practical skills and advanced knowledge in a specific application area. The student gains experience in experiments, project work, team work skills, self management and work discipline.	
Content	A specific research work or experiment or project which is done in one of the research groups of technical physics. The experiment is planned together with the supervisor(s) and consists of either experimental work or computational research work with modelling. Additionally is included literature surveys and report writing. The course may contain lectures and seminars. The project may also be planned together with industry and partly carried out in the environment of the company.	
Modes of Study	The amount of work hours in the project will determine the amount of credits, e.g. three months of work would give 15 ECTS cr. Credits will be granted when the final report is delivered. Extra credits can be received if specific examinations are made.	
Evaluation	0-5 or pass/fail, depending on the work performance and project report.	
Study materials	Literature related to the project.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BM30A2500	NANOPHYSICS	6 ECTS cr
	Nanophysics, Nanofysiikka	
Year and Period	M.Sc. (Tech.) 1-2 Period 1-2 The course is suitable also for doctoral studies.	
Teacher(s)	Ph.D. Tatiana Makarova Person in Charge: Professor, Ph.D. Erkki Lähderanta	
Aims	The objective of the course is to make information about the rapidly evolving areas of nanoscale science and technology available to a wide range of students.	
Content	Introduction, Forces in the Nanoworld, Scalling Laws, Nanochemistry, Nanoelectronics, Nanofluidics, Nanomagnetism, Nanomaterials, Nanomechanics, Nano-optics of Metals, Nano-optics of Semiconductors, Nanothermodynamics, Nanocarbon, Nanoethics.	
Modes of Study	Lectures 36 h, exercises 24 h, preparing for exercises 56 h, preparing for the examination 40 h, 1st-2nd period.	
Evaluation	0–5, exercises 10%, examination 90%.	
Prerequisites	Knowledgement about basic solid-state physics.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BM40A0000	INTERNATIONAL SUMMER SCHOOL IN NOVEL COMPUTING	1 - 3 ECTS cr
	International Summer School in Novel Computing, Tietokonelaskennan kansainvälinen kesäkoulu	
Year and Period	M.Sc. (Tech.) 2 INT The course is suitable also for doctoral studies.	
Teacher(s)	N. N. Person in Charge: Associate Professor, D.Sc. (Tech.) Arto Kaarna	
Aims	A student understands the scientific basics, current research activities and application areas of one of the selected topics of the summer school, and can further apply this knowledge in his/her research work. A student knows the practices of an international summer school.	
Content	Content changes annually. Lectures will be given by visiting international lecturers.	
Modes of Study	Lectures and/or exercises and/or practical assignments. A student must register to the course directly via the web page of the summer school. Total amount 26-78 h. Moodle is used in this course.	
Evaluation	Passed/failed. Participation and practical assignments.	
Study materials	Study materials will be announced just before or during the course.	

BM40A0600	INTRODUCTION TO COMPUTER GRAPHICS	5 ECTS cr
	Introduction to Computer Graphics, Tietokonegrafiikan perusteet	
Year and Period	M.Sc. (Tech.) 1 Period 2	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Arto Kaarna	
Aims	Student knows the basic algorithms and methods in 2D/3D computer graphics. Student can apply both a graphics library and a software package in composing and rendering 3D scenes.	
Content	Examples and applications of computer graphics. Introduction to two-dimensional graphics. Principals of graphics hardware. Raster graphics. Introduction to modeling of three-dimensional objects. Algorithms in three-dimensional graphics. Rendering pipeline. OpenGL graphics library. Programmable shaders.	

Modes of Study	Lectures 18 h, exercises 18 h, assignments 55 h, 2nd period. Independent study 36 h, exam 3 h. Total 130 h. Moodle is used in this course.
Evaluation	0-5, exam 70%, assignments 30%.
Study materials	John F. Hughes, Andries van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner, Kurt Akeley: Computer Graphics: Principles and Practice, 3rd Edition, 2013. Donald Hearn , M. Pauline Baker, Warren R. Carithers: Computer Graphics with OpenGL, Prentice-Hall, 4th edition, 2010. Edward Angel, Dave Shreiner.: Interactive Computer Graphics, A Top-Down Approach with Shader-Based OpenGL, 6th Edition, 2012.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM40A0700	*PATTERN RECOGNITION* 7 ECTS cr
	Pattern Recognition, Hahmontunnistus
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Lasse Lensu
Aims	A student can analyze a pattern recognition problem, select an appropriate pattern recognition method, and implement a solution. A student can analyze the performance and quality of a pattern recognition system.
Content	Introduction to pattern recognition. Bayesian inference and statistical pattern recognition. Discriminants and artificial neural networks. Decision tree, syntactic and structural approaches. Context-dependent classification. Unsupervised learning.
Modes of Study	Lectures 12 h, lecture preparation 12 h, exercises 18 h, exercise preparation 24 h, 1st period. Lectures 12 h, lecture preparation 12 h, exercises 18 h, exercise preparation 24 h, practical assignment 40 h, 2nd period. Self-study 7 h. Exam 3 h. Total amount 182 h. Moodle is used in this course.
Evaluation	0-5, exam 50%, exercises 50%.
Study materials	Lecture notes. Duda, R.O., Hart, P.E., Stork, D.G.: Pattern Classification, Wiley, 2001. Theodoridis, S., Koutroumbas, K.: Pattern Recognition, Academic Press, 2003.
Prerequisites	Recommended: BM20A5800 Funktiot, lineaarialgebra ja vektorit, BM20A5810 Differentiaalilaskenta ja sovellukset, BM20A5820 Integraalilaskenta ja sovellukset, BM20A5840 Usean muuttujan funktiot ja sarjat, CT60A0210 Käytännön ohjelmointi, BM20A1401 Tilastomatematiikka I, BM20A1501 Numeeriset menetelmät I, BM20A1601 Matriisilaskenta, BM40A0500 Johdatus laskennalliseen älykkyyteen or equivalent knowledge.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM40A0800	*MACHINE VISION AND DIGITAL IMAGE ANALYSIS* 7 ECTS cr
	Machine Vision and Digital Image Analysis, Konenäkö ja digitaalinen kuva-analyysi **The course will be lectured every other year, next during the academic year 2015 - 2016.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4

	The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Arto Kaarna
Aims	After the course a student is expected to be able to explain the fundamental steps of image processing and analysis, to implement solutions to the steps using Matlab, to introduce and compare machine vision applications, to plan a solution to a given object recognition problem, and to implement the solution using Matlab or other suitable programming language.
Content	Digital image processing: digital image, image transforms, image enhancement, image compression. Image analysis: segmentation, representation and description, recognition and interpretation. Hardware, software and applications.
Modes of Study	Lectures and seminars 18 h, exercises 10 h, 3rd period. Lectures and seminars 18 h, exercises 12 h, practical assignment seminars 4 h, 4th period. Preparation for the seminar presentation and acting as an opponent, homework, and practical assignment 79 h, self-studying of taught matters and relevant literature and preparation for the exam 38 h, 3rd and 4th period. Exam 3 h. Total amount 182 h. Moodle is used in this course.
Evaluation	0-5, exam 50%, exercises 50%. Seminar presentation. Acting as an opponent. Practical assignment.
Study materials	Gonzales, R.C., Woods, R.E.: Digital image processing, Prentice-Hall, 2002. Jain, A.K.: Fundamentals of digital image processing, Prentice-Hall, 1989.
Prerequisites	Recommended BM40A0600 Introduction to Computer Graphics, BM40A0700 Pattern Recognition, BM40A0900 Computer Vision, BM40A0500 Johdatus laskennalliseen älykkyyteen.

BM40A0900	***COMPUTER VISION*** ***7 ECTS cr***
	Computer Vision, Tietokonenäkö **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Arto Kaarna
Aims	A student understands the theoretical basis of geometric and dynamic computer vision, and can apply the knowledge to solve practical problems in computer vision. A student can explain basic approaches and applications for image processing and feature extraction for single images, stereo vision; for detecting, localizing, and recognizing objects; and for tracking objects in multiple images. Student is able to implement simple application in computer vision.
Content	Computer vision in 3D scenes. Imaging models and calibration. Coordinate frames and geometrical primitives. Single and multi-view geometry. Pose estimation. Dynamic vision and tracking. Structure from motion. Vision in robotics.
Modes of Study	Lectures 18 h, exercises 12 h, exercise preparation 18 h, 3rd period. Lectures 18 h, exercises 12 h, exercise preparation 18 h, practical assignment 40 h, 4th period. Independent study 43 h, exam 3 h. Total 182 h. Moodle is used in this course.
Evaluation	0-5, exam 60%, exercises 40%. Practical assignment.
Study materials	Emanuele Trucco, Alessandro Verri: Introductory Techniques for 3-D Computer Vision. Prentice Hall, 1998. E. R. Davies: Computer and Machine Vision, Fourth Edition: Theory, Algorithms, Practicalities, 4th Edition. Elsevier, 2012. Richard Hartley, Andrew Zisserman: Multiple View Geometry in Computer Vision, 2nd Edition. Cambridge University Press, 2004.

	David A. Forsyth, Jean Ponce: Computer Vision: A Modern Approach, 2nd Edition. Prentice Hall, 2011.
Prerequisites	BM20A5800 Funktiot, lineaarialgebra ja vektorit, BM20A5810 Differentiaalilaskenta ja sovellukset, BM20A5820 Integraalilaskenta ja sovellukset, BM20A5830 Differentiaaliyhtälöiden peruskurssi, BM20A5840 Usean muuttujan funktiot ja sarjat, CT60A0200 Ohjelmoinnin perusteet. Recommended BM20A1401 Tilastomatematiikka I, BM20A1501 Numeeriset menetelmät I, BM20A1601 Matriisilaskenta, BM40A0500 Johdatus laskennalliseen älykkyyteen or equivalent knowledge.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

BM40A1000	***SEMINAR ON INTELLIGENT COMPUTING 4 ECTS cr***
	Seminar on Intelligent Computing, Älykkään laskennan seminaari
Year and Period	M.Sc. (Tech.) 2 Period 2-3
Teacher(s)	D.Sc. (Tech.) Leena Ikonen
Aims	After the course a student is expected to be able to explain the basic principles of scientific work and its reporting both in the scientific forums and general media, to understand the principles of the academic thesis and possibilities of funding and different relevant work places, to write a seminar report about intelligent computing in the form of the academic thesis, to give the corresponding oral seminar presentation, and to act as an opponent.
Content	The first part of the seminar (the 2nd period) is implemented with Seminar on Software Engineering, giving the skills defined by the learning outcomes of the course, including the skills to give the seminar presentation in the second part of the seminar (the 3rd period) which consists of seminar presentations given by the participating students.
Modes of Study	Seminar presentations 8 h, 2nd period. Seminar presentations 4 h, 3rd period. Preparation for an oral and written seminar presentation and acting as an opponent 72 h, self-studying of taught matters and relevant literature 16 h. Total workload 100 h. Moodle is used in this course.
Evaluation	0-5, written seminar report 100%. Seminar presentation. Active participation to all seminar sessions. Acting as an opponent.
Study materials	Material published on the course web page.

BM40A1200	***DIGITAL IMAGING AND IMAGE PREPROCESSING 7 ECTS cr***
	Digital Imaging and Image Preprocessing, Digitaalinen kuvantaminen ja kuvien esikäsittely
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D. Tuure Tuuva Docent, Ph.D. Erik Vartiainen Professor, D.Sc. (Tech.) Lasse Lensu Person in Charge: Professor, D.Sc. (Tech.) Lasse Lensu
Aims	A student understands how radiation interacts with matter, how images can be captured and the image formation modelled, and how preprocessed images can be used for measurement purposes. The student is able to characterise and affect image quality in practice.
Content	Electromagnetic radiation and light interaction with matter, sources of radiation and illumination techniques, imaging sensors and manufacturing technologies, spectroscopy, imaging optics, sensor and image quality modelling and characterisation, digital image and image preprocessing techniques.
Modes of Study	Lectures 12 h, lecture preparation 12 h, exercises 12 h, exercise preparation 24 h, 1st period.

	Lectures 12 h, lecture preparation 12 h, exercises 12 h, exercise preparation 24 h, 2nd period. Self-study 19 h. Exam 3 h. Practical assignment 40 h, intensive week 2. Total amount 182 h. Moodle is used in this course.
Evaluation	0-5, exam 50%, exercises 50%.
Study materials	Kasap, S.O.: Optoelectronics and Photonics, Prentice-Hall, 2000. Gonzales, R.C., Woods, R.E.: Digital image processing, Prentice-Hall, 2002. Jain, A.K.: Fundamentals of digital image processing, Prentice-Hall, 1989.
Prerequisites	Recommended BM40A0500 Johdatus laskennalliseen älykkyyteen.

BM40A1300	***PROJECT WORK IN INTELLIGENT COMPUTING***	***10 - 30 ECTS cr***
	Project Work in Intelligent Computing, Älykkään laskennan projektityö	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	N. N. Person in Charge: Associate Professor, D.Sc. (Tech.) Arto Kaarna	
Aims	The student obtains practical skills on a research project in a specific application area. The student gains experience in project work, team work skills, self management, and work discipline.	
Content	A specific project which is done in one of the research areas in Intelligent Computing. The project is planned together with the supervisor(s) and consists of literature survey, modeling, implementation, analysis of results, and reporting. The course may contain lectures and seminars. The project may also be planned together with industry and partly carried out in the environment of the company.	
Modes of Study	Research work 200-400 h, independent study 50-200 h, report preparation 50-200 h. The granted ECTS credits will be defined according to the actual working hours. Moodle is used in this course.	
Evaluation	0-5 or pass/fail, depending on the work performance and project report.	
Study materials	Literature related to the project.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

6. LUT SCHOOL OF BUSINESS AND MANAGEMENT

Computer Science

6.1 Master's Programme in Computer Science

Aims and Learning Outcomes of the Master's Programme in Computer Science

The degree programme in Computer Science provides for the students the necessary theoretical and practical knowledge, skills and capabilities required in the ICT industry. A person who graduates from the degree programme is also capable of continuing his/her studies to doctoral level in the field of computer science. The degree programme combines up-to-date research knowledge with the fundamentals of computer science and learning is supported by modern and efficient teaching methods. The LUT Computer Science programmes have been awarded the Euro-Inf® quality label from EQUANIE and the seal of ASIIN e.V. for both the Bachelor's and Master's degree programmes. The accreditations were issued for the first time on September 28th, 2012, and are valid till September 30th, 2018.

The degree programme in Computer Science educates Masters of Science in Technology for the needs of industry, research institutions, businesses, and public administration. The graduates with a Master's degree from the programme are able to participate in software projects in the role of an expert or as a project manager and they are able to apply their knowledge and capabilities in projects. The graduates are able to apply scientific knowledge and methods in practice, they are able to communicate both orally and in written form and they are able to participate in a project group also in a multicultural environment. The education is given in English language and as such, the graduates can communicate both orally and in written form using English language. Furthermore, the graduates from Software Engineering

- are able to apply modern design techniques and methods in daily software engineering
- are able to participate in software projects as an expert in their specialisation area or as a project manager
- are able to recognise problems in software development and improve processes from technical, project management, and organisational viewpoints
- are able to design, model and implement applications and services for various environments.

The Master of Science (Tech.) degree programme takes two calendar years from which the spring of the second year is dedicated to the development of the Master's thesis. The first three semesters cover courses on general studies, major, minor, and elective ones.

Programme Specific Information

Students starting in the Master's Programme are expected to have following skills

The students in the Master's programme in Computer Science are expected to have understanding of basic engineering mathematics and the role of software and information systems in modern business. In addition, the students need understanding of programming, basics of software analysis and design methodologies, and project management. Knowledge of operating systems and software development environments makes learning faster and easier.

The students are expected to have skills to design and implement a program that uses database through a graphical user interface. The students are also expected to be able to work both individually and in groups, and have a good command of English language to be able to complete the programme in expected schedule.

Personal Study Plan

A personal study plan is prepared by the student in the beginning of the studies. The plan includes the courses the student will include in the degree, timing of the studies, and possible compensations. The studies are structured according to the study guide. At LUT, the personal study plan is checked two times during the studies, at the beginning of the studies and when applying for the Master's thesis topic. Students are adviced to update the study plan annually in the beginning of the academic year and to check the changes in the curriculum. Further information: Pauliina Talka, pauliina.talka(at)lut.fi.

The Degree Structure in Computer Science

Master of Science 120 ECTS cr

	ECTS cr
General studies	16
Major subject	75
Minor subject	20
Elective studies	9
Total	*120*

General studies

Obligatory (16 ECTS cr)		*year*	*per.*	*ECTS cr*
CT10A0015	Introduction to M.Sc. Studies in Computer Science	M.Sc. (Tech.) 1	1-4	1
CT10A9510	Research Methods in Software Engineering	M.Sc. (Tech.) 1	1-2	5
CT60A7101	Seminar on Software Engineering	M.Sc. (Tech.) 1	3-4	4
FV11A9800	Academic Writing in English Course 1	M.Sc. (Tech.) 1	1/3	2
FV11A9900	Academic Writing in English Course 2	M.Sc. (Tech.) 1	2/4	2
FV18A9101(*	Finnish 1		1/3	2

*) Teknisk svenska 2 ECTS is obligatory for Finnish students who have not attained proficiency in Swedish in their previous degree

MAJOR: Software Engineering

Obligatory Studies (52 ECTS cr)		*year*	*per.*	*ECTS cr*
CT30A8903	Software Systems as a Service: Technology and Engineering	M.Sc. (Tech.) 2	3-4	5
CT60A7201	Architecture in Systems and Software Development	M.Sc. (Tech.) 1	3-4	7
CT60A7500	Object-Oriented Programming Techniques	M.Sc. (Tech.) 1	3-4	5
CT60A5101	Models and Methods of Software Engineering	M.Sc. (Tech.) 1	1-2	5
CT10A6001	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

Elective Studies (min 23 ECTS cr)		*year*	*per.*	*ECTS cr*
CT10A7001(1	Green IT and Sustainable Computing	M.Sc. (Tech.) 1-2	3-4	5
CT10A9201	Game Design - from Concepts to Implementation	M.Sc. (Tech.) 1-2		3
CT10A9520	Research Project in Software Engineering	M.Sc. (Tech.) 1	1-4	1-10
CT30A5002	Games and Networking	M.Sc. (Tech.) 1	1-3	7
CT30A5110	Gamification - from Concepts to Implementations	M.Sc. (Tech.) 1-2	1-4	3
CT30A5301	Strategic Development Project of Network Administrative Tools	M.Sc. (Tech.) 1-2	1-4	3
CT30A8920	Sustainable Innovation by Design: A User Experience Perspective	M.Sc. (Tech.) 1	1-2	5
CT30A9301	Code Camp on Platform Based Application Development	M.Sc. (Tech.) 1-2	INT 43/INT 9	4

CT60A5200	Software Projects and Process Improvement	M.Sc. (Tech.) 2	INT 2,10 and 17	7
CT60A7001[1]	Critical Thinking and Argumentation in Software Engineering	M.Sc. (Tech.) 1-2	3-4	5
CT60A7302	Software Quality, Processes, and Organizations	M.Sc. (Tech.) 2	1-2	7
CT60A7321	Software Business Development	M.Sc. (Tech.) 1-2	INT 50	5
CT60A7400	Fundamentals of Information Systems	M.Sc. (Tech.) 1	1-2	7
CT60A8000	Game Development Project	M.Sc. (Tech.) 1-2		3-5
CT60A9500	Gadget Code Camp – Hacking Technology	M.Sc. (Tech.) 1-2		1
CS30A7401	Software and Application Innovation	M.Sc. (Tech.) 2	1-2	5
BL40A1000	Real-time Operating Systems and Programs	M.Sc. (Tech.) 2	1-2	5
BL40A1100	Embedded System Programming	M.Sc. (Tech.) 1	1-2	4
BM40A0000	International Summer School in Novel Computing	M.Sc. (Tech.) 2	INT	1-3

[1] Exchangeable

Minor Subject, 20 ECTS credits

The minor subject can be selected freely from any LUT minor subject listed in the end of this guide. If the student selects one of the minors from other degree programmes, the student should also check the prerequisites! The course descriptions and description of the minors can be found in this study guide in the section dedicated to each Master's programme; the university wide minor on Sustainability is described below. Additional information is provided by the study counselling staff of each Master's programme.

Minor subject: Sustainability (20 ECTS cr)

Obligatory studies (3 ECTS cr)		*per.*	*ECTS cr*
BH60A4400	Introduction to Sustainability	1	3

Elective Studies (min. 17 ECTS cr)		*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	2	3
BK30A0901	Additive Manufacturing - 3D Printing	3-4	5
BH40A1301	Power Machines in Renewable Energy	2	5
BH50A1200	Energy Systems Engineering	1-2	6
BH50A1400	Steam Boilers	1-2	6
BH50A1500	Bioenergy Technology Solutions	2-3	6
BH60A1600	Basic Course on Environmental Management and Economics	2	5
BH60A4500	Corporate Responsibility and Management 1	1-4	3
BH61A0600	Bioenergy	1	3
BJ02A4010	Industrial Water Treatment	2	5
BJ02A4020	Methods in Green Chemistry	4	5
BJ02A4030	Green Chemistry	1	5
BK50A2001	Package Performance and Sustainability	3	5
BK50A2200	Design Methodologies and Applications of Machine Element Design	1-2	5
BK90C1800	Green Fiber Materials	4	5
CS10A0770	Cleaner Technologies and Markets	3-4	5
CS30A1690	Social Sustainability	4	5
CS31A0603	Life-Cycle Costing of Investment Projects	1	5
CT10A7001	Green IT and Sustainable Computing	3-4	5

Elective Studies

Any course given in Lappeenranta University of Technology can be included in elective studies. We recommend courses given by the Computer Science and Finnish for Foreigners language courses. It is also possible to include CT10A0500 Work Internship in Master's Degree 2-10 credits in to the elective studies.

The minimum of the degree is 120 ECTS credits. Elective studies are selected such that minimum 120 ECTS credits are completed.

Double Degree Programme in Computer Science

Double degree programme in Computer Science is a co-operative degree programme between LUT and an international partner university. The students will study one year at their home university and come to LUT for the second year to specialize in Software Engineering. To get the two degrees the student must comply with the regulations of both the universities.

Degree structure of Double Degree Programme in Computer Science

Master of Science (Technology) 120 ECTS cr

	ECTS cr
Major subject	80
Minor subject	20-25
Elective studies	15-20
Total	*120*

Compensation of the first year studies at the home university to LUT degree is 60 ECTS credits.

Major Subject 60 ECTS credits at LUT, Software Engineering

Obligatory Studies (60 ECTS cr)		*per.*	*ECTS cr*
CT10A0015	Introduction to M.Sc. Studies in Computer Science	1-4	1
CT10A9510	Research Methods in Software Engineering	1-2	5
CT30A8920	Sustainable Innovation by Design: A User Experience Perspective	1-2	5
CT60A5101	Models and Methods of Software Engineering	1-2	5
CT60A7302	Software Quality, Processes, and Organizations	1-2	7
CT60A7400	Fundamentals of Information Systems	1-2	7
CT10A6001	Master's Thesis	1-4	30

6.2 Erasmus Mundus Master's Programme in Pervasive Computing and Communications for Sustainable Development (PERCCOM)

PERCCOM is an Erasmus Mundus Master's Programme hosted by University of Lorraine (France), Lappeenranta University of Technology (Finland), Saint Petersburg National Research University of Information Technology, Mechanics and Optics (Russia), and Luleå University of Technology (Sweden). Students will study one semester in France, Finland and Sweden each and on fourth semester either finish their Master's thesis in any of the hosting universities or in any other partner university. Master's thesis is supervised by all hosting universities and student is granted three separate Master's degrees. As such student is expected to fulfil the requirements of the Master's thesis according to LUT practices.

Degree structure of Erasmus Mundus Master's Programme in Pervasive Computing and Communications for Sustainable Development (PERCCOM)

Master of Science 120 ECTS cr

	ECTS cr
General studies	24
Major subject	75
Minor subject	21
Total	*120*

General studies

Obligatory Studies (24 ECTS cr)		*year*	*per.*	*ECTS cr*
A350A1000	Transformation of A Modern Industrial Society: The Finnish Model	1	3	2
CT60A9000	Towards Semester 3	1	4	1
CT60A9200	Seminar on Sustainable Software and Services 1	1	4	3
CT60A9400	Seminar on Sustainable Software and Services 2	1	4	3
Luleå Univ. of. Tech.	Multimedia Systems	2		7,5
Luleå Univ. of. Tech.	Swedish for Beginners AI:1a	2		1,5
Luleå Univ. of. Tech.	Seminar	2		3
Univ. of Lorraine	French Culture and Language	1		3

Major Subject, 75 ECTS credits

Software Engineering

Obligatory Studies (75 ECTS cr)		*year*	*per.*	*ECTS cr*
CT10A7001	Green IT and Sustainable Computing	1	3-4	5
CT30A9301	Code Camp on Platform Based Application Development	1	3-4 int.	4
CT60A7201	Architecture in Systems and Software Development	1	3-4	7
CT10A9520	Research Project in Software Engineering	1	3-4	5
Luleå Univ. of. Tech.	Network Programming and Distributed Applications	2		7,5
Luleå Univ. of. Tech.	Wireless Sensor Networks/Wireless Mobile Networks	2		7,5
Luleå Univ. of. Tech.	Special Studies in Pervasive and Mobile Computing (Project)	2		3
Univ. of Lorraine	Specification Definition of Master thesis project	1		6
CT10A6001	Master's Thesis	1- 2	1-4	30

Minor Subject, 21 ECTS credits

Sustainable and Resource Efficient Communication

Obligatory Studies (21 ECTS cr)		*year*	*per.*	*ECTS cr*
Univ. of Lorraine	Communication Protocols	1		3
Univ. of Lorraine	Quality of Sustainable Service	1		3
Univ. of Lorraine	Automatic Control for Sustainable Development	1		3
Univ. of Lorraine	Systems Engineering	1		3
Univ. of Lorraine	Sustainable Development & Circular Economy	1		3
Univ. of Lorraine	Seminar 1	1		3
Univ. of Lorraine	Seminar 2	1		3

Erasmus Mundus Master’s Programme students have possibility to extend their studies by selecting courses from the Sustainability minor. These courses and credits will be counted on top of the 120 ECTS credits required and provided by Erasmus Mundus Master’s Programme in Pervasive Computing and Communications for Sustainable Development.

Course Descriptions in Computer Science

		ECTS cr
CS30A7401	Software and Application Innovation	5
CT10A0011	Laboratory Work Course in Computer Science	10 - 30
CT10A0015	Introduction to M.Sc. Studies in Computer Science	1
CT10A0500	Work Internship in Master’s Degree	2 - 10
CT10A6001	Master's Thesis	30
CT10A7001	Green IT and Sustainable Computing	5
CT10A9201	Game Design - from Concepts to Implementation	3
CT10A9510	Research Methods in Software Engineering	5
CT10A9520	Research Project in Software Engineering	1 - 10
CT30A5002	Games and Networking	7
CT30A5110	Gamification - from Concepts to Implementations	3
CT30A8903	Software Systems as a Service: Technology and Engineering	5
CT30A8920	Sustainable Innovation by Design: A User Experience Perspective	5
CT30A9301	Code Camp on Platform Based Application Development	4
CT60A5101	Models and Methods of Software Engineering	5
CT60A5200	Software Projects and Process Improvement	7
CT60A7001	Critical Thinking and Argumentation in Software Engineering	5
CT60A7101	Seminar on Software Engineering	4
CT60A7201	Architecture in Systems and Software Development	7
CT60A7302	Software Quality, Processes, and Organizations	7
CT60A7321	Software Business Development	5
CT60A7400	Fundamentals of Information Systems	7
CT60A7500	Object-Oriented Programming Techniques	5
CT60A8000	Game Development Project	3 - 5
CT60A9000	Towards Semester 3	1
CT60A9200	Seminar on Sustainable Software and Services 1	3
CT60A9400	Seminar on Sustainable Software and Services 2	3
CT60A9500	Gadget Code Camp – Hacking Technology	1

CS30A7401	SOFTWARE AND APPLICATION INNOVATION	5 ECTS cr
	Software and Application Innovation **Can't be included in the same degree as CS30A7400 Software and Application Innovation.**	
Year and Period	M.Sc. (Tech.) 2 Period 1-2	
Teacher(s)	Professor, D.Sc. (Tech.) Helinä Melkas Professor, D.Sc. (Tech.) Jari Porras Project Researcher, M.Sc. (Tech.) Juho Salminen Person in Charge: Professor, D.Sc. (Tech.) Helinä Melkas	
Aims	This course combines technology and technology management perspectives for cross-scientific approach in software and application innovation process. After completion of the course students have broader perspective on innovation process in some yearly chancing technically focused area. Students know how to innovate new meaningful software solutions and application based on some technology, what is the technical and business feasibility of the solution in domestic and international markets.	
Content	Innovation management, idea generation and opportunity identification process. (Open) business models and technology commercialization in global markets. Product and service development. Basics and use cases of the selected technology, user-centric design and privacy perspectives in software and application development. The course is related to sustainability. The course is related to sustainability.	
Modes of Study	Lectures 12 h. Innovation exercise to be given during the lectures 35 h, practical work (documentation) 35 h, independent group work 40 h, presentations 8 h. Total 130 h.	
Evaluation	0 - 5. Practical work 100 %.	
Study materials	To be announced later.	

CT10A0011	LABORATORY WORK COURSE IN COMPUTER SCIENCE	10 - 30 ECTS cr
	Laboratory Work Course in Computer Science **The course is only intended for foreign visiting students. The students register for the course by contacting the supervisor.**	
Year and Period		
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Jari Porras and Professor, Ph.D. Kari Smolander	
Aims	Student has a deeper understanding in Computer Science in a specialized area.	
Content	A specific project which is planned together with the supervisor and consists mainly of laboratory work, literature work and report writing. The course may contain lectures and seminars.	
Modes of Study	Participation in the work of the research group and the research report, self-study 260-840 h.	
Evaluation	0-5 or passed/failed.	
Study materials	Literature related to the project.	

CT10A0015	INTRODUCTION TO M.SC. STUDIES IN COMPUTER SCIENCE	1 ECTS cr
	Introduction to M.Sc. Studies in Computer Science	
Year and Period	M.Sc. (Tech.) 1 Period 1-4	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Uolevi Nikula	

	Information Specialist, M.Sc. (Tech.) Marja Talikka Person in Charge: Associate Professor, D.Sc. (Tech.) Uolevi Nikula
Aims	The course provides the student with basic knowledge of studying at Lappeenranta University of Technology (LUT), Finland, in general and particularly in his/her school and degree programme. The course is aimed to help students to plan their studies at LUT and follow the progress of their studies with the help of an individual study plan. Students recognize their own learning strategy and learn about information retrieval and the information sources available at LUT for courses and studying by using the Academic Library's services, collections and databases.
Content	The Orientation Days activities. Practical study-related information. Degree requirements. Planning of Master's studies. Preparation of the individual study plan. Monitoring the progress of studies with the Academic Director and Student Affairs Secretary. The Academic Library collections and databases.
Modes of Study	Participation in the Orientation Days. Planning the individual study plan. Library introduction lectures and assignments on information retrieval and library databases on Moodle (Period 1). Study programme meetings with the Academic Director and Student Affairs Secretary (Periods 1-4). Assignments: individual study plan, library assignments. Independent study. Total 26 h. Moodle is used in this course.
Evaluation	Pass/Fail (assignments, active participation in study programme meetings)
Study materials	Materials will be announced during the course.

CT10A0500	***WORK INTERNSHIP IN MASTER'S DEGREE***	***2 - 10 ECTS cr***
	DI-tutkinnon työharjoittelu **No course registration (replaced by submitting the application for approval of the internship coordinator)**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Ossi Taipale	
Aims	After the work environment internship, the student has obtained a basic knowledge of the work, work environment and working community in his/her own field. The student is able to apply and generalize knowledge and skills acquired during the course of studies to work in his/her own field.	
Content	The student obtains a (summer) job from the company, works as a paid employee, requests a certificate of employment and applies for the approval of the work as an internship for the Master's degree. Full-time employment relationships of at least four weeks can be approved as internships. The completion of the Master's thesis is not accepted as an internship. An employment relationship that took place before the studies can be approved as an internship providing that it has not been accepted and included in any other previous degree.	
Modes of Study	First 2 ECTS credits: applying for a job and recruiting 10 h, tasks connected to starting an employment relationship (e.g. orientation, the rules of the employment relationship and the work place) 15 h, observing (while working) how the working community operates (e.g. how work/production is organized, supervision, the working manners of the working community/teams, the social environment of the work place) 22 h, a written internship report 5 h (2-3 pages), total 52 h. 3-10 ECTS credits: having different tasks in a company 26-208 h (1 ECTS credit/26 h). The number of ECTS credits of compulsory internship varies depending on the degree programme in question, further information is available in the degree structures of the study guide.	
Evaluation	Pass/Fail, internship report 100%.	

CT10A6001	MASTER'S THESIS 30 ECTS cr
	Diplomityö
Year and Period	M.Sc. (Tech.) 2 Period 1-4
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Jari Porras
Aims	A student is able to independent work and scientific writing, related into specific problems in the field of information technology.
Content	An independent thesis done in the field of information technology, according to the instructions given. In the beginning a student must contact the professor responsible. The starting and finishing point of the thesis vary. The course is related to sustainability.
Modes of Study	Master’s Thesis and maturity exam. Total 780 h.
Evaluation	0 - 5. Master's thesis 100 %.
Prerequisites	CT10A9500 Research Methods completed and a minimum of 15 ECTS credits of the major studies completed.

CT10A7001	GREEN IT AND SUSTAINABLE COMPUTING 5 ECTS cr
	Kestävä kehitys tietotekniikassa **Course for sustainability minor. Can't be included to a same degree as CT60A7001 Critical Thinking and Argumentation in Software Engineering.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Jari Porras
Aims	After the course students are familiar with technologies for Green IT and sustainable computing. Students know critical thinking and argumentation principles and are able to apply these skills in discussions carried over the topic. Students are able to discuss about the topic and examine it critically.
Content	The course emphasizes two separate aspects. First students are familiarized with critical thinking and argumentation skills and then these skills are applied in Green IT and sustainable computing field. Green IT and sustainable computing is covered through books and scientific articles. Students may be divided into small groups that will each study a separate topic. The course is related to sustainability.
Modes of Study	Lectures 2 h, homework 10 h, online course 26 h, 3. period. Seminars and discussions 19 h, homeworks 26 h, self-study 47 h, 4. period. Total 130 h.
Evaluation	0 - 5. Seminar work(s), active participation in discussions, homeworks.
Study materials	For critical thinking part A. Freeley, Argumentation and Debate: Critical Thinking for Reasoned Decision Making, Wadsworth Publishing For green it and sustainable computing part National Research Council, Computing Research for Sustainability, National Academies Press, 2012 L. Webber and M. Wallace, Green Tech: How to Plan and Implement Sustainable IT Solutions, AMACOM, 2009.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT10A9201	*GAME DESIGN - FROM CONCEPTS TO IMPLEMENTATION*	*3 ECTS cr*
	Game Design - from Concepts to Implementation, Pelisuunnittelu - konsepteista toteutukseen **LUT Summer School, 10 – 14.8.2015. Enrolment according to standard practice of LUT Summer School 2014.**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Assistant Professor Dario Maggioni, the University of Milan, Italy Research Fellow Giacomo Cappellini, National Research Council, Italy Person in Charge: Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen Post-Doctoral Researcher, D.Sc. (Tech.) Jussi Kasurinen	
Aims	After the course the student should be able to: Understand the basics of game design, the process, general concepts, architectures and infrastructures within the game design. Estimate technical requirements for videogames. Prototype a simple game.	
Content	Introduction to game design, game engines architecture. Online game design, infrastructures for online games. Mobile games. Introduction to Unity3D environment and editor, asset management, scripting and network operations. Implementation of a simple game in Unity3D environment, interoperability with other tools in the implementation. Game research seminar (1 afternoon).	
Modes of Study	Lectures 15 hours. Exercises 20 hours. Assignment 39 hours. Seminar 4 hours. Total 78 hours. Moodle is used in this course. Moodle is used in this course.	
Evaluation	Final grade 0-5. Active participation in the learning occasions 20%. Assignment 80%.	
Study materials	Learning materials provided during the lectures.	
Prerequisites	Basic knowledge of programming (e.g. C, C++, C#, Java, Python). Tasks require programming, but are started from basic examples.	

CT10A9510	*RESEARCH METHODS IN SOFTWARE ENGINEERING*	*5 ECTS cr*
	Ohjelmistotuotannon tutkimusmenetelmät	
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.	
Teacher(s)	Professor, Ph.D. Kari Smolander Person in Charge: Professor, Ph.D. Kari Smolander	
Aims	The student will be able to describe the essential concepts and methods in empirical software engineering research. The student will understand the principles of scientific research and reporting and be able to prepare a research plan for a Master's thesis and doctoral studies.	
Content	Principles of science and scientific communities. Epistemology and ontology in research. The practical research process. Designing research, research questions and hypotheses. Research methods including literature review, qualitative methods, experiments, quantitative methods, and design research. Reporting scientific work.	
Modes of Study	Lectures 12 h, lecture preparation 7 h, 1st period. Practical assignments: 47 h, 2nd period. Seminars: 12 h, 2nd period, preparing for the seminars 7 h. Reading literature 26 h. Preparation for exam 12 h. Exam 3 h. Total 126 h. Moodle is used in this course.	
Evaluation	0-5. Exam 60%, practical assignments 40%.	
Study materials	To be announced in the lectures.	

Prerequisites	B.Sc. studies finished.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT10A9520	***RESEARCH PROJECT IN SOFTWARE ENGINEERING***	***1 - 10 ECTS cr***
	Ohjelmistotuotannon tutkimusprojekti	
Year and Period	M.Sc. (Tech.) 1 Period 1-4 The course is suitable also for doctoral studies.	
Teacher(s)	Professor, Ph.D. Kari Smolander Person in Charge: Professor, Ph.D. Kari Smolander	
Aims	The student will be able to execute a research task in software engineering.	
Content	Research work on the topic defined by the Software Engineering and Information Management department. When starting the course, contact one of the professors of the department. A report on and a seminar presentation of the work carried out.	
Modes of Study	Participation in the work of the research group, 1st-4th period. Total 26-260 h.	
Evaluation	Passed/failed. Research report and seminar presentation.	
Study materials	Literature related to the research topic, agreed with the supervisor of the work.	
Prerequisites	CT10A9500 Research Methods or CT10A9510 Research Methods in Software Engineering	
Further Information	Due to the changing topic this course may be studied several times, but only with the different content.	

CT30A5002	***GAMES AND NETWORKING***	***7 ECTS cr***
	Pelit ja verkon vaikutus niihin **Replaces the course CT30A5001 Network Programming. Can't be included in the same degree as CT30A5001 Network Programming.**	
Year and Period	M.Sc. (Tech.) 1 Period 1-3 The course is suitable also for doctoral studies.	
Teacher(s)	Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen	
Aims	Students understand problematics of networking, are able to implement basic gaming protocols and understand their limitations in relation to scaling and delay issues.	
Content	Students familiarize themselves with different game types. Massively multiplayer online games, cloud based games and client-server games. Operation of a game engine. Study of existing game protocols. Network game traffic patterns, latency compensation techniques, scalability issues, network behavior in scope of games. Socket interface usage and event-based programming. Analysis and realization of network game protocol.	
Modes of Study	Lectures 12 h, exercises 4 h, 1.period. Lectures 12 h, exercises 12 hours, 2. period. Demonstration 8 h, 3. period. Reading assignments (+discussions), 2 hands on programming assignments and a group work 134 h. Total 182 h.	
Evaluation	0 - 5. Assignments 30 %, group work 40% and continuous evaluation 30 %.	
Study materials	Will be announced during the course.	
Prerequisites	CT30A2003 Tietoliikennetekniikan perusteet or equivalent skills, CT60A0210 Käytännön ohjelmointi or CT60A2410 Olio-ohjelmointi or equivalent skills.	

CT30A5110	GAMIFICATION - FROM CONCEPTS TO IMPLEMENTATIONS 3 ECTS cr
	Gamification - from Concepts to Implementations
Year and Period	M.Sc. (Tech.) 1-2 Period 1-4 The course is suitable also for doctoral studies.
Teacher(s)	Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen Person in Charge: Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen
Aims	After the course, the student should be able to understand the basics of the gamification concepts, design, process, general concepts, architectures and infrastructures in game design. Prototype of a gamified system.
Content	Gamification concepts, elements, motivational drivers, design, problems.
Modes of Study	The course can be completed by reading the course book, completing given excersises and writing a paper. Each student has to have a peer group during the course and the group has to report about their progress. A mandatory introduction lecture will be held in the beginning of the first period, where a timetable and tasks will be handed out. Introduction lecture 2h, self study 24 h, assignment 26 h, writing a study paper 26 h. Total 78 h.
Evaluation	0-5. Oral exam 50%. Assignment + study paper 50%.
Study materials	Kevin Werbach and Dan Hunter: For the Win: How Game Thinking Can Revolutionize Your Business, ISBN: 9781613630235 Learning materials provided during the course.
Prerequisites	Research Methods
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT30A8903	SOFTWARE SYSTEMS AS A SERVICE: TECHNOLOGY AND ENGINEERING 5 ECTS cr
	Software Systems as a Service: Technology and Engineering **Course can't be included in the same degree as CT30A8902 Service Oriented Architecture.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D., PEng., HDR. Ahmed Seffah and invited speakers from industry when available. Person in Charge: Professor, Ph.D., PEng., HDR. Ahmed Seffah
Aims	1. Understanding of the service orientation and the Internet of services, as a fundamental shift to producing, deploying and consuming software applications, and as a domain for academic research. 2. Implementing service systems and Web services that merge business and technical requirements to support the needs of an organization. 3. Mastering the technology used in modeling, designing, and composing services to create an effective SOA-based application. 4. Understanding the new business challenges and opportunities of software as a service versus shrink-wrapped software systems. 5. Applying the SOA (software-oriented architecture) principles and techniques to the design, programming, testing, and public cloud deployment of Web services.
Content	Service-orientation fundamentals and principles. Software as a Service (SaaS). Internet of services. Platform and software engineering tools as a Service (PaaS). Infrastructure as a service (IaaS). Service-Oriented Architecture

	(SOA) principles and technologies. Service design patterns. Security, sustainability, and privacy. SOA governance. Service lifecycle management. Web services programming. Successful and failures stories from industry. Large team-oriented project on service systems for sustainability innovation. Sustainability is addressed at two different levels in this course: 1. Similar to security and other software quality attributes, sustainability is defined as a key quality attribute of a service system 2. Students are encouraged to consider projects related to the re-engineering of existing software systems and/or the development of innovative services to support sustainability development including the management of natural resources consumption as well as the ways software services can make citizens more aware about their impacts on the environment. The course is related to sustainability.
Modes of Study	Lectures 18 h, lecture preparation (weekly mandatory readings) 12 h, in class exercises 18h, practical analysis, design and development team-oriented project 52 h, Self-study and research poster 24 h. Final exam preparation 4 h. Final exam (open book) 2 h. Total 130 h. Moodle is used in this course.
Evaluation	0-5. Final Exam 30%, Practical design, Practical analysis, design and development project 40%, Individual research poster and presentation 30%.
Study materials	Mandatory readings 1. Selected chapters from Thomas Erl. Service-Oriented Architecture: Concepts, Technology and Design. Prentice Hall, 2005 (http://www.servicetechbooks.com) 2. Selected research and white papers by the professor; announced during the lecture. Additional readings Thomas ERL Website (http://www.serviceorientation.com) Fox, Armando and Patterson, David. Engineering Software as a Service: An Agile Approach Using Cloud Computing. First edition.
Prerequisites	CT30A3201 WWW-sovellukset

CT30A8920	***SUSTAINABLE INNOVATION BY DESIGN: A USER EXPERIENCE PERSPECTIVE*** ***5 ECTS cr***
	Sustainable Innovation by Design: A User Experience Perspective **The maximum number of students in the course is 24. Priority is given to students for whom the course in obligatory.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, Ph.D., PEng., HDR. Ahmed Seffah
Aims	How do we design and deploy innovative software products someone is willing to buy and use? Why only few software innovations make it to market and most fail? The course answers to these questions while outlining the user experience design and design thinking theory for open sustainability innovation. Through a mix of readings on design and innovation theories, user research investigations and practical design work in the living lab, students will acquire a practical and a research experience in “innovation and change by design”. In particular, students will: 1. Have a deep immersion into the state of research in HCI, user experience design and design thinking as approaches to sustainability innovation 2. Acquire new skills in building a portfolio of design including sketches and prototypes created and tested in a living lab. Students will complete many hands-on activities and interact with your fellow students and representative of users as you experience a completely different way of learning how to develop human-centric software and information systems, services, and socio-technical system.

Content	Design theories, principles and methods. Principles of design thinking. Human-centric design processes. User experience in design practices. Co-design and innovation in living lab. User research in design. Sustainability by design. Persona and customer profiling. Diary studies. HCI design patterns. Storytelling. Paper prototyping. Usability and sustainability testing. Controlled experiments. Design of innovative software products. Introduction to design research and science. Socio-technical systems design. Historical, cultural, and technical foundations of design and innovation in a range of discipline areas (software engineering, MIS, HCI, arts. In a group of 3-5, students are asked to develop a design concept and validate it in the design living lab. Students are requested to write a research paper and to present a design portfolio that demonstrate their capacity to generate design ideas, innovative concepts, proposals or solutions independently and/or collaboratively in response to a set briefs and/or as a self-initiated activity or based on documented user experiences. The importance of sustainability in design and innovation is a key concern in software and information systems engineering and research. Design principles and methods could be used to create values of software products through the open innovation concept. This course follows from work of open innovation and user-centric design and design thinking theories and principles that established the basis of sustainability innovation. It analyzes the concept of sustainability innovation by design applied to software and information system) from the HCI (human-computer interaction), user experience and research perpective. The course is related to sustainability.
Modes of Study	Lectures 12h. Lecture preparation (mandatory readings) 24h. Practical large design project in a group of 3 (+2) students 60h. User research in living lab 16h. Written research paper and presentation of the design portfolio 18h. Total 130h. Moodle is used in this course.
Evaluation	0-5. Design Portfolio 60%. Research paper 30%. Oral presentation 10%.
Study materials	Course online tutorial, specific mandatory readings from the following books will be provided in class by the professor Tim Brown. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Terry Winograd (ed.): Bringing Design to Software. Addison-Wesley, 1996. Bill Buxton, Sketching User Experiences: Getting the Design Right and the Right Design, Morgan Kauffmann Series on Interactive Technologies, 2007. Mads, et al. (Eds). The Online Encyclopedia of Human Computer Interaction, 2nd Edition. Interaction Design Foundation. Students unfamiliar with basic HCI design are encouraged to walkthrough the textbook User Interface design and evaluation. D. Stone, C. Jarrett, M. Woodroffe. S. Minocha. Morgan Kaufffmann Series in Interactive technologies. 2005.
Prerequisites	Basic expertise in software /user interface design methodologies like UML.

CT30A9301	***CODE CAMP ON PLATFORM BASED APPLICATION DEVELOPMENT*** 　***4 ECTS cr***
	Ohjelmistotuotannon code camp **The course is arranged intensively 1-4 times/year.**
Year and Period	M.Sc. (Tech.) 1-2 INT 43/INT 9
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Jari Porras
Aims	Code camp is a short-term practically oriented course where students work together on their projects based on selected topic of the course. After the course students are expected to be able to use the achieved knowledge on the topic in their work and to implement other projects with selected platform and technology.

Content	Topic varies. Due to the changing topic this course may be studied multiple times, but only with the different content. The course is related to sustainability.
Modes of Study	Lectures and demonstrations, project work, presentation and reporting 52 h, self-study 52 h. Total 104 h.
Evaluation	0 – 5. Project work 60%, reports 30%, presentation 10%.
Study materials	To be announced in beginning of the course based on the selected topic.
Prerequisites	Based on the topic. To be announced with the final course description.

CT60A5101	***MODELS AND METHODS OF SOFTWARE ENGINEERING*** ***5 ECTS cr***
	Models and Methods of Software Engineering **The maximum number of students in the course is 48. Priority is given to students for whom the course in obligatory. Can't be included in the same degree as CT60A5100 Sotware Engineering Methods.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D., PEng., HDR. Ahmed Seffah
Aims	The course covers the main software engineering methods including object-oriented, agile, formal as well as traditional approaches. At the end of this course, the students should be able to: 1. Understand and select the appropriate method or methods for the software development project at hand and for the various types of software systems such as critical-safety systems, interactive consumer services, enterprise applications, hardware software, etc. 2. Master the importance of modeling techniques in software engineering and the diverse types of models. Students should be able to explain the concepts of models, meta-models, platforms dependent and independent models, model-to-model transformations, automated code generation from models. 3. Manage, plan, analyze and contribute to the requirements, design, implementation and maintenance of large software products. 4. Understand how human, social and technical factors may have both positive and negative influences on software engineering methods and practices. 5. Identify the challenges facing the software engineering research community as well as the avenues for further investigations.
Content	Software Engineering Body of Knowledge (SWEBOK). Agile software development. Formal methods. Prototyping techniques. Object-oriented design and analysis. Data-centric methods. Model-driven architecture (MDA). Modeling techniques. Importance of modeling in software development projects. Software engineering tools. Information, structure and behavioral modeling. Systematic literature review and large case studies on specific models and methods, their uses and abuses such as UML, use cases, user task-based prototypes, Z, B, G-Express and BPMN (Business Process Modeling Notation).
Modes of Study	Presentations 16 h, weekly self-study 24 h (mandatory research papers), practical and research assignments 64 h, period 1-2. Preparation for exam 14 h, exam (open book) 2 h. Total 120 h. The course is designed to be a forum for a scientific discussion and presentations by students and guests' reseachers. Except an introductory lectures, the professor will be mainly acting as a senior project manager and a researcher advising students regarding literature review, reliable information sources on software engineering as well as how to select, review and present a case study on software engineering methods. The students will have to work in a team of 2-3; each team will make 2 presentations in class; each student will have to contribute to the writing of a research paper. All together, the presentations provide a systematic framework for selecting the appropriate methods for complex software systems development projects. Moodle is used in this course.

Evaluation	0-5. Practical and research assignment (50%); individual research paper (30%) and final exam (20%).
Study materials	There is no book that covers all the topics addressed in the course. A selection of readings from top journals will be used as basic readings; students are requested to make their own literature review. IEEEE Transactions on Software Engineering IEEE Software ACM Transactions on Software Engineering Methodologies Journal of Software and Systems (JSS) Communication of the ACM The students are encouraged to walkthrough, one of the two following books as a basic introductory reading: R.S Pressman. Software Engineering: A Practitioner's Approach, 7/e, McGraw Hill, 2010 J. Sommerville. Software Engineering. 9/e, Addison Wesley, 2011
Prerequisites	CT60A4001 Ohjelmistotuotanto
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A5200	***SOFTWARE PROJECTS AND PROCESS IMPROVEMENT*** ***7 ECTS cr***
	Ohjelmistoprojektit ja toiminnan kehittäminen
Year and Period	M.Sc. (Tech.) 2 INT 2,10 and 17 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Associate Professor, D.Sc. (Tech.) Uolevi Nikula
Aims	The student demonstrates in practice his/her competence in participating in a software development project in a company. Each student creates a project plan and analyses it in the light of similar projects conducted earlier. During the project, the student compares the planned and actual project progress and provides a realistic report on the project status. After the project, the student analyses the project outcome and compares it with similar projects conducted earlier. All of the key experiences from the project are reported as a part of the project post mortem analysis.
Content	The course consists of three meetings in the spring term and individual work between the meetings. In the first meeting the project plan is presented, in the second meeting the progress of the project is reported, and in the third meeting project outcomes are presented and the final project report is turned in for grading.
Modes of Study	Each meeting takes one day (24 h), and the rest of the course load is spent on individual study (54 h), project management, analysis and report writing (52 h), and education related activities on the project (52 h). Actual work on the project is not counted as course work. Notice that the student him/herself is responsible for attaining a position in a company and making all the arrangements in the company to find a suitable project for this course.
Evaluation	0-5. Grading based on the three presentations and final report.
Study materials	Announced in the lectures.
Prerequisites	Software Engineering Methods or equivalent.
Further Information	3 meetings in intensive weeks 2, 10 and 17. This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A7001	*CRITICAL THINKING AND ARGUMENTATION IN SOFTWARE ENGINEERING* *5 ECTS cr*
	Kriittinen ajattelu ja argumentointi ohjelmistotuotannossa **Can't be included in the same degree as CT10A7001 Green IT and Sustainable Computing.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Jari Porras
Aims	After the course students are familiar with critical thinking and argumentation principles and are able to apply these skills in discussions carried over yearly changing topic. After the course students are familiar with the given topic and understand its importance in software engineering field. Students are able to discuss about the topic and examine it critically.
Content	The course is divided in two parts. Lectures and discussions in third period emphasize critical thinking and argumentation skills. Lectures and seminars in fourth period are used for critical discussions based on a yearly selected topic of software engineering. Students may be divided into small groups that will each study a separate topic.
Modes of Study	Lectures 2 h, homeworks 10 h, online course 26 h, 3. period. Seminars and discussions 19 h, homeworks 26 h, self-study 47 h, 4. period. Total 130 h.
Evaluation	0 - 5. Seminar work(s), active participation in discussions, homeworks.
Study materials	For critical thinking part: A. Freeley, Argumentation and Debate: Critical Thinking for Reasoned Decision Making, Wadsworth Publishing. Software engineering literature changes yearly.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A7101	*SEMINAR ON SOFTWARE ENGINEERING* *4 ECTS cr*
	Ohjelmistotuotannon seminaari
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Postdoctoral Researcher, D.Sc. (Tech.) Andrey Maglyas
Aims	After the course a student should be able to explain the basic principles of scientific work and its reporting, to understand the principles of writing a thesis, to get familiar with approaches in software engineering, to write a report about software engineering in the form of the academic thesis, to use scientific sources of information, to give the corresponding oral seminar presentation, and to act as an opponent.
Content	The first part (period 3) will be implemented together with intelligent computing course "Seminar on Intelligent Computing" (CT50A6501). This will consist of basics of scientific work and its reporting. The last part consists of seminar presentations by students.
Modes of Study	Seminars 8 h, self-study 18 h, 3rd period. Seminars 14 h, 4th period. Seminar presentation 56 h, 3rd or 4th period. Acting as an opponent 8 h. Total 104 h. Moodle is used in this course.
Evaluation	0 - 5. Written seminar report 60%. Seminar presentation 20%. Active participation to all seminar sessions 10%. Acting as an opponent 10%.
Study materials	Material published on the course web page.

CT60A7201	*ARCHITECTURE IN SYSTEMS AND SOFTWARE DEVELOPMENT* 7 ECTS cr
	Architecture in Systems and Software Development, Arkkitehtuuri järjestelmien ja ohjelmistojen kehityksessä **The maximum number of students is limited to 50. Priority is given to students for whom the course in obligatory.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D. Kari Smolander
Aims	The student understands the role of architecture in the development of software and information systems and has the basic skills of how to design and describe architecture.
Content	The role of architecture in development. Software architecture. Systems architecture. Enterprise architecture. Application integration. Architecture design. Architecture documentation. Architectural styles and patterns.
Modes of Study	Lectures, lecture exercises and presentations at lectures 18 h, weekly self-learning 7 h, 3rd period. Lectures, lecture exercises and presentations at lectures 18 h, weekly self-learning 7 h, 4th period. Practical assignment and presentation 60 h. Reading of a literature package 35 h. Preparing for the exam 28 h. Exam 3 h. Total 176 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 60 %, practical assignment 25 %, presentation 15 %.
Study materials	Lecture notes based on the following books: Bass, L., Clements, P., Kazman, R.: Software Architecture in Practice, 2nd Ed., Addison-Wesley, 2003. Linthicum, D.S.: Next Generation Application Integration: From Simple Information to Web Services, Addison-Wesley, 2003. Ross, J.W., Weill, P., Robertson, D.: Enterprise Architecture As Strategy: Creating a Foundation for Business Execution, Harvard Business School Press, 2006. Literature package given at the course.
Prerequisites	Software Engineering Methods or equivalent.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A7302	*SOFTWARE QUALITY, PROCESSES, AND ORGANIZATIONS* 7 ECTS cr
	Software Quality, Processes, and Organizations, Ohjelmistojen laatu, prosessit ja organisaatiot
Year and Period	M.Sc. (Tech.) 2 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Uolevi Nikula
Aims	After the course student can explain quality, process, and organization related issues in software development and how such issues can be solved based on literature and on personal experiences from the course project. Students can also synthesize the knowledge acquired during the course and develop quality and process documentation for a software company.
Content	Software development issues. Software development processes, their history, maturity, and state of the practice. Quality in software development, approaches to assure and improve quality. Processes and organizations.
Modes of Study	Lectures 12 h, exercises 12 h, assignments, self-study 18 h, team project 43 h 1. period.

	Lectures 12 h, exercises 12 h, assignments, self-study 18 h, team project 42 h, 2. Period. Preparation for exam 10 h, exam 3 h. Total amount 182 h.
Evaluation	0 - 5. Exam 50 %, assignments 50 %.
Study materials	Robillard, Kruchten, and d'Astous: Software Engineering Process with the UPEDU, Addison-Wesley, 2002. Other materials announced in the lectures.
Prerequisites	Software Engineering Methods or equivalent. Software development skills required including programming and design.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A7321	***SOFTWARE BUSINESS DEVELOPMENT 5 ECTS cr***
	Software Business Development
Year and Period	M.Sc. (Tech.) 1-2 INT 50 The course is suitable also for doctoral studies.
Teacher(s)	Docent, Ph.D. Marianne Kinnula
Aims	After completing the course, the student has knowledge of how to 1. develop a software business idea over the whole life cycle of the business, 2. conduct market and business analyses, 3. identify sources for financing the business, and how to 4. select a suitable business model for the company.
Content	The course introduces the concepts of business idea, business plan, software business models and strategies, and the software value network. Case studies vary yearly.
Modes of Study	Lectures 4 h, workshops 10 h, seminar presentations 6 h, homeworks and project (pre, course, post) 110h, 4th period. Total amount 130 h.
Evaluation	0-5, project 100%, accepted pre-task.
Study materials	To be announced in course pages and in lectures.

CT60A7400	***FUNDAMENTALS OF INFORMATION SYSTEMS 7 ECTS cr***
	Tietojärjestelmien perusteet
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Erja Mustonen-Ollila
Aims	In order to complete the course the student should be able to: Demonstrate a sound grasp of the history of information systems (IS) in business, including an IS development. Describe the organisational uses of information systems to improve overall quality. Demonstrate the concepts for the specification and design or the re-engineering of organisationally related systems of limited scope using information technology. Explain what is meant by an information system development process, and what performance measurement implies. Show how information technology can be used to design, facilitate, and communicate organisational goals and objectives of information systems. Describe career paths in information systems. Present and discuss the professional and ethical responsibilities of the IS practitioner. Recognise the role and use of IS in technology and in business systems and operations. Identify and describe organisational structure and business processes within these structures. Demonstrate an understanding of the process in systems design and development. Discuss, and describe fundamental concepts of IS theory and their importance to practitioners. Discuss the relationship of IS planning to organisational planning.
Content	Examination of the nature of the information systems discipline and key areas of professional interest and expertise. Introduction of the main topic areas in

	the study of information systems (IS) from both a theoretical and practical perspective. To discuss the role of information systems in society. To explain the operations of information systems, and the role of technology, business, and social environment within systems, and how information systems are developed, acquired or outsourced. To explain the use of information systems in business. To discuss and analyse the changing role of the information systems in the achievement of business objectives such as communication, collaboration, performance enhancement etc. The course is related to sustainability.
Modes of Study	Lectures 12 h, exercises 12 h, 1. period and 2. period. One large practical assignment 72 h. Scientific home work exercises 64 h, 1.-2. period. Preparation to the exam 15 h, exam 3 h. Total amount 182 h.
Evaluation	0 - 5. Exam 50 %, one practical assignment 50 %. It is also possible to replace some questions in the exam by doing an extensive amount of home work exercises (200 exercises).
Study materials	Stair, R., and Reynolds, G. (2006) The Fundamentals of Information Systems. 3rd edition. ISBN 13: 978-0-619-21560-6. ISBN 10: 0-619-21560-7.
Prerequisites	CT60A4001 Ohjelmistotuotanto
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction. Enrolment to tutorial groups in WebOodi

CT60A7500	***OBJECT-ORIENTED PROGRAMMING TECHNIQUES*** ***5 ECTS cr***
	Olio-ohjelmoinnin menetelmät
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, Ph.D. Kari Smolander
Aims	The student understands advanced concepts and techniques of object-oriented programming, especially design patterns, and can apply these techniques in solving practical programming tasks.
Content	Introduction to Java. Java run-time object model. Composition, inheritance, and interfaces. Reusability. Collections and containers. Reflection. Serialization. Design patterns and their applications. Design rules and principles.
Modes of Study	Lectures 12 h, exercises 12 h, exercise preparation 7 h, weekly self-study 7 h, 3. period. Lectures 12 h, exercises 12 h, exercise preparation 7 h, weekly self-study 7 h, 4. period. Three practical assignments 27 h. Preparing for the exam 16 h, exam 3 h. Total amount 122 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 60 %, exercises and practical assignment 40 %.
Study materials	Lecture notes. Eckel, B.: Thinking in Java, Prentice Hall. Gamma, E. et al.: Design Patterns, Addison-Wesley. Freeman, Freeman, Sierra & Bates: Head First Design Patterns, O'Reilly (2004 or newer).
Prerequisites	CT60A2410 Olio-ohjelmointi (Object-Oriented Programming) or equivalent.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A8000	GAME DEVELOPMENT PROJECT	3 - 5 ECTS cr
	Pelikehitysprojekti **The course is arranged intensively. Each course is announced separately.**	
Year and Period	M.Sc. (Tech.) 1-2	
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Jussi Kasurinen	
Aims	After finishing the course student understands how game development differs from "traditional" software projects, and can apply software development skills in a game context. Student understands the possibilities and restrictions of the game products and has identified the skills required for professional game developers. Student is able to apply the taught game development tools to design and implement game resources.	
Content	Game development process. Game design. Programming environments and game engines. Detailed topic varies yearly; course is given as a project or code camp course depending on the implementation.	
Modes of Study	Detailed implementation varies yearly; Lectures and demonstrations, 10 h. Working as a member of a student team and project work 48-100 h. Project reporting and presentation 20 h. Total 78-130 h.	
Evaluation	0 - 5. Project work 80%, team work 20% (evaluated by the teachers and peers).	
Study materials	On-line material, material provided by the lecturer.	
Prerequisites	CT60A2410 Olio-ohjelmointi, CT60A4001 Ohjelmistotuotanto	

CT60A9000	TOWARDS SEMESTER 3	1 ECTS cr
	Towards Semester 3, Valmistautuminen 3 lukukauteen **Only for Erasmus Mundus Perccom programme.**	
Year and Period	M.Sc. (Tech.) 1 Period 4	
Teacher(s)	Course will be arranged together with Luleå University of Technology in Erasmus Mundus Pervasive Computing and Communications for sustainable development programme. Person in Charge: Professor, D.Sc. (Tech.) Jari Porras	
Aims	After the course students will know the requirements set for studies in semester 3 in Luleå University of Technology.	
Content	Preparation for studies in semester 3. Required prerequisites. Practical arrangements for ending studies in Lappeenranta and moving to Luleå.	
Modes of Study	Lectures 6h, homeworks 20h, 4th period. Total 26h.	
Evaluation	Passed/Fail, homeworks	

CT60A9200	SEMINAR ON SUSTAINABLE SOFTWARE AND SERVICES 1	3 ECTS cr
	Seminar on Sustainable Software and Services 1, Kestävät ohjelmistot ja palvelut seminaari 1 **Only for Erasmus Mundus PERCCOM programme.**	
Year and Period	M.Sc. (Tech.) 1 Period 4	
Teacher(s)	Course will be arranged in St. Petersburg National Research University of Information Technologies, Mechanics and Optics together with Erasmus Mundus Pervasive Computing and Communications for sustainable development programme partners.	

	Person in Charge: Professor, D.Sc. (Tech.) Jari Porras
Aims	After the course students are familiar with the given topic on sustainable software and services and understand its importance from the software engineering perspective. Students are able to discuss about the topic and examine it critically.
Content	The course will be arranged in St. Petersburg in cooperation with Erasmus Mundus Pervasive Computing and Communications for sustainable development programme partners. The contents of the course varies yearly. The course is related to sustainability.
Modes of Study	Seminars 26h, documentation 26h, self-study and preparation 26h, 4th period. Total 78h.
Evaluation	0-5, Seminar work(s).

CT60A9400	***SEMINAR ON SUSTAINABLE SOFTWARE AND SERVICES 2*** **3 ECTS cr**
	Seminar on Sustainable Software and Services 2, Kestävät ohjelmistot ja palvelut seminaari 2 **Only for Erasmus Mundus PERCCOM programme.**
Year and Period	M.Sc. (Tech.) 1 Period 4
Teacher(s)	Course will be arranged in St. Petersburg National Research University of Information Technologies, Mechanics and Optics together with Erasmus Mundus Pervasive Computing and Communications for sustainable development programme partners. Person in Charge: Professor, D.Sc. (Tech.) Jari Porras
Aims	After the course students are familiar with the given topic on sustainable software and services and understand its importance from the software engineering perspective. Students are able to discuss about the topic and examine it critically.
Content	The course will be arranged in St. Petersburg in cooperation with Erasmus Mundus Pervasive Computing and Communications for sustainable development programme partners. The contents of the course varies yearly. The course is related to sustainability.
Modes of Study	Seminars 26h, documentation 26h, self-study and preparation 26h, 4th period. Total 78h.
Evaluation	0-5, Seminar work(s).

CT60A9500	***GADGET CODE CAMP – HACKING TECHNOLOGY*** **1 ECTS cr**
	Gadget Code Camp – Hacking Technology **LUT Summer School, 7. – 9.8.2015.**
Year and Period	M.Sc. (Tech.) 1-2
Teacher(s)	Doctoral Student, M.Sc. (Tech.) Antti Knutas Person in Charge: Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen
Aims	Build a prototype software product and learn to utilize cutting edge technologies.
Content	Brainstorm and bring out your most creative ideas! Develop for all sorts of gadgets from Arduinos to brainwave scanners. We will bring pile of the exotic gadgets. What's the most creative you and your team can implement with these devices? Code Camp is a learning and hacking experience. The code camp approach can be defined as a collaborative learning setting that aims to promote profession-oriented skills. In code camp, the term camp refers to a situation where

	students assemble and stay a while together. The term code refers to coding, i.e. writing computer programs. During a code camp, students write programs together, solve problems related to their work together, eat together and even might relax together in a sauna.
Modes of Study	Active participation as part of a team.
Evaluation	Pass/Fail. 70% course project, 30% project presentation.
Study materials	Given API-descriptions and Internet resources.
Prerequisites	Creative thinking, passion, willingness to have an awesome hacker experience, courage to try out new things and background on programming.

Industrial Engineering and Management

6.3 Master's Programme in Global Management of Innovation and Technology (GMIT)

Master's Programme in Industrial Engineering and Management – Global Management of Innovation and Technology – offers a wide variety of perspectives into the management of innovation and technology in an international environment that is based on the combination of business, engineering and management.

The programme starts annually and lasts two years. The programme course package is worth approximately 90 ECTS credits, and at the end of their studies, students write a Master's thesis counted as an additional 30 ECTS credits. The programme is in total worth 120 ECTS credits, leading to a Master of Science in Technology degree.

Aims and Learning Outcomes

LUT Industrial Engineering and Management educates knowledgeable, business oriented students devoted to their own special subjects of technology and management for the service of industrial companies, and commercial and public organisations. The graduates from Industrial Engineering and Management have a good understanding of technology, wide business knowledge, and a strong competence in the management and development tasks of a company. They have an ability to work in an international context, and act in a responsible and ethical way. They can and will further develop and enhance their own competencies.

After completing the degree, the graduate can

- create and analyse strategies within an international context relating to products, services and technologies
- practice and manage strategies of decision making, frameworks and tools in a global networks and markets
- analyse processes and structures of organisations and their development issues
- practice, plan and manage the build-up of product families, product systems, and product platforms for tangible and intangible goods using widely different management methods in companies and networks
- plan and manage international business
- apply theories, methods and tools of decision making and analysis to practical management activities.

Programme-specific Information

International studies combined with engineering and business management skills and a multi-cultural study environment provide graduates with interesting and challenging career prospects. Global customer-supplier relationships and business networks demand talented young professionals in management of innovations and technologies, industrial marketing, management of sales, supply chain management and technology sourcing. Master of Science graduates with an engineering and management background and a strong ability and will to continue learning after graduation will have many career opportunities at the executive level of management as well as in global technology and business.
Graduates from the degree programme of Industrial Engineering and Management have been employed e.g. as export managers, key account managers, logistics managers, controllers, analysts, business application specialists, operative purchasers, technology innovation managers etc. The studies also give graduates a firm basis for doctoral studies in the field of industrial engineering and management.

Field of Specialisation

The following field of specialisation is available as a major subject at Lappeenranta University of Technology at the degree programme of Industrial Engineering and Management: Global Management of Innovation and Technology. Efforts will be made to offer all students the opportunity to prepare their final Master's thesis for practical purposes in companies. In this way, students will have a chance to find solutions to practical problems that companies face. Besides the specific obligatory or elective courses offered in the degree programme, all other courses arranged at the university in English are available for the students, subject to practical limitations such as group size, teaching methods, schedules, etc.

The major subject allows focusing on a range of areas for the Master's thesis phase. Students may prepare their final thesis on topics including industrial marketing and international business, innovation and technology management, product and service development in networked company structures, methods and tools for decision making in product development and technology management, managing ramp-ups and innovative product launches in the market place, supply-demand networks, and service management. As a rule, all lecturing professors of the programme are available for supervising thesis. The topics may vary depending on the needs of the companies.

Degree Structure

Master of Science 120 ECTS cr

	ECTS cr
General studies	11
Major subject	70
Minor subject	20
Elective studies	19
Total	*120*

General Studies

Obligatory studies (11 ECTS cr)		*year*	*per.*	*ECTS cr*
CS10A0120	Introduction to M.Sc. Studies in Industrial Engineering and Management	M.Sc. (Tech.) 1	1-4	1
CS10A0863	Research Methods for Master Students	M.Sc. (Tech.) 1	1-2	6
FV11A9800	Academic Writing in English Course 1	M.Sc. (Tech.) 1	1/3	2
FV11A9900	Academic Writing in English Course 2	M.Sc. (Tech.) 1	2/4	2

Major Subject Global Management of Innovation and Technology 70 ECTS cr

Major Subject 70 ECTS cr

Obligatory studies (60 ECTS cr)		*year*	*per.*	*ECTS cr*
CS10A0551	International Business Methods	M.Sc. (Tech.) 1	3	6
CS30A1340	Strategic Technology and Innovation Management	M.Sc. (Tech.) 1	3-4	8
CS30A1375	Product Development	M.Sc. (Tech.) 1	1-2	5
CS30A1661	Open Innovation	M.Sc. (Tech.) 2	3-4	6
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	M.Sc. (Tech.) 2	INT 43	5
CS90A0060	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

Elective studies min. 10 ECTS cr		*year*	*per.*	*ECTS cr*
CS10A0151	Business Relationships and Networks	M.Sc. (Tech.) 1	3-4	5
CS10A0431	Industrial Project and Solution Marketing	M.Sc. (Tech.) 2	1	5
CS10A0651	Management of Innovations in Russia	M.Sc. (Tech.) 1	4	5
CS30A1371	Creative Design and Problem Solving	M.Sc. (Tech.) 1	1-2	5
CS30A1551	System Dynamics and Industrial Management	M.Sc. (Tech.) 1-2	INT 43 - per. 2	5
CS30A1670	Service Innovation and Management	M.Sc. (Tech.) 2	3-4	5
CS30A7401	Software and Application Innovation	M.Sc. (Tech.) 2	1-2	5
A330A0200(*	International Marketing of High Technology Products and Innovations	M.Sc. (Tech.) 2	1-2	6
A330A0220(*	International Marketing of High Technology Products and Innovations: applications	M.Sc. (Tech.) 2	1-2	3
CS30A1684	Advanced Course in Strategic Management	M.Sc. (Tech.) 1-2		3
CS30A7361	Sustainable Products and Processes: Cradle-to-Grave Approach	M.Sc. (Tech.) 1-2		3
CS30A7370	Simulation Modelling in Industrial Management	M.Sc. (Tech.) 1-2		3
CS30A7380	Systematic Creativity - TRIZ Basics	M.Sc. (Tech.) 1-2		3
CS30A7390	Inventive Product Design and Advanced TRIZ	M.Sc. (Tech.) 1-2		3

*) Exchangeable

Minor Subject Business Technology 20 ECTS cr

Minor: Business Technology

Obligatory studies (10 ECTS cr)		*year*	*per.*	*ECTS cr*
CS30A1390	Systems Engineering	M.Sc. (Tech.) 1	3-4	5
CS35A0152	Product Lifecycle Management	M.Sc. (Tech.) 1	4	5

Elective studies min. 10 ECTS cr		*year*	*per.*	*ECTS cr*
CT30A5110	Gamification - from Concepts to Implementations	M.Sc. (Tech.) 1-2	1-4	3
CT30A8920	Sustainable Innovation by Design: A User Experience Perspective	M.Sc. (Tech.) 1	1-2	5
CT60A7201	Architecture in Systems and Software Development	M.Sc. (Tech.) 1	3-4	7
CT60A7400	Fundamentals of Information Systems	M.Sc. (Tech.) 1	1-2	7
CT10A7001(*	Green IT and Sustainable Computing	M.Sc. (Tech.) 1-2	3-4	5
CT60A7001(*	Critical Thinking and Argumentation in Software Engineering	M.Sc. (Tech.) 1-2	3-4	5

*) Exchangeable

Elective Studies 19 ECTS cr

Elective studies are needed to attain the full 120 ECTS credits. It is recommended to choose the elective studies among the courses that are listed under major subject. However, elective courses can include any courses offered by LUT if the required prerequisites are completed. The elective studies complete the requirements of the degree (120 ECTS cr); if the general studies, studies in the major and minor subjects fulfil the requirements for the degree, the elective studies may be 0 ECTS cr.
Teknisk svenska 2 ECTS is obligatory for Finnish students who have not attained proficiency in Swedish in their previous degree.

Double Degree program organized in cooperation with the Illinois Institute of Technology – IIT (USA)

Students admitted to complete the Master's degree in the GMIT program at the LUT may apply to the double degree (DD) program organized in cooperation with the Illinois Institute of Technology – IIT (USA). The corresponding program in IIT is Master of Industrial Technology and Operations (MITO). LUT will select the candidates to be recommended on the basis of the specific selection criteria from the pool of students who apply to the program. The Admission of LUT students to IIT will be determined by IIT. The application requirements and application period is published in UNI-portal annually.

Master’s Degree Programme in Industrial Engineering and Management

Global Management of Innovation and Technology (GMIT)

Double Degree LUT – partner university

Joint Master’s Degree Programme is a double degree programme between LUT and partner universities. The students will study one year at their home university and then come to LUT for second year to specialize in Global Management of Innovation and Technology. Student is expected to do Master's thesis according to LUT practices.

Student is also obliged to complete studies at home university and obtain diploma from there.

Please note that if the Bachelor’s degree is from the field of economics / business, the degree from the Industrial Engineering and Management has to include the minor Business Technology and some complementary studies if needed (which are not included in the Master’s degree).

Degree Structure for Double Degree Students in GMIT

Master of Science 120 ECTS cr

	ECTS cr
General studies	11
Major subject	70
Minor subject	20
Elective studies	19
Total	*120*

Compensation from the partner university’s studies to LUT degree (altogether max. 50 ECTS credits) is included followingly:
General studies 11 ECTS credits, minor subject 20 ECTS credits and elective studies 19 ECTS credits.

Major Subject Global Management of Innovation and Technology 70 ECTS cr

Major Subject 70 ECTS cr

Obligatory Studies (67 ECTS cr)		*year*	*per.*	*ECTS cr*
CS10A0120	Introduction to M.Sc. Studies in Industrial Engineering and Management	M.Sc. (Tech.) 1	1-4	1
CS10A0551	International Business Methods	M.Sc. (Tech.) 1	3	6
CS10A0863	Research Methods for Master Students	M.Sc. (Tech.) 1	1-2	6
CS30A1340	Strategic Technology and Innovation Management	M.Sc. (Tech.) 1	3-4	8
CS30A1375	Product Development	M.Sc. (Tech.) 1	1-2	5
CS30A1661	Open Innovation	M.Sc. (Tech.) 2	3-4	6
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	M.Sc. (Tech.) 2	INT 43	5
CS90A0060	Master’s Thesis	M.Sc. (Tech.) 2	1-4	30

Elective studies min. 3 ECTS cr		*year*	*per.*	*ECTS cr*
CS10A0431	Industrial Project and Solution Marketing	M.Sc. (Tech.) 2	1	5
CS10A0151	Business Relationships and Networks	M.Sc. (Tech.) 1	3-4	5
CS10A0651	Management of Innovations in Russia	M.Sc. (Tech.) 1	4	5
CS30A1371	Creative Design and Problem Solving	M.Sc. (Tech.) 1	1-2	5
CS30A1390	Systems Engineering	M.Sc. (Tech.) 2	3-4	5
CS30A1551	System Dynamics and Industrial Management	M.Sc. (Tech.) 1-2	INT 43 - per. 2	5
CS30A1670	Service Innovation and Management	M.Sc. (Tech.) 2	3-4	5
CS30A7401	Software and Application Innovation	M.Sc. (Tech.) 2	1-2	5
A330A0200(*	International Marketing of High Technology Products and Innovations	M.Sc. (Tech.) 2	1-2	6
A330A0220(*	International Marketing of High Technology Products and Innovations: applications	M.Sc. (Tech.) 2	1-2	3

*) Exchangeable

Please note that if the Bachelor's degree is from the field of economics / business, the degree from the Industrial Engineering and Management has to include the minor Business Technology.

Course Descriptions in Industrial Engineering and Management

		ECTS cr
CS10A0120	Introduction to M.Sc. Studies in Industrial Engineering and Management	1
CS10A0151	Business Relationships and Networks	5
CS10A0260	Managing International Business	5
CS10A0270	Economic Challenges in Russia	3
CS10A0351	Qualitative Research in Industrial Management	5
CS10A0431	Industrial Project and Solution Marketing	5
CS10A0551	International Business Methods	6
CS10A0651	Management of Innovations in Russia	5
CS10A0760	Business in Russia	6
CS10A0770	Cleaner Technologies and Markets	5
CS10A0863	Research Methods for Master Students	6
CS30A1340	Strategic Technology and Innovation Management	8
CS30A1371	Creative Design and Problem Solving	5
CS30A1375	Product Development	5
CS30A1390	Systems Engineering	5
CS30A1551	System Dynamics and Industrial Management	5
CS30A1601	Case Course in Strategy Consulting	3
CS30A1640	Inventive Product Design and Advanced TRIZ	5
CS30A1661	Open Innovation	6
CS30A1670	Service Innovation and Management	5
CS30A1682	Advanced Course in Strategic Management	5
CS30A1684	Advanced Course in Strategic Management	3
CS30A1690	Social Sustainability	5
CS30A7330	Innovation Management in New Product Creation	3
CS30A7361	Sustainable Products and Processes: Cradle-to-Grave Approach	3
CS30A7370	Simulation Modelling in Industrial Management	3
CS30A7380	Systematic Creativity - TRIZ Basics	3
CS30A7390	Inventive Product Design and Advanced TRIZ	3
CS30A7401	Software and Application Innovation	5
CS31A0603	Life-Cycle Costing of Investment Projects	5
CS34A0301	Theory of the Entrepreneurship	5
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	5
CS35A0152	Product Lifecycle Management	5
CS90A0060	Master's Thesis	30
CT10A7001	Green IT and Sustainable Computing	5
CT30A5110	Gamification - from Concepts to Implementations	3
CT30A8920	Sustainable Innovation by Design: A User Experience Perspective	5
CT60A7001	Critical Thinking and Argumentation in Software Engineering	5
CT60A7201	Architecture in Systems and Software Development	7
CT60A7400	Fundamentals of Information Systems	7

CS10A0120	INTRODUCTION TO M.SC. STUDIES IN INDUSTRIAL ENGINEERING AND MANAGEMENT 1 ECTS cr
	Introduction to M.Sc. Studies in Industrial Engineering and Management
Year and Period	M.Sc. (Tech.) 1 Period 1-4
Teacher(s)	Professor, D.Sc. (Tech.) Juha Väätänen Doctoral Student, M.Sc. (Tech.) Pekka Torvinen Information Specialist, M.Sc. (Tech.) Marja Talikka Person in Charge: Professor, D.Sc. (Tech.) Juha Väätänen
Aims	The course provides the student with basic knowledge of studying at Lappeenranta University of Technology (LUT), Finland, in general and particularly in his/her school and degree programme. The course is aimed to help students to plan their studies at LUT and follow the progress of their studies with the help of a individual study plan. Students recognize their own learning strategy and learn about information retrieval and the information sources available at LUT for courses and studying by using the Academic Library's services, collections and databases.
Content	The Orientation Days activities. Practical study-related information. Degree requirements. Planning of Master's studies. Preparation of the individual study plan. Monitoring the progess of studies with the Academic Director and Student Affairs Secretary. The Academic Library collections and databases.
Modes of Study	Participation in the Orientation Days. Planning the individual study plan. Library introduction lectures and assignments on information retrieval and library databases on Moodle (Period 1). Study programme meetings with the Academic Director and Student Affairs Secretary (Periods 1-4). Assignments: individual study plan, library assignments. Independent study. Total 26 h. Moodle is used in this course.
Evaluation	Pass/Fail (assignments, active participation in study programme meetings)
Study materials	Materials will be announced during the course.

CS10A0151	BUSINESS RELATIONSHIPS AND NETWORKS 5 ECTS cr
	Business Relationships and Networks
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Asta Salmi Doctoral Student, M.Sc. (Tech.) Minna Oinonen Visiting lecturers. Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Asta Salmi
Aims	Student: 1. Understands the premises of relationship and network theories in industrial marketing 2. Knows theoretical approaches to inter-organizational relationships for industrial business management 3. Is able to identify the interdependencies in industrial supplier-customer relationships and capable to apply theoretical frameworks in analyzing and managing these relationships 4. Is familiar with and capable of applying theoretical frameworks related to industrial business networks 5. Knows the principles and frameworks of marketing and purchasing in industrial network management 6. Understands the drivers and features of sustainable business networks and contemporary challenges in building these networks
Content	Relationship and network theory in industrial marketing. Theoretical approaches to inter-organizational relationships and networks in industrial busi-

	ness management. Management and co-operation in supplier-customer relationships. Characteristics of industrial purchasing and supplier relationships. Global supply networks and global value chains. Challenges and management of cross-sectoral networks. Sustainable and eco-industrial networks and challenges of managing them. The course is related to sustainability.
Modes of Study	Lectures 32 h, seminar and assignments 20 h, learning diary 80 h. Total 132 h. Moodle is used in this course.
Evaluation	0 - 5. Learning diary and assignments 100%.
Study materials	Ford David, Gadde Lars-Erik, Håkansson Håkan, Snehota Ivan: Managing Business Relationships, 3rd edition. John Wiley & Sons Ltd, IMP Group, 2011. Book chapters will be announced during the course. Selected articles. Lecture materials.
Prerequisites	CS10A0001 Markkinoinnin peruskurssi
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0260	***MANAGING INTERNATIONAL BUSINESS 5 ECTS cr***
	Managing International Business
Year and Period	B.Sc. (Tech.) 3 Period 2
Teacher(s)	Professor, D.Sc. (Tech.) Juha Väätänen Doctoral Student, M.Sc. (Tech.) Pekka Torvinen Person in Charge: Professor, D.Sc. (Tech.) Juha Väätänen
Aims	Student 1. recognizes the different entry modes and is able to describe the advantages and disadvantages between the different operation methods 2. is able to describe the most well known internationalization theories and evaluate the international operations of enterprises based on these theories 3. recognizes the characteristics of international business relationships and understands the key practices of global account management 4. knows the principles of building a global marketing strategy and the factors affecting it.
Content	Entry modes in international business. Internationalization theories. Multinational enterprises in global business. Marketing strategies. International business relationships and networks. Global account management.
Modes of Study	Lectures 18 h, written report 43 h, course literature 40 h, self study and exam preparation 30 h. Total 131 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 65 %, written report 35 %. Each of the components has to be passed acceptably.
Study materials	Hollensen, S., 2004, Global Marketing: A Decision-oriented approach, Harlow : FT Prentice Hall. Additional materials will be announced on lectures.
Prerequisites	The amount of participants may be limited. In this case the priority would be given to the students of Industrial Engineering and Management.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0270	***ECONOMIC CHALLENGES IN RUSSIA 3 ECTS cr***
	Venäjän taloudelliset haasteet
Year and Period	M.Sc. (Tech.) 1 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Soc.Sc. Pekka Sutela Project Researcher, M.Sc. (Tech.) Ekaterina Albats Person in Charge: Professor, D.Soc.Sc. Pekka Sutela

Aims	After the course, students will be able to follow and understand Russia's economic development, understand various different political and economic options of countries, draw conclusions on the political and economic future of Russia.
Content	The course provides an up-to-date introduction to the political economy of Russia since 1991. It first outlines the inheritance left by the Soviet Union and then deals with the Russian economics of transition in the 1990s. The political economy of the Putin years since 2000 are discussed in some detail, including issues of economic policy, financial and fiscal issues, the role of energy and the growth experience of the 2000s. The path of the economy in the Great Depression is also discussed, and attention is paid to Putin's current third term as President. Finally, the economic and political economy challenges ahead are outlined, including demography, deceleration of growth, the role of Russia in the global economy and issues of economic relations with the neighbouring countries.
Modes of Study	Lectures 24 h, course reading package 22 h, exam preparation 22 h, total 68 h. Moodle is used in this course.
Evaluation	0-5, Exam 100%
Study materials	Sutela P. (2012) The Political Economy of Putin's Russia. Routledge. EBRD Transition Report, newest version. Available on EBRD website. Gaddy, C. G. and Ickes, B. 2013. Bear Traps on Russia's road to Modernization. Routledge, New York, USA.
Prerequisites	Sufficient prior business studies required.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0351	***QUALITATIVE RESEARCH IN INDUSTRIAL MANAGEMENT*** ***5 ECTS cr***
	Qualitative Research in Industrial Management **M.Sc. (Tech) 1 students, as well as LBM postgraduate students, who apply qualitative research methods in their doctoral thesis. The maximum number of students is 25.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Asta Salmi Post-Doctoral Researcher, D.Sc. (Tech.) Joona Keränen Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Asta Salmi
Aims	Upon completion of the course, students will gain an understanding of major qualitative research methods. The course provides students with resources and skills to plan and conduct a qualitative study. The student will learn to make informed choices in their own research (master or doctoral thesis) and understand the possibilities and limits of their chosen methods.
Content	The course focuses on the process of doing research and systematic empirical analysis; and builds understanding of various types of qualitative research approaches, data and methods. The course introduces the student to the following topics: 1. Philosophical assumptions in qualitative research. 2. Research design. 3. Collection and analysis of appropriate qualitative empirical data. 4. Criteria for qualitative research. 5. Reporting of qualitative research. The course has several in-class and home assignments (individually and in groups) to develop the student skills in conducting high-quality research.
Modes of Study	Lectures and seminars 22 h. Independent learning and course assignments 60 h. Exam preparation and exam 45 h. Total 127 h. Moodle is used in this course.
Evaluation	0-5. Exam 50 %, Assignments 50 %.
Study materials	Creswell, John: Qualitative Inquiry and Research Design: Choosing Among Five Approaches, 2013.

	Eriksson, Päivi & Kovalainen, Anne: Qualitative methods in business research, 2008. Selected articles. Lecture materials
Prerequisites	CS10A0001 Markkinoinnin peruskurssi
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0431	***INDUSTRIAL PROJECT AND SOLUTION MARKETING 5 ECTS cr***
	Teollinen projekti- ja ratkaisumarkkinointi **Can't be included in the same degree as CS10A0430 Projektien ja ratkaisujen markkinointi.**
Year and Period	M.Sc. (Tech.) 2 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Olli Pekkarinen Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Olli Pekkarinen
Aims	After the course student 1. Understands the basic approaches to industrial project and solution marketing. 2. Is able to evaluate the applicability of different industrial project and solution marketing theoretical frameworks in varying business situations. 3. Is able to apply the latest research findings in the area of industrial project and solution marketing in solving business challenges. 4. Understands challenges related to industrial project and solution marketing research in industrial management.
Content	Contemporary issues in project and solution marketing and their latest research orientations, including the following: the background, concepts, characteristics and reasons for industrial project and solution marketing. Industrial services as a key part of industrial projects and solutions. Problems and guidelines regarding the reorientation of business towards industrial project and solution provision. Special characteristics of industrial projects and solutions related to sustainable design. Managerial and practical illustrations related to marketing and selling industrial projects and solutions. The main trends within recent industrial project and solution marketing research focus, both globally and at LUT. The course is related to sustainability.
Modes of Study	Lectures 5 x 2 h, workshops 2 x 4 h, reading the literature, preparation for the workshops and the exam 112 h. Total 130 h. 1st period. Moodle is used in this course.
Evaluation	0–5. Exam 65%, seminar 35%
Study materials	Kaario, Kari: Transformation Kaleidoscope. The Missing Link for Successful Sales Strategy. WSOYPro, 2009. Article collection.
Prerequisites	CS10A0151 Business Relationships and Networks
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0551	***INTERNATIONAL BUSINESS METHODS 6 ECTS cr***
	Kansainvälisen liiketoiminnan menetelmät
Year and Period	M.Sc. (Tech.) 1 Period 3
Teacher(s)	Professor, D.Sc. (Tech.) Juha Väätänen Doctoral Student, M.Sc. (Tech.) Pekka Torvinen Person in Charge: Professor, D.Sc. (Tech.) Juha Väätänen

Aims	Student is able to distinguish and evaluate the characteristics of international business. Student learns the different dimensions and drivers of market globalization. Student knows how international trade and investments affect to home and host countries. Students are able to evaluate the risks and opportunities in the global markets, know the international business theories and tell why and how companies internationalize.
Content	The course gives students knowledge of international business. It covers following topics of international business: (1) International business theories, (2) International trade and investments, (3) Drivers of globalization, (4) Global business environment, relations and trade agreements, (5) Motives for internationalization, (6) Modes of international operations, (7) Risks assessment in international markets.
Modes of Study	Lectures 18 h, exercises 8 h, written assignments 33 h, written report 30 h, course literature 32 h, self study and exam preparation 33 h. There are two exercise groups per week for this course. Total 154 h. Moodle is used in this course.
Evaluation	0 - 5. Examination 60 %, exercises 20 %, research report 20 %. Each of the components has to be passed acceptably.
Study materials	Cavusgil, S. T., Knight, G., and Riesenberger, J. (2008) International Business: The New Realities, Second Edition. Additional materials will be announced on lectures.
Prerequisites	CS10A0260 Managing International Business Sufficient prior business studies required. Due to the teaching methods, the amount of participants may be limited. In this case the priority would be given to the students of Industrial Management.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0651	***MANAGEMENT OF INNOVATIONS IN RUSSIA 5 ECTS cr***
	Management of Innovations in Russia
Year and Period	M.Sc. (Tech.) 1 Period 4 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Daria Podmetina
Aims	This course aims at providing students with knowledge of innovation process and innovation strategy on individual, company and country levels, discussing the national/regional innovation systems in Russia and role of and the interaction between main players of the innovation system (universities and research organizations, enterprises, government and industries). The problems of establishing innovative companies, innovative entrepreneurship and incubation process will be discussed on the course. We will also cover problems of innovation commercialization and implementation of modern innovation theories in Russia and will discuss, on the examples of case studies, innovation management in Russian firms.
Content	National Innovation System in Russia: main players, role of government, innovation policy, role of universities and research institutions, innovation infrastructure. Innovative industries in Russia. International cooperation and involvement in global innovation. Innovative entrepreneurship, innovative startups and business incubation in Russia. Commercialization of innovations. Technology and innovation management in Russia. Case studies. The course is related to sustainability.
Modes of Study	Lectures 12 h, written report 45 h, course literature 45 h, self-study and exam preparation 32 h. Total 134 h. The course is using Noppa.
Evaluation	0-5. Based on exam (60 %), written report (40%).
Study materials	1. Russia: Focus on Innovation (2013). Public analytical report on the implementation of the Strategy for Innovative Development of the Russian Federation for the period until the year 2020;

	2. Gupta, N., Ship, S. S., Nash, S. H., Herrera, G.J., Healey, D. W. (2013). Innovation Policies in Russia, IDA – Institute for Defense Analysis Report, IDA paper P-5079; 3. Russia’s Productivity Imperative. Leveraging technology and Innovation to drive growth (2009) IBM Global Business Services Executive Report; 4. Developing Mechanisms to Enhance the Russian Development Innovation Institutions (2013). Russian Economic School Report; 5. Adams, J., Pendlebury, D., and Stembridge, B. (2013). Building BRICKS: Exploring the global research and innovation impact of Brazil, Russia, India, China and South Korea, Thomson Reuters report. 6. National innovation system and state innovation policy of the Russian Federation (2009), OECD; 7. Desai, R.M., Goldberg, I. (2007) Enhancing Russia’s competitiveness and innovative capacity, The World Bank 8. Additional material will be announced at the lectures.
Prerequisites	It is a master level course, thus sufficient prior business studies required. Due to the teaching methods, the amount of participants is limited to 50. If more students register, the priority would be given to the students of industrial engineering and management.

CS10A0760	*BUSINESS IN RUSSIA* 6 ECTS cr
	Business in Russia
Year and Period	M.Sc. (Tech.) 1 Period 3
Teacher(s)	Professor, D.Sc. (Tech.) Juha Väätänen Project Researcher, M.Sc. (Tech.) Ekaterina Albats Person in Charge: Professor, D.Sc. (Tech.) Juha Väätänen
Aims	Student is able to 1. analyze consumer markets, 2. define the special characteristics of Russian business, 3. assess competitiveness of industrial sectors and enterprises, 4. asses foreign direct investment projects, 5. evaluate the impact of foreign direct investment, 6. recognize Russia’s competitive advantages and disadvantages, 7. explain the methods of increasing competitiveness and productivity on national, industrial and enterprise level.
Content	Consumer markets. Living standard analysis. Russian enterprise structures. Industrial and service sectors. New enterprises. Role of government. How to do Business in Russia? – Trade, foreign direct investments and e-commerce. Russia’s competitiveness and future trends. The course is related to sustainability.
Modes of Study	Lectures 18 h, seminar work and presentation 60 h, course literature 45 h, self study and exam preparation 33 h. Total 156 h.
Evaluation	0 - 5. Exam 60 %, written report 20 %, presentation 20 %. Each of the components has to be passed acceptably.
Study materials	The World Bank in the Russian Federation. Policy Uncertainty Clouds Medium-Term Prospects. Latest available version. Diversifying Russia. Harnessing regional diversity. EBRD. Latest available version. Additional material will be announced on lectures
Prerequisites	Recommended: CS10A0270 Economic Challenges in Russia. Other sufficient prior business studies are encouraged. Due to the teaching methods, the amount of participants may be limited. In this case the priority would be given to the students of Industrial Engineering and Management.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0770	*CLEANER TECHNOLOGIES AND MARKETS* 5 ECTS cr
	Cleaner Technologies and Markets
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Anne Jalkala

	Doctoral Student, M.Sc. (Tech.) Samuli Patala Visiting lecturers Person in Charge: Professor, D.Sc. (Tech.) Anne Jalkala
Aims	After the course the student: 1. Understands the characteristics of cleaner technologies and their global markets. 2. Can recognize how the different elements of cleaner technology offerings, including services, can provide environmental and economic benefits. 3. Understands the tools and processes involved in marketing cleaner technologies in industrial markets; including co-creation with customers, customer value assessment and commercialization.
Content	The characteristics and forms of cleaner technologies. Key global markets in the cleantech sector. Co-creation with customers. Value assessment methods. Commercialization of cleaner technologies. The course is related to sustainability.
Modes of Study	Lectures 18 h, learning diary 20 h, 3. period. Seminar 8 h, written assignment 40 h, preparation for the exam 46 h, 4. period. Total 132 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 50 %, written assignment 50 %. Extra points for the written assignment can be obtained through a learning diary and by attending visiting lectures.
Study materials	The course literature will be announced before the lectures.
Prerequisites	Required: Introduction to Sustainability and CS90A0011 Tuotantotalouden perusteet or CS31A0210 Yritystalouden perusteet or equivalent course Recommended: CS10A0001 Markkinoinnin peruskurssi or AC40A0000 Kansainvälisen markkinoinnin perusteet or equivalent basic course in marketing.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS10A0863	***RESEARCH METHODS FOR MASTER STUDENTS*** ***6 ECTS cr***
	Research Methods for Master Students
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Daria Podmetina Post-Doctoral Researcher, D.Sc. (Tech.) Irina Fiegenbaum Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Daria Podmetina
Aims	The course aims to provide methodological support and clear guidelines to master students on how to conduct the research in industrial engineering and management and how to report its results. In the end of the course, students should be able to find and critically analyze empirical literature; to formulate clear research questions and research design; to collect and analyze qualitative and quantitative data; to interpret and report the results of the research.
Content	The course includes following topics: the nature of business and industrial management research; formulating and clarifying the research topic; reviewing the literature; understanding research philosophies and approaches; formulating the research design; research ethics; collecting primary data and using secondary data; analyzing quantitative and qualitative data; writing project report and presenting the results. The course also has several in-class and home individual and group assignments targeted at developing the skills in conducting research and writing high quality master thesis.
Modes of Study	Lectures 36 h, exercises 6 h, research proposal and presentation 35 h, written assignments 25 h, course literature 30 h, self-study and exam preparation 25 h. Total 157 h. Course is using Noppa and Moodle. Moodle is used in this course.
Evaluation	0-5. Based on exam (40 %), research report and presentation (40%), and home written assignments and active participation during lectures (20%).

Study materials	Course book: Saunders, M, Lewis, P. and Thornhill, A. (2009). Research methods for business students, 5th ed., FT/Prentice Hall. Additional materials will be announced on the lectures.
Prerequisites	Course participation is targeted and limited to the students with major in Industrial Marketing and International Business and students of Global Management of Innovation and Technology (GMIT) international master program.

CS30A1340	***STRATEGIC TECHNOLOGY AND INNOVATION MANAGEMENT 8 ECTS cr***
	Strategic Technology and Innovation Management **Due to the teaching methods, the number of participants may be limited. In this case, priority is given to students of Innovation and Technology Management and GMIT.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Ville Ojanen Associate Professor, D.Sc. (Tech.) Kalle Elfvengren Doctoral Student, N. N. Person in Charge: Professor, D.Sc. (Tech.) Ville Ojanen
Aims	Student can 1. design and analyze technology and innovation strategy of a company, 2. apply different tools and frameworks of technology management, 3. Develop and plan alternative progress routes for managing technology, innovations, as well as product and service portfolios.
Content	Core material: Innovation as a core business process. Innovative organisation. Development of technology and innovation strategy. Innovation networks. Decision-making in technological and market uncertainty. Creation of new products and services. New technology-based ventures. Innovation performance and learning. Methods of technology management.
Modes of Study	Lectures and exercises 20 h in the 3rd period. Lectures and exercises 16 h in the 4th period. Seminars 12 h in the 4th period. Preparation for lectures and exercises 12 h, case study work, seminar work, essays and other written reports 140 h. Total 200 h. Moodle is used in this course.
Evaluation	0-5. No exam. Seminar work, case studies and other written reports and presentations plus continuous activity evaluation 100%.
Study materials	Joe Tidd and John Bessant. Managing Innovation – Integrating Technological, Market and Organizational Change, 4th ed. 2009, or newer. Lecture notes and other material announced in the beginning of the course.
Prerequisites	Recommended: CS30A0951 Innovaatio- ja teknologiajohtamisen peruskurssi (Finnish course). Recommended: B. Sc. in Industrial Engineering and Management or equivalent basic knowlege of innovation and technology management.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS30A1371	***CREATIVE DESIGN AND PROBLEM SOLVING 5 ECTS cr***
	Creative Design and Problem Solving **Maximum number of students: 45 persons. Can't be included in the same degree as CS30A1370 Creative Design.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D. Andrzej Kraslawski Person in Charge: Professor, Ph.D. Andrzej Kraslawski
Aims	Learning outcomes:

	After fulfilling all requirements of the course, the students will be able to: 1. Understand the principles of creative problem solving 2. Know the basic methods of creative design 3. Work in team during the design process 4. Apply methods of creative design to products, processes, services and business methods
Content	The major subjects of the course are: Major Steps in Problem Solving Types of Problems Types of Design Concept of Creativity Survey of Intuitive and Structured Methods of Creativity Enhancement Types of Brainstorming Check lists Morphological analysis Synectics Case-based Reasoning Graphical Methods Evaluation of Ideas The course is related to sustainability.
Modes of Study	The course is organised as a combination of regular lectures and interactive problem-solving sessions and project works. The in-class problem-solving sessions will be based on the team work realised by the groups of 3-5 students. The 3-4 project works will be realised by the groups of 3-4 students during the out-of-class activities and it will be finished with the preparation of the project report. In-class teaching and problem-solving sessions 42 h, project works 88 h. Total workload 130 h.
Evaluation	Final grade 0-5. Evaluation: Generated solutions of the in class problems 40 %, project reports 30 %, written exam 30%. Obligatory presence during 90% of in-class activities.
Study materials	Course slides.
Prerequisites	Basic courses of management. Basic knowledge of engineering disciplines (e.g. process or mechanical engineering).
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS30A1375	***PRODUCT DEVELOPMENT*** ***5 ECTS cr***
	Product Development
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Professor, Ph.D. Andrzej Kraslawski Person in Charge: Professor, Ph.D. Andrzej Kraslawski
Aims	After fulfilling all requirements of the course, the students will be able to: 1. Understand the concept of new product development 2. Recognise the phases of new product development 3. Work in a team during product development 4. Apply the basic methods of product development.
Content	The key topics of the course are: 1. Major Phases of New Product Development, 2. Engineering Concept Development and Testing (design for manufacturability, user-centred engineering, visualisation of design, robust design), 3. Integration of Technical Design and Business Analysis, 4. Intellectual Property in New Product Development, 5. Project Management, 6. Introducing a New Product to the Market The course is related to sustainability.
Modes of Study	The course is organised as a combination of regular lectures and interactive problem-solving sessions and project work. The classroom problem-solving sessions will be based on team-work in groups of 3-5 students.

	The 3-4 projects will be carried out in groups of 3-4 students independently and will result in the preparation of the project report. Classroom teaching and problem-solving sessions 36 hours. Project work 94 hours. Period 1. in-class activities (lectures, problem solving), period 2. out-of-class activities (project work). Total workload 130 hours.
Evaluation	0-5. Evaluation: solutions created in the classroom problem-solving sessions 40%, project reports 40%, written exam 20%. Attendance requirement: 90% of classroom sessions.
Study materials	Course slides.
Prerequisites	Basic understanding of management. Basic knowledge of engineering disciplines.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS30A1390	*SYSTEMS ENGINEERING* 5 ECTS cr
	Systems Engineering
Year and Period	M.Sc. (Tech.) 2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D. Andrzej Kraslawski Person in Charge: Professor, Ph.D. Andrzej Kraslawski
Aims	After fulfilling all of the requirements of the course, the students will be able to: 1. Understand the basic concepts of systems engineering 2. Distinguish the basic methods of systems analysis 3. Work in a team during systems design 4. Apply the methods of systems modelling and optimisation.
Content	The key topics of the course are: the concept of system, developing system requirements, the index of performance, system development and integration, system modelling, multi-criteria decision-making, ranking the alternatives. The course is related to sustainability.
Modes of Study	The course is organised as a combination of regular lectures and interactive problem-solving sessions and project work. The classroom problem-solving sessions will be based on team work in groups of 3-5 students. The 2-3 projects will be carried out in groups of 3-4 students independently and will result in the preparation of a project report. Classroom teaching and problem-solving sessions 30 hours. Project work 100 hours. Period 3. in-class activities (lectures, problem solving), period 4. out-of-class activities (project work). Total workload 130 hours.
Evaluation	0-5. Evaluation: solutions generated in classroom sessions 30%, project reports 40%, written exam 30%. Obligatory presence during 90% of in-class activities.
Study materials	Course slides.
Prerequisites	Basic courses on management.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS30A1551	*SYSTEM DYNAMICS AND INDUSTRIAL MANAGEMENT* 5 ECTS cr
	System Dynamics and Industrial Management, Systeemidynamiikka tuotantotaloudessa **The maximum number of students at the course is 60.**
Year and Period	M.Sc. (Tech.) 1-2 INT 43 - per. 2 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Olli-Pekka Hilmola
Aims	Student 1. is able to construct different systems from the main research topics of industrial management, and identifies the dynamic interconnected nature

	(time dependent) of the performance of these systems 2. is able to use system dynamics simulation for quantifying the behavior of different systems by using simulation elements and levels 3. identifies the situations, where system dynamics based quantitative modelling is applicable, and possibly using these skills in thesis phase (M.Sc. and D.Sc.).
Content	In this course system dynamics is used in the modelling of logistics systems (distribution and supply chains) and product development processes. Objective of the course is to give an understanding for a student how to analyze systems through relationships of different modeling elements (delay, feedback/feed forward, flow and stock), which often create complex interactions. Implications of system behavior on company level as well as country level issues of decision making in logistics as well as innovation management are discussed. During the course we also use and analyze practical problem solving tasks, using simulation models from the previous research. The course is related to sustainability.
Modes of Study	Lectures 12 h, exercises and final seminar 14 h; Seminar work takes 52 hours of student time in a group (from one to three persons), and exam another 52 hours from student in terms of reading course literature and getting familiar with other material. Total 130 h.
Evaluation	0 - 5. Exam 50 % and seminar work 50 %.
Study materials	1. John D. Sterman (2000). Business Dynamics - Systems Thinking and Modeling for a Complex World, McGraw-Hill/Irwin. 2. Lättilä, Lauri (2012). Improving Transportation and Warehousing Efficiency with Simulation-Based Decision Support Systems. Lappeenranta University of Technology, Industrial Management, Acta Universitatis Lappeenrantaensis, No. 478. In parts, where system dynamics is used. 3. Article collection provided by the lecturer.
Prerequisites	Recommended: At least introductory courses taken from logistics/supply chain management as well as technology/innovation management.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

CS30A1601	***CASE COURSE IN STRATEGY CONSULTING 3 ECTS cr***
	Case Course in Strategy Consulting **The course group is restricted to max. 20 students. More information on the course web pages.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Samuli Kortelainen Doctoral Student, M.Sc. (Tech.) Nina Tervonen Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Samuli Kortelainen
Aims	Student 1. can apply frameworks and tools of company strategy analysis in the context of strategic decision making 2. has the capability to assess and make conclusions about the strategic position of the company 3. can compose and produce company strategies and present them 4. has the capability and experience to work in the team and perform in English in the strategy context.
Content	Application of analysis methods and frames of reference. Strategic decision-making. Development of strategic thinking, problem-solving skills, group work and presentation skills through case exercises. The course includes four case exercises to be prepared in teams. Local qualification round of the T.I.M.E.S. case competition (Tournament in Management and Engineering Skills) will be organized separately. The exercises will be completed in groups. The winners of the qualification will represent Lappeenranta University of Technology in the semi-final of the competition.
Modes of Study	The course requires active participation in all sessions and the final exam. The course will be held in Finnish, presentations in English. Lectures 6 h, excercises 24 h, preparation, independent preparation for excercises 50 h. Total 80

	h. The course is designed to be compatible with the course produced by Language Centre Presenting English, FV11A6500(LUA). Moodle is used in this course.
Evaluation	0 - 5. Case presentation 100 %.
Study materials	Material given during the lecture and exercises.

CS30A1640	*INVENTIVE PRODUCT DESIGN AND ADVANCED TRIZ* 5 ECTS cr
	Inventive Product Design and Advanced TRIZ **The maximum number of students in the course is 30. Can't be included in the same degree as CS30A7390 Inventive Product Design and Advanced TRIZ (Summer School).**
Year and Period	M.Sc. (Tech.) 1-2 Period 4 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, Ph.D. Leonid Chechurin
Aims	After having completed the course, student is to know and able to apply instruments for product/process inventive design. The course helps to recognize the role, place and institutions of invention in innovation process/business. It contains basics on patenting, patent search and analysis, including modern approaches (big data, semantic etc). The course presents conceptual design context and its tools (Quality Function Deployment, Kano model, Decision making tools etc). It reviews modern design tools: Axiomatic Design, Design For X (Manufacturing, Robustness, Assembly, Environment, etc) and focuses on the role and main instruments of TRIZ (Ideal Final Result, Contradictions, SuFiled, Trends of Engineering System Evolution). We learn how to model an engineering system/product by Function framework, perform Function Model analysis transformation, Trimming (system reduction), Function-Oriented search, build Fault tree. About 20 case studies and 100 examples of inventive designs are presented.
Content	Introduction Optimization and Invention. Design roadmaps. 1. Information search and analysis: Patent and Scientific paper data bases. Search by keywords and classification codes. Function oriented search. Similarity: bibliographic, semantic. Technology landscapes. Subject-Object-Action framework. ArrowSmith approach. 2. Function based analysis: Ontologies of system description. Function based modeling. Subject-Object-Function framework. Function analysis. 3. Design evaluation: Axiomatic Design. DFx: design for manufacturability and assembly, design for robustness, design for environment, etc. TRIZ's design ideality concept. Trends of engineering system evolution as evaluation tool. Case studies and examples, Hands on. 4. Design modification: Function-based design improvement: trimming, contradiction elimination. Substance-Field. Standards for SuField model transformations. Case Studies, examples, Hands on. 5. Algorithm: Inventive design roadmap. Context of inventive design in industrial environment: market analysis tools (QFD, Kano, etc.), integration to research management tools, decision making tools. Case studies. Conclusion. The course is related to sustainability.
Modes of Study	Lectures 24 h, exercises 24 h, team work and project work 30 h, presentations of the team work/ project work results 8 h, independent work, reading 49 h. Total workload 135 h. Moodle is used in this course.
Evaluation	Final grade 0 - 5. Test 30% + Report on project (Assignment) 50% + Personal reading 20%.
Study materials	Handouts of lecture notes, internet resources in open access (given).

Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS30A1661	***OPEN INNOVATION*** ***6 ECTS cr***
	Open Innovation **The maximum number of students at the course is 40. Participants will be selected on basis of a mandatory motivation letter provided via WebOodi.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Researcher, D.Sc. (Tech.) Antero Kutvonen Visiting lecturers Person in Charge: Professor, D.Sc. (Tech.) Marko Torkkeli
Aims	Student 1. can explain the concept of open innovation through both theory and examples (to e.g. a company executive) 2. identifies open innovation activities in real life companies and explain the motives for engaging in them and the mechanisms through which they create value for the company 3. can distinguish between modes of inbound and outbound open innovation 4. can analyze the relation between a company's strategic choices and application of open innovation 5. attains a basic familiarity with the scientific literature on the theme and the ability to view open innovation in the context of other innovation management theories.
Content	Must know: The fundamental definitions and concept of open innovation. Modes of inbound open innovation, i.e. external acquisition of knowledge, and outbound open innovation, i.e. external exploitation of knowledge. Difference between closed and open innovation in managing technology. Identifying open innovation activities in real life firms. Monetary and strategic motives for engaging in open innovation. Should know: Process models of inbound and outbound open innovation. The role and importance of the individual process phases. The relation between corporate strategy, technology strategy and open innovation activities. Most common examples of firms used to explain open innovation. Varying topics from state-of-the-art open innovation research, depending on guest lecturer. Basics of IPR management in open innovation. Nice to know: Development of the open innovation concept on the basis of prior innovation management theories. Knowledge of the main scientific literature surrounding open innovation. Theoretical determinants of open innovation.
Modes of Study	Lectures and guest speakers 35 h as intensive teaching. Small group assignments during lectures. Group exams (or substituting them with summaries of scientific articles, 24 h) on each intensive day, preparing for exams 24 h. Independent study 72 h. Total 155 h.
Evaluation	0 - 5. Continuous evaluation based on small group exams (80%) and participation in lectures (20%). Possibility to substitute group exams with literary work (summaries of scientific articles) in case of absence.
Study materials	The course book and reading material will be announced at the first lecture.

CS30A1670	***SERVICE INNOVATION AND MANAGEMENT*** ***5 ECTS cr***
	Service Innovation and Management **Due to the teaching methods, the amount of participants may be limited. In this case the priority is given to the students of Innovation and technology management and GMIT.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Ville Ojanen Associate Professor, D.Sc. (Tech.) Kalle Elfvengren

Aims	Student can 1. recognize and categorize the variety of services and service firms in modern industrial environment as well as understand their influence in management of industrial innovations 2. identify the characteristics of services and evaluate the similarities, differences and links between services and physical products 3. define the dimensions of service innovations 4. explain the processes of new service development 5. summarize the main managerial challenges in service innovation management 6. select and apply the suitable frameworks, tools and methods, to overcome some typical real-world challenges in service innovation management
Content	Typologies of service firms. Characteristics of services. Product-service systems in manufacturing industry. Knowledge-intensive business services. New service development process. Dimensions of service innovations. Productization of services. Supporting methods for service innovation management. Managerial challenges in service innovation management. Utilization of frameworks, methods and tools in service innovation management. Roles of different types of firms in service systems and networks. Value creation through services. Customer-centric service development.
Modes of Study	Lectures 12 h, preparation for the lectures 4 h, writing case reports in groups 16 h, starting project work 12 h, 3rd period. Lectures and exercises 8 h, seminars 12 h, writing project work 70 h, 4th period. Total 134 h. Moodle is used in this course.
Evaluation	0 - 5. Written reports and seminars 100 %.
Study materials	Lecture notes. Other material, books and articles announced in the beginning of the course.
Prerequisites	Recommended: B.Sc. on Industrial Engineering and Management, or equivalent knowledge

CS30A1682	***ADVANCED COURSE IN STRATEGIC MANAGEMENT*** ***5 ECTS cr***
	Advanced Course in Strategic Management **The student who has completed the course CS30A1684 Advanced Course in Strategic Management (LUT Summer School) can't include this course CS30A1682 into the LUT degree.**
Year and Period	M.Sc. (Tech.) 2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Samuli Kortelainen
Aims	Strategic management literature is a widely research topic, that has lead to a wide and many times confusing and even contradictory literature. In order to fully understand the current state of literature, the lens needs to be first turned to the history of different strategic schools. Therefore, the course starts from the roots of strategy management and then builds a comprehensive view to the current status of strategic management literature. After the successful completion of course the student has: 1. Comprehensive picture of the current state of strategic management theory o Understanding reasoning behind different strategic management theories 2. Understanding on the limitations and restrictions in current strategic management theory and their practical implications 3. Holistic view to current new themes linking strategic management theories to other industrial management disciplines
Content	1. Main schools of strategic management The course begins on looking at the development history of main strategic management schools, where the goal is to identify similarities and differences between different literature streams. 2. The challenges and criticism of current strategic management theories Although strategic management theories are widely applied, they are also subjected to wide range of criticism. The second part of lectures focuses on these critical aspects of strategic management.

	3. Current development paths of strategic management theory Third part focuses on the various detailed development steps in strategic management literature to counter or point critical points in original theories.
Modes of Study	Lectures 18 h, in-class room exercises 10 h, seminarwork and presentation 50 h, preparation to exam 50 h. Total 128 h. Individual 24 h exam or traditional exam. Moodle is used in this course.
Evaluation	0 - 5. Exam 50 %, exercise 50 %.

CS30A1684	***ADVANCED COURSE IN STRATEGIC MANAGEMENT*** ***3 ECTS cr***
	Advanced Course in Strategic Management **LUT Summer School, 3 – 7.8.2015. The student who has completed the course CS30A1681 or CS30A1682 Advanced course in strategic management can't include this course CS30A1684 into the LUT degree.**
Year and Period	M.Sc. (Tech.) 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Samuli Kortelainen
Aims	Strategic management literature is a widely research topic, that has led to a wide and many times confusing and even contradictory literature. In order to fully understand the current state of literature, the lens needs to be first turned to the history of different strategic schools. Therefore, the course starts from the roots of strategy management and then builds a comprehensive view to the current status of strategic management literature. After the successful completion of course the student has: 1. Comprehensive picture of the current state of strategic management theory. 2. Understanding reasoning behind different strategic management theories. 3. Understanding on the limitations and restrictions in current strategic management theory and their practical implications. 4. Holistic view to current new themes linking strategic management theories to other industrial management disciplines.
Content	Main schools of strategic management - The course begins on looking at the development history of main strategic management schools, where the goal is to identify similarities and differences between different literature streams. The challenges and criticism of current strategic management theories - Although strategic management theories are widely applied, they are also subjected to wide range of criticism. The second part of lectures focuses on these critical aspects of strategic management. Current development paths of strategic management theory - Third part focuses on the various detailed development steps in strategic management literature to counter or point critical points in original theories. Linking strategic management to other management theories - There are multiple different management literature streams (e.g. marketing, supply-chain, and innovation) that also tackle strategic issues. The fourth part of lectures focuses on bridging these management theories. New entries to strategic management discussion - The final part of lecture series focuses on raising themes in strategic management such as multi-sided markets and business models.
Modes of Study	Lectures 16 hours. In-class room exercises 10 hours. Essay summarizing critical strategic management articles, workload 24 hours. Preparing for the exam 16 hours; final exam executed on the final day of the course 12 hours. Total workload 78 hours. Moodle is used in this course. Moodle is used in this course.
Evaluation	Final grade 0 – 5: Exam 70%. Essay 30%
Study materials	Course slides. Selected articles.

Prerequisites	Successfully completed Bachelor or higher level studies in Industrial Management. Good understanding on basic strategic management concepts. Basic knowledge on other management topics (marketing, innovation management).

CS30A1690	***SOCIAL SUSTAINABILITY*** ***5 ECTS cr***
	Social Sustainability
Year and Period	B.Sc. (Tech.) 3 Period 4
Teacher(s)	Professor, D.Sc. (Tech.) Helinä Melkas Researcher, M.Sc. (Tech.) Suvi Konsti-Laakso Doctoral student, MBA, M.Ed. Rakhshanda Khan, Senior Researcher, Ph.D. Satu Pekkarinen Person in Charge: Professor, D.Sc. (Tech.) Helinä Melkas
Aims	The student learns to understand the significance and meaning of social sustainability in development of business, organization as well as product and service processes. This aim is approached by looking into the theme both from theoretical and practice-based viewpoints. The student gains insight into the kinds of tools and methods that enable social sustainability to become part of business, management as well as product and service development. The student recognizes appropriate situations for applying these methods, and gains elements for critical thinking.
Content	Core content: social sustainability at different levels (global, societal and organizational), social innovation, social enterprise, end-user involvement, employee involvement, human impact assessment Supplementary content: practical cases, methods and Living Lab activities The course is related to sustainability.
Modes of Study	Lectures 15 h; case exercise to be given during the lectures 45 h; independent and/or group studies 60 h; presentation of case exercises in a closing seminar 10 h; exam after the course = total 130 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 50 %. Case exercise 50 %.
Study materials	The study materials consist of articles and will be announced later.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS30A7330	***INNOVATION MANAGEMENT IN NEW PRODUCT CREATION*** ***3 ECTS cr***
	Innovation Management in New Product Creation **LUT Summer School, 20 – 24.7.2015. The student who has completed the course CS30A7210 Innovation Management and New Product development can't include this course CS30A7330 into the LUT degree.**
Year and Period	M.Sc. (Tech.) 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Tuomo Kässi Dr. Eelko Huitzing Person in Charge: Professor, D.Sc. (Tech.) Tuomo Kässi
Aims	After the course the student should be able to: 1. Recognize the most important concepts of innovation and technology management. 2. Explain different points of views of business functions in the framework of product and service development. 3. Explain stages, risks and challenges of growth companies and businesses, particularly in technology driven field. 4. Analyze alternative operative actions for innovative strategies and processes in a company. 5. Exploit the alternative models of innovation generation concepts. 6. Produce, propose, and manage build-up of product families, product systems, and product platforms in tangible products and services. 7. Apply principles of innovation management in the selected field of issues.

Content	Fields and concepts of innovation and technology management: 1. Innovation management: introduction. 2. Managing innovation within firms. 3. Innovation in international perspective. 4. Managing innovation projects and portfolio. 5. Managing intellectual property. 6. Managing organizational knowledge. 7. Strategic alliances and networks. 8. Managing research and development. 9. Exploration and exploitation 10. Managing projects. 11. Open innovation and projects. 12. Products and brands. 13. New product development. 14. New service innovation. 15. Developing with customer involvement.
Modes of Study	Lectures, four full-day class sessions, 28 hours. Preparation for the course by individual reading, 28 hours. Material will be sent to participants before the course by email. Preparing for the exam, 10 hours. Written individual or group problem solving task at the end of the course, 12 hours. Total workload 78 hours. Moodle is used in this course. Moodle is used in this course.
Evaluation	Final grade 1 – 5. Evaluation: Written exam 80 %. Essay prepared on the basis of preparation materials 20 %. Final grade will be given when the both performances have been completed and evaluated.
Study materials	Paul Trott: Innovation Management and New Product Development, FT Prentice Hall, 4th ed., UK, 2008 or newer. Course materials to be available during the course.
Prerequisites	Successfully completed Bachelor or higher level studies in the some field of “hard” technology or in Industrial Management.

CS30A7361	***SUSTAINABLE PRODUCTS AND PROCESSES: CRADLE-TO-GRAVE APPROACH*** ***3 ECTS cr***
	Sustainable Products and Processes: Cradle-to-Grave Approach **LUT Summer School, 3 - 7.08.2015. Can't be included in the same degree as CS30A7360 Sustainable Products and Processes: Design Methods and Tools.**
Year and Period	M.Sc. (Tech.) 1-2
Teacher(s)	Person in Charge: Professor, Ph.D. Andrzej Kraslawski
Aims	After fulfilling all requirements of this course, the student will be able to: 1. Understand the principles of designing of sustainable products and processes 2. Assess sustainability of products and processes 3. Apply methods of creative design of sustainable products and processes
Content	The major issues: Life Cycle of Products and Processes Concept of Sustainability 1. Environmental issues (climate change, ozone depletion, acidification, organic matter in water, ecotoxicology, hazardous wastes) 2. Use of resources (raw materials, utilities) 3. Social impact (health, safety, comfort of life) Sustainability Indicators Life Cycle Inventory Life Cycle Assessment Creativity Methods for Product and Process Design (check lists, morphological analysis, brainstorming)

	Re-use of Process Equipment for Sustainable Production The course is related to sustainability.
Modes of Study	The course is organised as a combination of regular lectures and interactive problem-solving sessions and project work. The in-class problem-solving sessions will be based on the team work realised by the groups of 3-5 students. The project work will be realised by the groups of 3-4 students during the out-of-class activities and it will be finished with the preparation of the project report. In-class teaching 10 h, problem-solving sessions 20 h, project work 48 h. Total workload 78 h.
Evaluation	Final grade 0-5. Evaluation: Problem solving during the lectures 60 %, project report 40 %.
Study materials	Course slides
Prerequisites	Basic knowledge of industrial and process engineering
Further Information	Maximum number of students: 30 students.

CS30A7370	***SIMULATION MODELLING IN INDUSTRIAL MANAGEMENT*** ***3 ECTS cr***
	Simulation Modelling in Industrial Management **LUT Summer School, 10 – 14.8.2015.**
Year and Period	M.Sc. (Tech.) 1-2
Teacher(s)	Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Samuli Kortelainen
Aims	The amount of data available for decision makers is constantly increasing. The increase of data enables new opportunities for managers, but also creates a demand to develop systems that can generate this data into usable intelligence. Simulation techniques offer interesting option for managers to better understand and develop firm’s business processes. The key simulation skills that the student has to possess after successful completion of the course: 1. Understanding on what system and complexity theories mean, and what are their business implications. 2. Capability and design simulations model with a systematic process. 3. Understand the possibilities, but also restrictions, of simulation modelling as an analysis tool. 4. Practical simulations skills with the three most common simulation methods (system dynamics, discrete event simulation, agent based modelling). 5. Skill to use simulation models to conduct tests on system performance.
Content	This course is designated to explore two critical aspects to simulation modelling to business management: 1. The analysis and development of already existing processes. 2. The analysis and testing of new proposed process. First, the natural way to use simulation modelling is to model the firm’s current operations. The goal in this kind of simulation is to understand and then develop how practical processes. As such, simulation offers an opportunity to support management of firm’s operational processes. During the course, this methodology is used to simulate firm’s manufacture processes, but also more abstract service processes.
Modes of Study	The teaching is dominantly interactive workshop in small groups supported by in-class lectures. In addition there is a pre-course essay for the course, which has 3 questions. Expected length is 20 pages. In-class teaching 6 hours. Workshop + learning diary at the end of each lecture day 24 hours. Pre-course work 48 hours. Total workload 78 hours. Moodle is used in this course. Moodle is used in this course.
Evaluation	0-5. Evaluation: essay 60 %, learning diary 40 %.
Study materials	Course slides and selected articles to be announced during the course.

Prerequisites	Previous studies in management are strongly suggested. Skills that assist learning: 1. Basic Excel and coding skills 2. Good skills in logical thinking 3. Basic math skills 4. Positive attitude
Further Information	Maximum course attendance 20 persons.

CS30A7380	*SYSTEMATIC CREATIVITY - TRIZ BASICS* *3 ECTS cr*
	Systematic Creativity - TRIZ Basics **LUT Summer School, 20 – 24.7.2015.**
Year and Period	M.Sc. (Tech.) 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Prof. Sergei Ikovenko, Massachusetts Institute of Technology Person in Charge: Professor, Ph.D. Leonid Chechurin
Aims	After having completed the course, student should be able to: 1. Recognize the role, place and institutions of invention in innovation process/business. 2. Recognize the trends of technology/technical system evolution. 3. Model a problem situation as a contradiction and apply standard methods of their resolving. Model a problem situation as Su-Field triple and apply standard SuField transformations 4. Formulate the model of inventive (to be) solution. 5. Organize effective search/adaptation of the inventive solution.
Content	Introduction: creativity, invention, innovation. Creativity obstacles and supporters. Place of creativity in modern economy. Invention and Innovation. Basic institutions of invention: know-how, patent, public good (paper). Thinking inertia and other invention killers. Tools for creativity support and place of TRIZ among them. Genrich Altshuller and the history of TRIZ. Part 1. Trends of Engineering System Evolution (TESE) Altshuller's finding: evolution patters engineering systems. S-curve evolution trend, Trend of ideality increase, Dynamization, Functionality Increase, Transition to Macrollevel etc. Applications to technology intelligence and system design. Part 2. Ideal Final Result concept Axiom of Ideality in TRIZ. Formulation, examples. Operation time, operation zone. 3 ways to reach IFR. Ideality and system reduction (trimming). Part 3. Contradiction analysis and elimination Invention as contradiction elimination. Engineering contradictions and elimination standards. Altshuller Matrix. Physical contradictions and elimination standards. Separation principles. Case studies and examples, Hands on. Part 4. SuFiled modeling and transformation Modeling of interactions in engineering system by subject-object-action triple. Substabce-Field. Standards for SuField model transformations. Case Studies, examples, Hands on. Part 5. Algorithm Algorithm of inventive problem analysis (simplified ARIZ). Case studies. Project presentation. Conclusion The course is related to sustainability.
Modes of Study	Lectures and exercises 24 hours, team work and a limited project work 20 hours, presentations of the results of the team work/ project work 8 hours, independent work, reading 26 hours. Total workload 78 hours. Moodle is used in this course.
Evaluation	Final grade 0 - 5.

	Attendance 30% + Test 30% + Report on project (Assignment) 40%
Study materials	Hand outs of lecture notes, internet resources in open access (given).
Prerequisites	Preferably, students of engineering major or bachelor degree in non-technical studies.
Further Information	LUT Summer School, intensive course.

CS30A7390	***INVENTIVE PRODUCT DESIGN AND ADVANCED TRIZ*** ***3 ECTS cr***
	Inventive Product Design and Advanced TRIZ **LUT Summer School, 27 – 31.7.2015. Can't be included in the same degree as CS30A1640 Inventive Product Design and Advanced TRIZ.**
Year and Period	M.Sc. (Tech.) 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, Ph.D. Leonid Chechurin
Aims	Knowledge and skills of product analysis and conceptual design, tools to support creativity After having completed the course, student should be able to: 1. Recognize the role, place and institutions of invention in innovation process/business. Basics of patenting, patent search and analysis, including modern approaches (big data, semantic etc). Know the conceptual design context and its tools (Quality Function Deployment, Kano model, Decision making tools etc). 2. Distinguish modern design tools: Axiomatic Design, Design For X (Manufacturing, Robustness, Assembly, Environment, etc). Role and main instruments of Classical TRIZ (Ideal Final Result, Contradictions, SuFiled, Trends of Engineering System Evolution). 3. Model an engineering system/product by Function framework. Perform Function Model analysis transformation, trimming. Perform Function-Oriented search. Build Fault Tree.
Content	Introduction Optimization and Invention. Design roadmaps. Part 1. Information search and analysis Patent and Scientific paper data bases. Search by keywords and classification codes. Function oriented search. Similarity: bibliographic, semantic. Technology landscapes. Subject-Object-Action framework. ArrowSmith approach. Part 2. Function based analysis Ontologies of system description. Function based modeling. Subject-Object-Function framework. Function analysis. Part 3. Design evaluation Axiomatic Design. DFx: design for manufacturability and assembly, design for robustness, design for environment, etc. TRIZ's design ideality concept. Trends of engineering system evolution as evaluation tool. Case studies and examples, Hands on. Part 4. Design modification Function-based design improvement: trimming, contradiction elimination. Substance-Field. Standards for SuField model transformations. Case Studies, examples, Hands on. Part 5. Algorithm Inventive design roadmap. Context of inventive design in industrial environment: market analysis tools (QFD, Kano, etc.), integration to research management tools, decision making tools. Case studies Conclusion The course is related to sustainability.

Modes of Study	Introductory lectures and exercises 24 h, team work and a limited project work 20 h, presentations of the results of the team work/project work 8 h, independent work, reading 26 h. Total workload 78 hours. Moodle is used in this course.
Evaluation	Final grade 0 - 5 Attendance 20% + Test 30% + Report on project (Assignment) 50%
Study materials	Hand outs of lecture notes, internet resources in open access (given).
Prerequisites	Preferably, students of engineering major with bachelor degree or M. Sc. in non-technical studies. Basic definitions of TRIZ are needed (Ideal Final Result, Contradictions, TESE)

CS30A7401	***SOFTWARE AND APPLICATION INNOVATION 5 ECTS cr***
	Software and Application Innovation **Can't be included in the same degree as CS30A7400 Software and Application Innovation.**
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Helinä Melkas Professor, D.Sc. (Tech.) Jari Porras Project Researcher, M.Sc. (Tech.) Juho Salminen Person in Charge: Professor, D.Sc. (Tech.) Helinä Melkas
Aims	This course combines technology and technology management perspectives for cross-scientific approach in software and application innovation process. After completion of the course students have broader perspective on innovation process in some yearly chancing technically focused area. Students know how to innovate new meaningful software solutions and application based on some technology, what is the technical and business feasibility of the solution in domestic and international markets.
Content	Innovation management, idea generation and opportunity identification process. (Open) business models and technology commercialization in global markets. Product and service development. Basics and use cases of the selected technology, user-centric design and privacy perspectives in software and application development. The course is related to sustainability. The course is related to sustainability.
Modes of Study	Lectures 12 h. Innovation exercise to be given during the lectures 35 h, practical work (documentation) 35 h, independent group work 40 h, presentations 8 h. Total 130 h.
Evaluation	0 - 5. Practical work 100 %.
Study materials	To be announced later.

CS31A0603	***LIFE-CYCLE COSTING OF INVESTMENT PROJECTS 5 ECTS cr***
	Life-Cycle Costing of Investment Projects **Can't be included in the same degree as CS31A0602 Investointihankkeiden elinkaarilaskelmat.**
Year and Period	M.Sc. (Tech.) 1-2 Period 1
Teacher(s)	Doctoral Student, M.Sc. (Tech.) Anna-Maria Talonpoika Person in Charge: Professor, D.Sc. (Tech.) Timo Kärri
Aims	The student can prepare and evaluate investment proposals and consider requirements of sustainability during the life-cycle of projects.
Content	Main content: Investment proposal. Life-cycle of investment project, life-cycle costs and profits, capital costs, initial investment and working capital, classifi-

	cation and selection of projects, uncertainty and risks. Evaluation methods introduced: net present value, internal rate of return, return on investment, payback period, benefit-cost ratio and profitability index. Supplementary content: Investment process, timing and financing of projects, public-private partnership, life-cycle models of machine replacements, concept of real option, evaluation of projects from the perspective of sustainability. The course is related to sustainability.
Modes of Study	Lectures 2 h, exercises 10 h, group assignments 52 h, individual assignments 26 h and preparation for the exam 40 h. Total 130 h. Moodle is used in this course.
Evaluation	0-5. Exam 40 %, group assignments 40 %, individual assignments 20 %.
Study materials	Mott, G.: Investment appraisal. Pitman Publishing, 1997, (196 p.). Götze, U. et al.: Investment appraisal - Methods and models. Springer. 2008, (341 p.). Other material presented in the lectures.
Prerequisites	Basic knowledge of cost management.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS34A0301	*THEORY OF THE ENTREPRENEURSHIP* *5 ECTS cr*
	Yrittäjyyden teoria **If all participants speak Finnish, the course will be lectured in Finnish. Can't be included in the same degree as CS34A0300 Yrittäjyyden teoria.**
Year and Period	M.Sc. (Tech.) 1 Period 1 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Timo Pihkala D.Sc. (Econ. & Bus. Adm.) Tuuli Ikäheimonen Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Timo Pihkala
Aims	To familiarize the student with the dominating trends in entrepreneurship theory to the extent that he/she is able to exploit them in understanding research conducted in this field and when writing his/her own thesis.
Content	Literature covering central theoretical trends in entrepreneurship research.
Modes of Study	Independent studying 125 h. Lectures 8 h. Total 133 h. Moodle is used in this course.
Evaluation	0 - 5. Exam.
Study materials	Bridge, S., O´Neill, K. and Cromie, S. (2003): Understanding, Enterprise, Entrepreneurship and Small Business. (2nd ed.) Palgrave-MacMillan Shane, Scott: A general theory of entrepreneurship. The individual-opportunity nexus. Edward Elgar
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

CS34A0400	*STRATEGIC ENTREPRENEURSHIP IN AGE OF UNCERTAINTY* *5 ECTS cr*
	Strategic Entrepreneurship in Age of Uncertainty **Maximum number of students is 50.**
Year and Period	M.Sc. (Tech.) 2 INT 43
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Irina Fiegenbaum Doctoral Student, M.Sc. (Tech.) Justyna Dabrowska Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Irina Fiegenbaum
Aims	“Managing in a knowledge-based economy”, “Managing by Core Competences”, “Knowledge intensive firms”, “Uncertainty”. The latest buzz words or another passing managerial fad? Old wine in new bottles? Or perhaps, just perhaps, a fundamental means of survival and success for modern

	day corporations? Given the amount of effort that has been devoted to the topic by both academics and practitioners, it appears worth our while to take a deep and dispassionate look at the role of entrepreneurial thinking in sustained competitive advantage. The goal is to learn as you go and effectively convert assumptions to knowledge at a low cost. During the course students learn to develop and test a business idea following the discovery driven planning steps as well as using the uncertainty management tools of Attribute Mapping, Supply chain analysis, Differentiation and Quizzing and FMEA. The course does not teach business plan writing but rather orients on opportunity recognition and feasibility assessment.
Content	Entrepreneurial thinking, uncertainty management, strategic entrepreneurship, discovery-driven planning. The course is related to sustainability.
Modes of Study	Lectures 28 h, journal article reading 50 h, seminar work writing 60 h, 1. period. Total 138 h.
Evaluation	0 - 5. Based on assignment and in-class work, participation in the lectures required.
Study materials	Lectures and additional reading provided in the class. Book: McGrath Rita and MacMillan Ian, (2000). The Entrepreneurial Mindset. Harvard Business School Pr.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

CS35A0152	*PRODUCT LIFECYCLE MANAGEMENT 5 ECTS cr*
	Product Lifecycle Management **This course is aimed for the students of Master's Degree level.**
Year and Period	M.Sc. (Tech.) 2 Period 4
Teacher(s)	Lecturer, M.Sc. (Tech.) Jorma Papinniemi Assistant, N. N. Visiting lecturers Person in Charge: Lecturer, M.Sc. (Tech.) Jorma Papinniemi
Aims	Student can 1. define and explain the concepts related to product data management and product life cycle management 2. recognize the company's product processes and understands their interaction with the company's overall operations 3. compare PLM-/PDM systems' characteristics, technical features and managerial functions and is able to see their role in product development and business management.
Content	Different views on product and lifecycle management. Product architectures and modularity. Product information modeling and change management. Requirements information management & systems engineering. Configuration process and configurators. PLM systems and their functionalities: managing generic products, individual products, items and documents. PLM project and system implementation. PLM for sustainability. Demos of PLM systems. The course is related to sustainability.
Modes of Study	Lectures 21 h, seminars 14 h, 4th period as intensive studies. Course assignment 45 h and exam 58 h, 4th period. Total 138 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 60 %, project assignment and seminar participation 40 %.
Study materials	Journal articles and lecture material. Sääksvuori-Immonen: Product Lifecycle Management, Springer 2008. Forza-Salvador: Product Information Management for Mass Customization, Palgrave Macmillan, 2007. (partly)
Prerequisites	B.Sc. on Industrial Management, or equivalent knowledge.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS90A0060	***MASTER'S THESIS***	***30 ECTS cr***
	Diplomityö	
Year and Period	M.Sc. (Tech.) 2 Period 1-4	
Teacher(s)	Professors of major subjects	
Aims	In their Master's thesis, students demonstrate their knowledge of a topic of scientific and societal importance in a specific professional area. The student must demonstrate the ability to carry out the project independently and following a plan. The thesis must be organised coherently, the presentation academic and the language revised.	
Content	The Master's thesis is the final project of the degree of Master of Science (Technology). Usually it involves a development project commissioned by a company and takes about six months. The work entails working on a development project related to industrial management, preparing a report in the form of a thesis, and presenting the work in a way that the professor of the major subject requires. The course is related to sustainability.	
Modes of Study	Development project and related report, presentation of the work (professor of the major subject defines the way), maturity test (usually on the contents of the thesis).	
Evaluation	0 - 5. Master's thesis 100 %.	
Prerequisites	B.Sc. (Tech.) degree (not required of students admitted directly into a Master's programme), complementary studies (for students admitted directly into a Master's programme), major studies min. 15 ECTS credits.	

CT10A7001	***GREEN IT AND SUSTAINABLE COMPUTING***	***5 ECTS cr***
	Kestävä kehitys tietotekniikassa **Course for sustainability minor. Can't be included to a same degree as CT60A7001 Critical Thinking and Argumentation in Software Engineering.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.	
Teacher(s)	Professor, D.Sc. (Tech.) Jari Porras	
Aims	After the course students are familiar with technologies for Green IT and sustainable computing. Students know critical thinking and argumentation principles and are able to apply these skills in discussions carried over the topic. Students are able to discuss about the topic and examine it critically.	
Content	The course emphasizes two separate aspects. First students are familiarized with critical thinking and argumentation skills and then these skills are applied in Green IT and sustainable computing field. Green IT and sustainable computing is covered through books and scientific articles. Students may be divided into small groups that will each study a separate topic. The course is related to sustainability.	
Modes of Study	Lectures 2 h, homework 10 h, online course 26 h, 3. period. Seminars and discussions 19 h, homeworks 26 h, self-study 47 h, 4. period. Total 130 h.	
Evaluation	0 - 5. Seminar work(s), active participation in discussions, homeworks.	
Study materials	For critical thinking part A. Freeley, Argumentation and Debate: Critical Thinking for Reasoned Decision Making, Wadsworth Publishing For green it and sustainable computing part National Research Council, Computing Research for Sustainability, National Academies Press, 2012 L. Webber and M. Wallace, Green Tech: How to Plan and Implement Sustainable IT Solutions, AMACOM, 2009.	

Further Informa-tion	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT30A5110	*GAMIFICATION - FROM CONCEPTS TO IM-PLEMENTATIONS* 3 ECTS cr
	Gamification - from Concepts to Implementations
Year and Period	M.Sc. (Tech.) 1-2 Period 1-4 The course is suitable also for doctoral studies.
Teacher(s)	Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen Person in Charge: Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen
Aims	After the course, the student should be able to understand the basics of the gamification concepts, design, process, general concepts, architectures and infrastructures in game design. Prototype of a gamified system.
Content	Gamification concepts, elements, motivational drivers, design, problems.
Modes of Study	The course can be completed by reading the course book, completing given excersises and writing a paper. Each student has to have a peer group during the course and the group has to report about their progress. A mandatory introduction lecture will be held in the beginning of the first period, where a timetable and tasks will be handed out. Introduction lecture 2h, self study 24 h, assignment 26 h, writing a study paper 26 h. Total 78 h.
Evaluation	0-5. Oral exam 50%. Assignment + study paper 50%.
Study materials	Kevin Werbach and Dan Hunter: For the Win: How Game Thinking Can Revolutionize Your Business, ISBN: 9781613630235 Learning materials provided during the course.
Prerequisites	Research Methods
Further Informa-tion	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT30A8920	*SUSTAINABLE INNOVATION BY DESIGN: A USER EXPERIENCE PERSPECTIVE* 5 ECTS cr
	Sustainable Innovation by Design: A User Experience Perspective **The maximum number of students in the course is 24. Priority is given to students for whom the course in obligatory.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.
Teacher(s)	Person in Charge: Professor, Ph.D., PEng., HDR. Ahmed Seffah
Aims	How do we design and deploy innovative software products someone is willing to buy and use? Why only few software innovations make it to market and most fail? The course answers to these questions while outlining the user experience design and design thinking theory for open sustainability innovation. Through a mix of readings on design and innovation theories, user research investigations and practical design work in the living lab, students will acquire a practical and a research experience in “innovation and change by design”. In particular, students will: 1. Have a deep immersion into the state of research in HCI, user experience design and design thinking as approaches to sustainability innovation 2. Acquire new skills in building a portfolio of design including sketches and prototypes created and tested in a living lab. Students will complete many hands-on activities and interact with your fellow students and representative of users as you experience a completely different way of learning how to develop human-centric software and information systems, services, and socio-technical system.

Content	Design theories, principles and methods. Principles of design thinking. Human-centric design processes. User experience in design practices. Co-design and innovation in living lab. User research in design. Sustainability by design. Persona and customer profiling. Diary studies. HCI design patterns. Storytelling. Paper prototyping. Usability and sustainability testing. Controlled experiments. Design of innovative software products. Introduction to design research and science. Socio-technical systems design. Historical, cultural, and technical foundations of design and innovation in a range of discipline areas (software engineering, MIS, HCI, arts. In a group of 3-5, students are asked to develop a design concept and validate it in the design living lab. Students are requested to write a research paper and to present a design portfolio that demonstrate their capacity to generate design ideas, innovative concepts, proposals or solutions independently and/or collaboratively in response to a set briefs and/or as a self-initiated activity or based on documented user experiences. The importance of sustainability in design and innovation is a key concern in software and information systems engineering and research. Design principles and methods could be used to create values of software products through the open innovation concept. This course follows from work of open innovation and user-centric design and design thinking theories and principles that established the basis of sustainability innovation. It analyzes the concept of sustainability innovation by design applied to software and information system) from the HCI (human-computer interaction), user experience and research perpective. The course is related to sustainability.
Modes of Study	Lectures 12h. Lecture preparation (mandatory readings) 24h. Practical large design project in a group of 3 (+2) students 60h. User research in living lab 16h. Written research paper and presentation of the design portfolio 18h. Total 130h. Moodle is used in this course.
Evaluation	0-5. Design Portfolio 60%. Research paper 30%. Oral presentation 10%.
Study materials	Course online tutorial, specific mandatory readings from the following books will be provided in class by the professor Tim Brown. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Terry Winograd (ed.): Bringing Design to Software. Addison-Wesley, 1996. Bill Buxton, Sketching User Experiences: Getting the Design Right and the Right Design, Morgan Kauffmann Series on Interactive Technologies, 2007. Mads, et al. (Eds). The Online Encyclopedia of Human Computer Interaction, 2nd Edition. Interaction Design Foundation. Students unfamiliar with basic HCI design are encouraged to walkthrough the textbook User Interface design and evaluation. D. Stone, C. Jarrett, M. Woodroffe. S. Minocha. Morgan Kaufffmann Series in Interactive technologies. 2005.
Prerequisites	Basic expertise in software /user interface design methodologies like UML.

CT60A7001	***CRITICAL THINKING AND ARGUMENTATION IN SOFTWARE ENGINEERING 5 ECTS cr***
	Kriittinen ajattelu ja argumentointi ohjelmistotuotannossa **Can't be included in the same degree as CT10A7001 Green IT and Sustainable Computing.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Jari Porras
Aims	After the course students are familiar with critical thinking and argumentation principles and are able to apply these skills in discussions carried over yearly changing topic. After the course students are familiar with the given topic and

	understand its importance in software engineering field. Students are able to discuss about the topic and examine it critically.
Content	The course is divided in two parts. Lectures and discussions in third period emphasize critical thinking and argumentation skills. Lectures and seminars in fourth period are used for critical discussions based on a yearly selected topic of software engineering. Students may be divided into small groups that will each study a separate topic.
Modes of Study	Lectures 2 h, homeworks 10 h, online course 26 h, 3. period. Seminars and discussions 19 h, homeworks 26 h, self-study 47 h, 4. period. Total 130 h.
Evaluation	0 - 5. Seminar work(s), active participation in discussions, homeworks.
Study materials	For critical thinking part: A. Freeley, Argumentation and Debate: Critical Thinking for Reasoned Decision Making, Wadsworth Publishing. Software engineering literature changes yearly.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A7201	***ARCHITECTURE IN SYSTEMS AND SOFTWARE DEVELOPMENT*** ***7 ECTS cr***
	Architecture in Systems and Software Development, Arkkitehtuuri järjestelmien ja ohjelmistojen kehityksessä **The maximum number of students is limited to 50. Priority is given to students for whom the course in obligatory.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, Ph.D. Kari Smolander
Aims	The student understands the role of architecture in the development of software and information systems and has the basic skills of how to design and describe architecture.
Content	The role of architecture in development. Software architecture. Systems architecture. Enterprise architecture. Application integration. Architecture design. Architecture documentation. Architectural styles and patterns.
Modes of Study	Lectures, lecture exercises and presentations at lectures 18 h, weekly self-learning 7 h, 3rd period. Lectures, lecture exercises and presentations at lectures 18 h, weekly self-learning 7 h, 4th period. Practical assignment and presentation 60 h. Reading of a literature package 35 h. Preparing for the exam 28 h. Exam 3 h. Total 176 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 60 %, practical assignment 25 %, presentation 15 %.
Study materials	Lecture notes based on the following books: Bass, L., Clements, P., Kazman, R.: Software Architecture in Practice, 2nd Ed., Addison-Wesley, 2003. Linthicum, D.S.: Next Generation Application Integration: From Simple Information to Web Services, Addison-Wesley, 2003. Ross, J.W., Weill, P., Robertson, D.: Enterprise Architecture As Strategy: Creating a Foundation for Business Execution, Harvard Business School Press, 2006. Literature package given at the course.
Prerequisites	Software Engineering Methods or equivalent.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT60A7400	***FUNDAMENTALS OF INFORMATION SYSTEMS***	***7 ECTS cr***
	Tietojärjestelmien perusteet	
Year and Period	M.Sc. (Tech.) 1 Period 1-2 The course is suitable also for doctoral studies.	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Erja Mustonen-Ollila	
Aims	In order to complete the course the student should be able to: Demonstrate a sound grasp of the history of information systems (IS) in business, including an IS development. Describe the organisational uses of information systems to improve overall quality. Demonstrate the concepts for the specification and design or the re-engineering of organisationally related systems of limited scope using information technology. Explain what is meant by an information system development process, and what performance measurement implies. Show how information technology can be used to design, facilitate, and communicate organisational goals and objectives of information systems. Describe career paths in information systems. Present and discuss the professional and ethical responsibilities of the IS practitioner. Recognise the role and use of IS in technology and in business systems and operations. Identify and describe organisational structure and business processes within these structures. Demonstrate an understanding of the process in systems design and development. Discuss, and describe fundamental concepts of IS theory and their importance to practitioners. Discuss the relationship of IS planning to organisational planning.	
Content	Examination of the nature of the information systems discipline and key areas of professional interest and expertise. Introduction of the main topic areas in the study of information systems (IS) from both a theoretical and practical perspective. To discuss the role of information systems in society. To explain the operations of information systems, and the role of technology, business, and social environment within systems, and how information systems are developed, acquired or outsourced. To explain the use of information systems in business. To discuss and analyse the changing role of the information systems in the achievement of business objectives such as communication, collaboration, performance enhancement etc. The course is related to sustainability.	
Modes of Study	Lectures 12 h, exercises 12 h, 1. period and 2. period. One large practical assignment 72 h. Scientific home work exercises 64 h, 1.-2. period. Preparation to the exam 15 h, exam 3 h. Total amount 182 h.	
Evaluation	0 - 5. Exam 50 %, one practical assignment 50 %. It is also possible to replace some questions in the exam by doing an extensive amount of home work exercises (200 exercises).	
Study materials	Stair, R., and Reynolds, G. (2006) The Fundamentals of Information Systems. 3rd edition. ISBN 13: 978-0-619-21560-6. ISBN 10: 0-619-21560-7.	
Prerequisites	CT60A4001 Ohjelmistotuotanto	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction. Enrolment to tutorial groups in WebOodi	

Business Administration

Learning Outcomes of the Master's Programmes in Business Administration

The aims and content of Master's studies in business administration in Lappeenranta University of Technology are based on the university's strategic focus areas – especially sustainable value creation. The Master's studies are divided into six alternative Master's programmes:

Master's programmes in Finnish:

- Accounting (LAMO)
- Knowledge Management and Leadership (TIJO)

Master's programmes in English:

- International Marketing Management (MIMM)
- Strategy, Innovation and Sustainability (MSIS)
- Strategic Finance and Business Analytics (MSF)
- Supply Management (MSM)

The aim of the Master's studies is to provide students with wide-ranging skills and knowledge to work in management positions in business. Students who complete the degree also possess the knowledge, skills and mindset needed for postgraduate studies. In other words, the Master's degree helps the graduate to respond to the growing professional requirements of industries and also lays a foundation for doctoral studies in business administration.

Students are able to influence the contents of their studies by making choices based on their own strengths, interests and goals. The learning outcomes of the Master's programmes are of the same academic level but different in content. The detailed learning outcomes are described in the programme descriptions.

Study Guidelines

Language studies 6 ECTS credits (all Master's programmes)

Important! In Master's programmes in English (MSM, MIMM, MSF and MSIS), English is not accepted into language studies.

The six-credit module required must be in ONE LANGUAGE. Language studies in the Master's degree may not be in the same language as in the Bachelor's degree.

The following courses cannot be included in the compulsory language studies in the Master's degree: FV11A0200 Activation of English Skills, FV16A1250 Espanjan kielen perussanasto, FV16A1251 Espanjan kielen ydinsanasto, FV13A0100 Prepkurs and FV13A1400 Ekonomisvenska or any Swedish courses which are accepted as proof of proficiency in the second official language of Finland under the Government Decree on University Degrees. Other Swedish courses may be included in compulsory language studies.

Further information is available in the Language Centre study guide.

International student exchange, internships abroad and language studies

Additional language credits can be awarded for student exchange or internships abroad. Student exchange or an internship of one semester (3-6 months) amount to 3 ECTS credits of language studies, and those of one academic year (7-12 months) amount to 6 ECTS credits. Language credits are granted for internships that are accepted into the degree by the student's specialization or Master's programme.

Language studies may include studies in the language of the target country or in the language of the programme, or in the case of internships, the official working language of the company. Credits are awarded for only one language. Language studies can be included in either the Bachelor's or Master's degree.

Language credits for international exchange and internships are approved based on the student's application. **Language credits are awarded to students who have taken part in student exchange no earlier than in the academic year 2009-2010. Other language studies (completed language courses) are also approved by business administration. Language credits can also be granted for internships completed abroad after 1 May 2011.**

For internships abroad, language credits can be awarded only once.

If the student only completes language and culture studies (e.g. Japanese or Chinese language and culture) during the stay abroad, no additional language credits will be awarded for the exchange itself.

6.4 Master's Programme in Supply Management (MSM) - LUT

MSM - Double Degree students at Twente University follow this same curriculum.

Aims and Learning Outcomes

The Master's programme in Supply Management is designed for future specialists and managers of supplier relationships, networks and strategic buying. The programme gives students frameworks, tools and models how to effectively manage costs and risks of supply market, evaluate and select suppliers, develop supply strategies and integration of supply chain.

Graduates can find specialist and management positions in both the public and private sector, as well as in global and local companies in the fields of supply management, international business, logistics, supply chain management and consulting. Examples of such positions include global sourcing director, supply manager, category manager and strategic buyer.

The core studies of the programme focus on strategic and operative supply management, purchasing, collaboration and relationships between suppliers and buyers, management of supply chains, networks and external resources. The program builds on previous studies at the undergraduate level of business management and international business. The curriculum of the programme is built on three cornerstones in the field: 1) strategic supply management, 2) supplier and network management, and 3) supply chain management.

After completing the programme students are able to:

- Understand the strategic role of supply management and purchasing in global business and value creation.
- Create ability to develop and evaluate supply management strategies in global context.
- Create ability to develop and analyze purchasing and supply management processes as a part of business strategy.
- Know the main theories of managing supply, suppliers and value networks.
- Recognize the global supply network risks and challenges.
- Apply relevant methods and skills to manage supply chains and supplier relationships.
- Utilize strong analytical skills and apply tools required for professional practices.

Programme-specific Information

Inclusion of online courses (MOOCs) to the MSM curriculum:
If a student wants to include MOOCs in the MSM degree, it must be agreed beforehand with the Academic Director by submitting an informal application letter (course details and ECTS, suitability to the programme). A maximum of 12 ECTS of MOOCs can be included in the MSM degree. These courses can be located to replace elective courses in core studies (Supply Strategy, Supplier Relationships & Networks and Supply Chain Management).

Internship:
Students may include 6 ECTS work experience (internship) into the degree, but this must be agreed beforehand. Only the internship which the student does during the studies at LUT can be accepted. Two weeks of internship correspond to 1 ECTS. The internship may be located to replace an elective course in core studies (Supply Strategy, Supplier Relationships & Networks and Supply Chain Management) depending on the focus of the internship.

The Master's Program in Supply Management is a two year programme corresponding minimum 120 ECTS credits.

Degree Structure

Core Studies (incl. academic skills)	48
Specialisation studies	42
Minor studies	24
Language studies (not English)	6
Credits	**120 op (min.)**

CORE STUDIES 48 ECTS cr

Supply Strategy 12 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A310A0101	Strategic Supply Management	M.Sc. (Econ. & Bus. Adm.) 1	1-2	6

And at least 6 ECTS cr of the following courses:		*year*	*per.*	*ECTS cr*
A210A0200	Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 1-2	per 3-INT 17	6
A365A0100	Organization Theory	M.Sc. (Econ. & Bus. Adm.) 1	1	6
A350A0601	Contemporary Issues i§n Strategic Management and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	3	6

Supplier Relationships & Networks 12 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A310A0500	Global Sourcing and Sub-Contracting	M.Sc. (Econ. & Bus. Adm.) 1	4	6

And at least 6 ECTS cr of the following courses:		*year*	*per.*	*ECTS cr*
A310A0601	Reading Course of Supplier Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1-2	4	3
A310A0750	Logistics Outsourcing and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	INT 43	3
A330A0050	Customer Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1-2	4	6
CS10A0151	Business Relationships and Networks	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	5

Supply Chain Management 18 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A310A0301	Supply Chain Improvement	M.Sc. (Econ. & Bus. Adm.) 1	3-4	6
A310A0650	Cost and Risk Management in Supply Chain	M.Sc. (Econ. & Bus. Adm.) 1	4	6

And at least 6 ECTS cr of the following courses:		*year*	*per.*	*ECTS cr*
A210A0350	Real Options and Managerial Decision-making	M.Sc. (Econ. & Bus. Adm.) 2	3	6
A210A0601	Information Systems in Corporate Management and Decision-making	M.Sc. (Econ. & Bus. Adm.) 1	2	6
A310A0401	Public Procurement	M.Sc. (Econ. & Bus. Adm.) 1	INT 9	6

ACADEMIC SKILLS 6 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A365A0551	Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1-2	3
A310A8500	Master´s Thesis Seminar, Supply Management	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	3

SPECIALISATION STUDIES 42 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A310A0201	External Resource Management	M.Sc. (Econ. & Bus. Adm.) 2	2	6
A350A0110	Project Course on Strategy and Business Models	M.Sc. (Econ. & Bus. Adm.) 1-2	1-2/3-4	6
A310A9100	Master's Thesis, Supply Management	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	30

Complementary Studies

Complementary studies must be completed in addition to the actual Master's level studies in business administration. They are not included in the Master's degree.

Important! *Students who have received their education in Finnish or Swedish must demonstrate in studies included in education for a lower or higher university degree that they have attained proficiency in Swedish required by decree (Government Decree on University Degrees, section 6)*

If the required proficiency in Swedish has not been demonstrated in a previous degree, it must be demonstrated in studies at LUT in addition to other complementary studies. However, this is not required of students who have been educated in a language other than Finnish or Swedish or who have been educated abroad. This rule applies to all degree programmes.

Master's Degree in Supply Management (MSM) and MSM – HSE students

All other students than students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland

Obligatory courses:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
A350A0050	Business Research Methods	1-2	6

Students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory course:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3

6.5 Master's Programme in Supply Management, HSE Double Degree

The Master's Program in Supply Management is a two year programme corresponding minimum 120 ECTS credits.

The Degree Structure

Core Studies (incl. academic skills)	48
Specialisation studies	42
Minor studies	24
Language studies (not English)	6
Credits	**120 op (min.)**

The Master's Program in Supply Management is a two year programme corresponding minimum 120 ECTS credits. It is a double degree program between two universities in Finland and Russia: The Higher School of Economics (HSE) in Moscow and Lappeenranta University of Technology's School of Business and Management, Business Administration. HSE students admitted into double degree program receive a degree certificate from both universities provided that they fulfill the requirements of both universities.

HSE students study 1st year of their studies at HSE and at least one semester of 2nd year of their studies at LUT. During the studies in LUT HSE students participate to courses offered by LUT MSM program to fulfill their curriculum. HSE students need to take a minimum 30 ECTS in LUT and participate in the joint Master's Thesis research seminar.

Internship:
Students may include 6 ECTS work experience (internship) into the degree, but this must be agreed beforehand. Only the internship which the student does during the studies at LUT can be accepted. Two weeks of internship correspond to 1 ECTS. The internship may be located to replace an elective course in core studies (Supply Strategy, Supplier Relationships & Networks and Supply Chain Management) depending on the focus of the internship.

CORE STUDIES 48 ECTS cr

Supply Strategy 12 ECTS cr

Obligatory	*year*	*per.*	*ECTS cr*
A310A0101 Strategic Supply Management	M.Sc. (Econ. & Bus. Adm.) 1	1-2	6

And 6 ECTS cr of the following courses:	*year*	*per.*	*ECTS cr*
A210A0200 Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 1-2	per 3-INT 17	6
A365A0100 Organization Theory	M.Sc. (Econ. & Bus. Adm.) 1	1	6
A350A0601 Contemporary Issues in Strategic Management and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	3	6

Supplier Relationships & Networks 12 ECTS cr

Obligatory	*year*	*per.*	*ECTS cr*
A310A0500 Global Sourcing and Sub-Contracting	M.Sc. (Econ. & Bus. Adm.) 1	4	6

And at least 6 ECTS cr of the following courses:		year	per.	ECTS cr
A310A0601	Reading Course of Supplier Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1-2	4	3
A310A0750	Logistics Outsourcing and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	INT 43	3
A330A0050	Customer Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1-2	per 4-INT 16	6
CS10A0151	Business Relationships and Networks	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	5

Supply Chain Management 18 ECTS cr

Obligatory		year	per.	ECTS cr
A310A0301	Supply Chain Improvement	M.Sc. (Econ. & Bus. Adm.) 1	3-4	6
A310A0650	Cost and Risk Management in Supply Chain	M.Sc. (Econ. & Bus. Adm.) 1	4	6

And at least 6 ECTS cr of the following courses:		year	per.	ECTS cr
A310A0401	Public Procurement	KTM 1	INT 9	6
A210A0350	Real Options and Managerial Decision-making	KTM 2	INT 9	6
A210A0601	Information Systems in Corporate Management and Decision-making	KTM 1	2	6
A310A0700	Logistic Solutions, field trip for HSE DD	KTM 1	INT 43	1

ACADEMIC SKILLS 6 ECTS cr

Obligatory		year	per.	ECTS cr
A365A0551	Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1-2	3
A310A8500	Master´s Thesis Seminar, Supply Management	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	3

SPECIALISATION STUDIES 42 ECTS cr

Obligatory		year	per.	ECTS cr
A310A0201	External Resource Management	M.Sc. (Econ. & Bus. Adm.) 2	2	6
A350A0110	Project Course on Strategy and Business Models	M.Sc. (Econ. & Bus. Adm.) 1-2	1-2/3-4	6
A310A9100	Master's Thesis, Supply Management	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	30

6.6 Master's Programme in Strategic Finance and Business Analytics (MSF)

Aims and Learning Outcomes

The Master's programme in Strategic Finance and Business Analytics combines the disciplines of strategic finance and business analytics to offer students an interesting and a relevant skillset for working in an international business environment in various management positions. The content of the program is based on the theories and concepts of financial economics and corporate finance and on practice-oriented decision-making skills and analytics know-how that help to build a sound base for a career in financial management and decision-making. Industry collaboration is a part of our curriculum. The program encourages students to take advantage of the international academic partnership network of the LUT School of Business and Management, business administration. Our graduates will fit into the finance and management teams of the global corporations, as well as, the local SMEs.

After completing the MSF programme the students will be able to:

- Describe and examine main theories and concepts of finance and international financial markets.
- Understand the supporting role of information technology in business and in decision-making and evaluate possibilities to use information technology in business development.
- Demonstrate analytical financial and business skills in practice.
- Conduct an independent scientific research project, report and present it professionally.

Programme-specific Information

International exchange:
International exchange is recommended in the second year of studies and generally after 55 cr of completed studies. Studies completed at a partner university can replace core and minor studies elective courses.

Internship:
Students may include 6 ECTS international work experience (internship) into the degree, but this must be agreed beforehand. Only the internship which the student does during the studies at LUT can be accepted. Two weeks of internship correspond to 1 ECTS. The internship may be located to replace an elective course in core studies.

The degree of Master of Science in Economics and Business Administration requires completing 120 ECTS credits during 2 years of full time studies.

Degree Structure

Core Studies (incl. academic skills)	54	ECTS cr
Specialisation Studies	36	ECTS cr
Minor Studies	24	ECTS cr
Language Studies	6	ECTS cr
Credits	120 (min.)	ECTS cr

CORE STUDIES IN STRATEGIC FINANCE, INTERNATIONAL FINANCE AND ACOUNTING AND IN CORPORATE STRATEGY 54 ECTS CR

Strategic Finance

Obligatory (24 ECTS cr)		*year*	*per.*	*ECTS cr*
A220A0101	Derivatives and Financial Risk Management	M.Sc. (Econ. & Bus. Adm.) 2	Per 1-INT 43	6
A220A0200	International Financial Management	M.Sc. (Econ. & Bus. Adm.) 1	1	6
A220A0600	Banking and Insurance Finance	M.Sc. (Econ. & Bus. Adm.) 1	4	6

A220A0650	Financial Theory and Valuation	M.Sc. (Econ. & Bus. Adm.) 1	3	6

And at least 24 ECTS cr of the following elective courses:		*year*	*per.*	*ECTS cr*
A220A0400	Empirical Research in Finance	M.Sc. (Econ. & Bus. Adm.) 2	4	6
A220A0500	Contemporary Issues in Strategic Finance	M.Sc. (Econ. & Bus. Adm.) 1	3-4 or intensive	3
CS30A1682	Advanced Course in Strategic Management	M.Sc. (Econ. & Bus. Adm.) 2	3-4	5

International Finance and Accounting

Electives		*year*	*per.*	*ECTS cr*
A210A0050	Comparative International Accounting: Theory and Practice	M.Sc. (Econ. & Bus. Adm.) 1	1-2	6

Corporate Strategy

Electives		*year*	*per.*	*ECTS cr*
A210A0200	Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 1-2	per 3-INT 17	6
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
A350A0110	Project Course on Strategy and Business Models	M.Sc. (Econ. & Bus. Adm.) 1-2	1-2/3-4	6

ACADEMIC SKILLS (6 ECTS cr)

Obligatory		*year*	*per.*	*ECTS cr*
A365A0551	Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1-2	3
A220A8500	Master's Thesis Seminar, Strategic Finance	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	3

SPECIALISATION STUDIES 36 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A210A0350	Real Options and Managerial Decision-making	M.Sc. (Econ. & Bus. Adm.) 2	3	6
A220A9000	Master’s Thesis, Strategic Finance	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	30

OBLIGATORY MINOR: Business Analytics 24 ECTS cr

Obligatory (13 ECTS cr)		*year*	*per.*	*ECTS cr*
A220A0000	Financial Econometrics	M.Sc. (Econ. & Bus. Adm.) 2	2	6
A220A0052	Investment and Business Analysis with Excel	M.Sc. (Econ. & Bus. Adm.) 1	4	3
BM20A5001	Principles of Technical Computing	M.Sc. (Econ. & Bus. Adm.) 1	1	4

Choose at least 11 ECTS cr of the following elective courses:		*year*	*per.*	*ECTS cr*
A210A0601	Information Systems in Corporate Management and Decision-making	M.Sc. (Econ. & Bus. Adm.) 1	2	6
A220A0550	Advanced Decision-making	M.Sc. (Econ. & Bus. Adm.) 2	3	6
A220A0750	Elective Special Course on Business Analytics or Decision-making	M.Sc. (Econ. & Bus. Adm.) 2		3
CS30A1371	Creative Design and Problem Solving	M.Sc. (Econ. & Bus. Adm.) 1	1-2	5
CS30A1390	Systems Engineering	M.Sc. (Econ. & Bus. Adm.) 2	3-4	5

CS30A1551	System Dynamics and Industrial Management	INT 43 - 5 per. 2

Suggested study plan for MSF students

On year 1, period 1, take "Principles of Technical Computing" to learn MATLAB, then you are able to take the obligatory course on "Financial Econometrics" (uses MATLAB) on the 2nd period. Take the course "Information Systems in Corporate Management and Decision-Making" for an overview of the use of information systems and a number of smart analysis methods.

Suggested courses for MSF students for hands-on skills on business analytics and decision-making modeling include "Advanced Decision-Making" and "Elective Special Course on Business Analytics or Decision-making".

Complementary Studies

Complementary studies must be completed in addition to the actual Master's level studies in business administration. They are not included in the Master's degree.

<u>Important!</u> Students who have received their education in Finnish or Swedish must demonstrate in studies included in education for a lower or higher university degree that they have attained proficiency in Swedish required by decree (Government Decree on University Degrees, section 6)

If the required proficiency in Swedish has not been demonstrated in a previous degree, it must be demonstrated in studies at LUT in addition to other complementary studies. However, this is not required of students who have been educated in a language other than Finnish or Swedish or who have been educated abroad. This rule applies to all degree programmes.

Master's Degree in Strategic Finance and Business Analytics (MSF)

All other students than students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory courses:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
A350A0050	Business Research Methods	3-4	6
A350A0250	Multivariate and Econometric Analysis Methods	3-4	6

Students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory courses:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
A350A0250	Multivariate and Econometric Analysis Methods	3-4	6

6.7 Master's Programme in International Marketing Management (MIMM)

Aims and Learning Outcomes

The Master's Programme in International Marketing Management integrates marketing, international business and technology management disciplines to address the needs of global firms operating in turbulent environments facing growing challenges in their marketing management. The programme focuses especially on the management of global knowledge-intensive innovation activities from marketing perspective, and is thus tailored for future marketing managers operating in international environments. International marketing management is seen as the centerpiece and combinatory element of the many operations a firm must conduct and coordinate in the globalized world. The programme aims to combine the most important areas of strategic marketing, international business and technology management. The demand for this specialized competence is strong, and the unique combination of know-how should ensure the employability of the student after graduation. International Marketing Management graduates have found professions in a broad range of firms and sectors: marketing, international business, product development, sales, logistics, international service business, consulting, and market research. The job titles include Marketing Manager, Export Manager, Area Manager, Subsidiary Manager, Project Manager in International Marketing, and Business Development Consultant, for example.

The overall purpose of the MIMM programme is to provide the students with knowledge, skills, values and attitudes in marketing management. The programme builds on previous studies at the undergraduate level in marketing, international business and/or technology management. After completing the programme, students will be able to:

- Understand and assess the challenges of turbulent business environments.
- Evaluate and design strategies in such environments either in marketing, international business and/or technology management fields and in their intersection.
- Apply relevant business skills.
- Choose relevant additional knowledge and skills to support subject based expertise and international readiness.
- Conduct an independent scientific research project and report it.
- Utilize strong analytical skills and apply tools required for professional practices.
- Show a global, innovative, market-oriented and ethical mindset.

Programme-specific Information

International exchange is recommended (but not compulsory) in the MIMM programme. We recommend students to study 24-30 ECTS abroad. The students may also include the LUT Summer School 2015 modules into their core study electives, see the separate LUT Summer School programme.

Instructions on how to include exchange courses into the MIMM degree, in order of preference:

1. Study a minor package: agree on the topic of the minor studies with MIMM Program Director in advance.
2. Locate exchange courses to replace the elective courses in core studies (marketing, international business or technology management).
3. Find courses that correspond to MIMM Programme ILO's 1 & 2 to replace 2-year MIMM Specialization courses. (Programme ILO's: 1) Understand and assess the challenges of turbulent business environments, 2) Evaluate and design strategies in such environments either in marketing, international business and/or technology management fields and in their intersection)

Inclusion of online courses (MOOCs) to the MIMM curriculum:
If a student wants to include MOOCs in the MIMM degree, it must agreed beforehand with the Academic Director by submitting an informal application letter (course details and ECTS, suitability to the programme). A maximum of 12 ECTS of MOOCs can be included in the MIMM degree. These courses can be located to replace elective courses in core studies (marketing, international business or technology management).

Internship:
Students may include 6 ECTS international work experience (internship) into the degree, but this must be agreed beforehand. Only the internship which the student does during the studies at LUT can be accepted. Two weeks of internship correspond to 1 ECTS. The internship may be located to replace an elective course in core studies depending on the focus of the internship (Marketing, IB or TM).

Recommended minor studies: Sustainability (24 ECTS) or Knowledge and Innovation Management (24 ECTS). Suomenkieliset opiskelijat voivat suorittaa myös muita, suomenkielisiä sivuopintokokonaisuuksia. See the degree structures of these minors in the chapter minor subjects in English.

Degree Structure

Core Studies(incl. academic skills)	42	ECTS cr
Specialisation Studies	48	ECTS cr
Minor Studies	24-25	ECTS cr
Language Studies (not English)	6	ECTS cr
Credits	120-121	ECTS cr

CORE STUDIES IN MARKETING, INTERNATIONAL BUSINESS AND TECHNOLOGY MANAGEMENT

Students will read a minimum of 12 ECTS cr in marketing, 12 ECTS cr in international business and 12 ECTS cr in technology management during their core studies.

Marketing 12 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A330A0300	Strategic Global Marketing Management	M.Sc. (Econ. & Bus. Adm.) 1	1	6

And a minimum of 6 ECTS cr from the following:

Electives		*year*	*per.*	*ECTS cr*
A330A0010	Contemporary Issues in International Marketing	M.Sc. (Econ. & Bus. Adm.) 1	3, intensive	3
A330A0020(*	Asian Management	M.Sc. (Econ. & Bus. Adm.) 1		3
A330A0050	Customer Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1	4	6
A330A0400	International Marketing Research	M.Sc. (Econ. & Bus. Adm.) 1	INT 1-INT 17	6
A330A0500	Brand Management	M.Sc. (Econ. & Bus. Adm.) 1	INT 16	3

*) Not lectured during the academic year 2015-16

International Business 12 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A330A0250	Internationalization of the Firm and Global Marketing	M.Sc. (Econ. & Bus. Adm.) 1	2	6

And a minimum of 6 ECTS cr of the following:

Electives		*year*	*per.*	*ECTS cr*
A220A0650	Financial Theory and Valuation	M.Sc. (Econ. & Bus. Adm.) 1	3	6
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
A365A0100	Organization Theory	M.Sc. (Econ. & Bus. Adm.) 1	1	6
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Econ. & Bus. Adm.) 1	1-4	3

Technology Management 12 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A350A0300	Technology and Innovation Management	M.Sc. (Econ. & Bus. Adm.) 1	1	6
A330A0200(1	International Marketing of High Technology Products and Innovations	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A5000(1	International Marketing of High Technology Products and Innovations	M.Sc. (Econ. & Bus. Adm.) 2		3
A330A0220(*	International Marketing of High Technology Products and Innovations: applications	M.Sc. (Econ. & Bus. Adm.) 2	1-2	3

1) Exchangeable
*) Only for students who have taken the Summer School course A330A5000

ACADEMIC SKILLS

Obligatory (6 ECTS cr)		*year*	*per.*	*ECTS cr*
A365A0551	Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1-2	3
A330A8500	Master's Thesis Seminar, International Marketing Management	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	3

SPECIALISATION STUDIES IN MARKETING, INTERNATIONAL BUSINESS AND TECHNOLOGY MANAGEMENT 48 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A330A0100	International Business Strategies	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A0151	International Entrepreneurship Challenge	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A350A0110	Project Course on Strategy and Business Models	M.Sc. (Econ. & Bus. Adm.) 1	1-2/3-4	6
A330A9000	Master's Thesis, International Marketing Management	M.Sc. (Econ. & Bus. Adm.) 2	1-2/3-4	30

Complementary Studies

Complementary studies must be completed in addition to the actual Master's level studies in business administration. They are not included in the Master's degree.

<u>Important!</u> Students who have received their education in Finnish or Swedish must demonstrate in studies included in education for a lower or higher university degree that they have attained proficiency in Swedish required by decree (Government Decree on University Degrees, section 6)

If the required proficiency in Swedish has not been demonstrated in a previous degree, it must be demonstrated in studies at LUT in addition to other complementary studies. However, this is not required of students who have been educated in a language other than Finnish or Swedish or who have been educated abroad. This rule applies to all degree programmes.

Master´s Degree in International Marketing Management (MIMM)

All other students than students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory courses:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
A350A0050	Business Research Methods	3-4	6

Students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory course:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3

6.8 Master's Programme in International Marketing Management (SKEMA-Dual Degree)

Programme-specific Information

The Master's Program in International Marketing Management (SKEMA-Dual Degree) is the result of cooperation between two universities in Finland and France: the SKEMA Business School (SKEMA) in France and Lappeenranta University of Technology's School of Business and Management, Business Administration. This Dual Degree Program involves SKEMA´s Master of Science in International Marketing and Business Development and LUT´s (MIMM) "Master's in International Marketing Management" program.

Students admitted into the dual degree program receive a degree certificate from both universities provided that they fulfill the requirements of both universities.

The Master's program titled as "International Marketing Management", takes two years, corresponds to the minimum of 120 ECTS credits and leads to the degrees of Master of Science in Economics and Business Administration at LUT, School of Business and Master of Science in International Marketing and Business Development (MSc IMBD) at SKEMA.

Four semesters include obligatory lectures and exercises, as well as elective courses. After these four semesters students are expected to write the Master's thesis. The language of tuition in the program is English.

LUT MIMM DD-students
LUT MIMM students study 1st year of their studies and the first semester of the 2nd year at LUT and the second semester of the 2nd year of their studies at SKEMA. LUT MIMM (SKEMA DD) students follow the degree structure mentioned below during the first three semesters of their studies.

During the second semester of the 2nd year of studies LUT MIMM students participate to courses offered by SKEMA to fulfill their curriculum. LUT students need to take a minimum of 30 ECTS in SKEMA and participate in the joint Master's Thesis research seminar. The 30 ECTS in SKEMA will form the compulsory minor studies titled Business development.

LUT MIMM (SKEMA DD) students will have to take complementary language studies of a minimum of 6 ECTS credits of one language (other than English) and study another complementary minor at LUT during the first three semesters at LUT (min 24 ECTS). These studies are not included in the Master's degree, but are an addition to it.

SKEMA MIMM DD-students
SKEMA MIMM students study 1st year of their studies at SKEMA, then the first semester of the 2nd year of their studies at LUT and the second semester of the 2nd year again at SKEMA. SKEMA MIMM students follow the degree structure of SKEMA during the 1st year of their studies.

During the first semester of the 2nd year of studies SKEMA MIMM students participate to courses offered by LUT to fulfill their curriculum (specialisation studies and courses International Marketing of High Technology Products and Innovations, Technology and Innovation Management and Business Research Methods). SKEMA students need to take a minimum of 60 ECTS credits (including 30 ECTS credits of Master's thesis) in LUT and participate in the joint Master's Thesis research seminar.

Master's Programme in International Marketing Management (SKEMA DD-students)

Degree Structure

Core Studies (incl. academic skills) (30 ECTS cr in SKEMA + courses International Marketing of High Technology Products and Innovations and Technology and Innovation Management in LUT)	42	*ECTS cr*
Specialisation Studies (in LUT)	42	*ECTS cr*
Business Research Methods (in LUT)	6	*ECTS cr*
Minor Studies (Business development) (in SKEMA)	30	*ECTS cr*
Credits	120 (min.)	*ECTS cr*

Master's Programme in International Marketing Management (LUT DD-students)

Degree Structure

Core Studies (incl. academic skills, in LUT)	42	*ECTS cr*
Specialisation Studies (in LUT)	48	*ECTS cr*
Minor Studies (Business development) (in SKEMA)	30	*ECTS cr*
Credits	120 (min.)	*ECTS cr*

Compulsory minor studies in Business Development is studied during the second year, second semester at SKEMA (30 ECTS).
Prerequisites / additional studies for LUT students: second minor during the first year at LUT (24 ECTS) and 6 ECTS of languages.

Core Studies in Marketing, International Business and Technology Management (42 ECTS cr)

Students will read a minimum of 12 ECTS in marketing, 12 ECTS in international business and 12 ECTS in technology management during their core studies.

Marketing 12 ECTS cr

Obligatory		*year*	*per.*	*ECTS*
A330A0300	Strategic Global Marketing Management	M.Sc. (Econ. & Bus. Adm.) 1	1	6
And min. of 6 ECTS of the following:				
A330A0050	Customer Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1	4	6
A330A0010	Contemporary Issues in International Marketing	M.Sc. (Econ. & Bus. Adm.) 1	3,Int.	3
A330A0020	Asian Management (Not lectured 2015-16)	M.Sc. (Econ.& Bus. Adm.) 1	3-4.Int.	3
A330A0500	Brand Management	M.Sc. (Econ.& Bus. Adm.) 1	4, Int.	3
A330A0400	International Marketing Research	M.Sc. (Econ.& Bus. Adm.) 1	3-4,Int.	6

International Business 12 ECTS cr

Obligatory		*year*	*per.*	*ECTS*
A330A0250	Internationalization of the Firm and Global Marketing	M.Sc. (Econ. & Bus. Adm.) 1	2	6
And min. 6 ECTS of the following:				
A365A0100	Organization theory	M.Sc. (Econ. & Bus. Adm.) 1	1-2	6
A220A0650	Financial Theory and Valuation	M.Sc. (Econ. & Bus. Adm.) 1	3	6
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Econ&Bus. Adm) 1	1-4	3
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. &Bus. Adm.) 1	2	3

Technology Management 12 ECTS

Obligatory		*year*	*per.*	*ECTS*
A350A0300	Technology and Innovation Management	M.Sc. (Econ. & Bus. Adm.) 1	1	6
A330A0200 1)	International Marketing of High Technology Products and Innovations OR	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A5000 1)	*International Marketing of High Technology Products and Innovations (Summer School course)* *AND*	*M. Sc. (Econ.& Bus. Adm. 2*	*1*	*3*
A330A0220 1)	*International Marketing of High Technology Products and Innovations: Applications*	*M.Sc. (Econ. & Bus. Adm.) 2*	*1-2*	*3*

1) Courses are alternative to each other.

Academic skills 6 ECTS cr

A365A0551	Master´s Transferable Skills	M.Sc. (Econ & Bus. Adm) 1	1-2	3
A330A8500	Master's Thesis Seminar	M.Sc. (Econ & Bus. Adm) 2	1-2/3-4	3

Specialisation Studies in Marketing, International Business and Technology Management (48 ECTS cr)

Obligatory courses		*year*	*per.*	*ECTS*
A350A0110	Project Course on Strategy and Business Models*)	M.Sc. (Econ. & Bus. Adm.) 1	1-2	6
A330A0100	International Business Strategies	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A0151	International Entrepreneurship Challenge	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A9000	Master's Thesis (international marketing management)	M.Sc. (Econ. & Bus. Adm.) 2	3-4	30

*) SKEMA DD-student don't take this course.

Complementary Studies

Complementary studies must be completed in addition to the actual Master's level studies in business administration. They are not included in the Master's degree.

Important! Students who have received their education in Finnish or Swedish must demonstrate in studies included in education for a lower or higher university degree that they have attained proficiency in Swedish required by decree (Government Decree on University Degrees, section 6)

If the required proficiency in Swedish has not been demonstrated in a previous degree, it must be demonstrated in studies at LUT in addition to other complementary studies. However, this is not required of students who have been educated in a language other than Finnish or Swedish or who have been educated abroad. This rule applies to all degree programmes.

Master's in International Marketing Management (MIMM) DD - SKEMA

All other students than students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory courses:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
A350A0050	Business Research Methods	3-4	6

Students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory course:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3

6.9 Master's Programme in Strategy, Innovation and Sustainability (MSIS-LUT)

Aims and Learning Outcomes

The international Master's Programme in Strategy, Innovation and Sustainability gives students the required theoretical and practical competences for managing organizations and networks in dynamic and global business environments. In particular, the MSIS programme corresponds to the increasing international demand for strategic and innovation management professionals, who understand how sustainability issues create both challenges and opportunities for value creation. Students are offered a broad variety of assignments done both in groups and individually that help them to achieve the necessary analytical and managerial skills required from strategy and innovation professionals in today's job markets.

Based on a foundation of general management and business administration, the programme develops advanced competences in the intersections of strategy, innovation and sustainability. It pays special attention to understanding of modern business environments where creating economic value needs to be simultaneously aligned with creating long-term value to the entire society in a responsible manner.

After completing the programme, students will be able to:

- Discuss and assess theories and models related to strategy, innovation and sustainable value creation.
- Analyze managerial problems and make strategic decisions related to innovations in the context of international business and sustainable value creation.
- Demonstrate analytical business skills.
- Utilize intercultural and teamwork competences.
- Conduct an independent scientific research project, report and present it professionally.
- Show a global, innovative, and sustainability-aware mindset.

Programme-specific Information

International exchange is recommended during M. Sc. (Econ. & Bus) second Fall semester. The exchange studies should be included in elective studies, and it is also possible to conduct specific minor studies during exchange (this should be accepted by the programme's Academic Director beforehand).

Inclusion of online courses (MOOCs) to the MSIS curriculum:
If a student wants to include MOOCs in the MSIS degree, it must agreed beforehand with the Academic Director by submitting an informal application letter (course details and ECTS, suitability to the programme). A maximum of 12 ECTS of MOOCs can be included in the MSIS degree. These courses can be located to replace elective courses in core studies (strategy, innovation or sustainability)

Three minor topics are especially recommended for MSIS students at LUT, which can help students to increase their knowledge in a chosen topic area. These include minor studies in Sustainability, International Marketing, or Business and Technology in Russia.

Degree Structure

Core Studies (incl. academic skills)	48	ECTS cr
Specialisation Studies	42	ECTS cr
Minor Studies	24	ECTS cr
Language	6	ECTS cr
Credits	120 (min.)	ECTS cr

CORE STUDIES (total 48 ECTS cr, 30 ECTS cr Obligatory studies and 18 ECTS cr can be selected form any of the listed electives)

Strategy

Obligatory		*year*	*per.*	*ECTS cr*
A210A0200	Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 2	per 3-INT 17	6

Electives		*year*	*per.*	*ECTS cr*
A210A0050	Comparative International Accounting: Theory and Practice	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6
A220A0650	Financial Theory and Valuation	M.Sc. (Econ. & Bus. Adm.) 1	3	6
A330A0100	International Business Strategies	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6
A350A0250	Multivariate and Econometric Analysis Methods	M.Sc. (Econ. & Bus. Adm.) 1/2	3-4	6
A310A0500	Global Sourcing and Sub-Contracting	M.Sc. (Econ. & Bus. Adm.) 1	4	6
A310A0650	Cost and Risk Management in Supply Chain	M.Sc. (Econ. & Bus. Adm.) 1	4	6
CS30A1682	Advanced Course in Strategic Management	M.Sc. (Econ. & Bus. Adm.) 1/2	3-4	5
MSIS-HARE	Internship for Master´s Programmes	M.Sc. (Econ. & Bus. Adm.) 2	1-4	3

Innovation

Obligatory		*year*	*per.*	*ECTS cr*
A350A0300	Technology and Innovation Management	M.Sc. (Econ. & Bus. Adm.) 1-2	1	6
A350A0601	Contemporary Issues in Strategic Management and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	3	6

Electives		*year*	*per.*	*ECTS cr*
A330A0010	Contemporary Issues in International Marketing	M.Sc. (Econ. & Bus. Adm.) 1/2	3, intensive	3
A330A0200	International Marketing of High Technology Products and Innovations	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6

Sustainability

Obligatory		*year*	*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Econ. & Bus. Adm.) 1	1-4	3

Electives		*year*	*per.*	*ECTS cr*
A350A0550(*	Project Course on Sustainable Business	M.Sc. (Econ. & Bus. Adm.) 1	per 3, INT 9	3

*) Available for MSIS-students only

ACADEMIC SKILLS (6 ECTS cr)

Obligatory		*year*	*per.*	*ECTS cr*
A365A0551	Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1-2	3
A350A8500	Master's Thesis Seminar, Strategy, Innovation and Sustainability	M.Sc. (Econ. & Bus. Adm.) 2	1-4	3

SPECIALISATION STUDIES 42 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A350A0110	Project Course on Strategy and Business Models	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	6
A365A0300	Knowledge-based Networks	M.Sc. (Econ. & Bus. Adm.) 1/2	per 2-INT 51	6
A350A9100	Master's Thesis, Strategy, Innovation and Sustainability	M.Sc. (Econ. & Bus. Adm.) 1/2	1-4	30

Recommended minor studies (min. 24 ECTS cr)

Sustainability
International Marketing
Business and Technology in Russia

See the degree structures of these minors in the chapter minor subjects in English.

Complementary Studies

Complementary studies must be completed in addition to the actual Master's level studies in business administration. They are not included in the Master's degree.

<u>Important!</u> Students who have received their education in Finnish or Swedish must demonstrate in studies included in education for a lower or higher university degree that they have attained proficiency in Swedish required by decree (Government Decree on University Degrees, section 6)

If the required proficiency in Swedish has not been demonstrated in a previous degree, it must be demonstrated in studies at LUT in addition to other complementary studies. However, this is not required of students who have been educated in a language other than Finnish or Swedish or who have been educated abroad. This rule applies to all degree programmes.

Master´s Degree in Strategy, Innovation and Sustainability (MSIS) – LUT

All other students than students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory courses:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
A350A0050	Business Research Methods	1-2	6

Students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory course:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3

6.10 Master's Programme in Strategy, Innovation and Sustainability (MSIS) Double Degree - GSOM

Programme-specific Information

LUT MSIS students study 1st year of their studies at LUT and at least the first semester of the 2nd year of their studies at GSOM. LUT MSIS students study the obligatory courses at LUT and core studies elective courses mainly at GSOM. LUT students need to take a minimum of 30 ECTS in GSOM and participate in the joint Master's Thesis research seminar.

GSOM MSIS students study 1st year of their studies at GSOM and at least the first semester of the 2nd year of their studies at LUT. During the 2nd year of studies GSOM MSIS students participate to courses offered by LUT to fulfill their curriculum. GSOM students need to take a minimum of 30 ECTS in LUT and participate in the joint Master's Thesis research seminar.

Students will have to take complementary language studies of a minimum of 6 ECTS credits of one language (other than English). Russian language studies are recommended. These studies are not included in the Master's degree, but are an addition to it.

Degree Structure

Core Studies (incl. academic skills)	51	*ECTS cr*
Specialisation Studies	42	*ECTS cr*
Minor Studies	27	*ECTS cr*
Credits	*120 (min.)*	*ECTS cr*

CORE STUDIES (total 51 ECTS cr, 30 ECTS Obligatory studies, and 21 ECTS CR can be selected from any of the listed electives)

Strategy

Obligatory		*year*	*per.*	*ECTS cr*
A210A0200	Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 2	per 3-INT 17	6

Electives		*year*	*per.*	*ECTS cr*
A330A0100	International Business Strategies	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6
A210A0050	Comparative International Accounting: Theory and Practice	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6
A350A0250	Multivariate and Econometric Analysis Methods	M.Sc. (Econ. & Bus. Adm.) 1/2	3-4	6
A310A0500	Global Sourcing and Sub-Contracting	M.Sc. (Econ. & Bus. Adm.) 1	4	6
A310A0650	Cost and Risk Management in Supply Chain	M.Sc. (Econ. & Bus. Adm.) 1	4	6
CS30A1682	Advanced Course in Strategic Management	M.Sc. (Econ. & Bus. Adm.) 1/2	3-4	5

Innovation

Obligatory		*year*	*per.*	*ECTS cr*
A350A0300	Technology and Innovation Management	M.Sc. (Econ. & Bus. Adm.) 1-2	1	6
A350A0601	Contemporary Issues in Strategic Management and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	3	6

Electives		*year*	*per.*	*ECTS cr*
A330A0010	Contemporary Issues in International Marketing	M.Sc. (Econ. & Bus. Adm.) 1/2	3, intensive	3
A330A0200	International Marketing of High Technology Products and Innovations	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6

Sustainability

Obligatory		*year*	*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Econ. & Bus. Adm.) 1	1-4	3

Electives		*year*	*per.*	*ECTS cr*
A350A0550(*	Project Course on Sustainable Business	M.Sc. (Econ. & Bus. Adm.) 1	per 3, INT 9	3

*) Available for MSIS-students only

ACADEMIC SKILLS (6 ECTS cr)

Obligatory		*year*	*per.*	*ECTS cr*
A365A0551	Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1-2	3
A350A8500	Master's Thesis Seminar, Strategy, Innovation and Sustainability	M.Sc. (Econ. & Bus. Adm.) 2	1-4	3

SPECIALISATION STUDIES 42 ECTS cr

Obligatory		*year*	*per.*	*ECTS cr*
A350A0110	Project Course on Strategy and Business Models	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	6
A365A0300	Knowledge-based Networks	M.Sc. (Econ. & Bus. Adm.) 1/2	per 2-INT 51	6
A350A9100	Master's Thesis, Strategy, Innovation and Sustainability	M.Sc. (Econ. & Bus. Adm.) 1/2	1-4	30

Obligatory Minor Studies (27 ECTS cr), Business Administration

Obligatory courses:		*year*	*per.*	*ECTS cr*
A220A0650	Financial Theory and Valuation	M.Sc. (Econ. & Bus. Adm.) 1	3	6
A350A0200	Introduction to Economics	M.Sc. (Econ. & Bus. Adm.) 1	1/2/3/4	6
A365A0100	Organization Theory	M.Sc. (Econ. & Bus. Adm.) 1	1	6
A210A0601	Information Systems in Corporate Management and Decision-making	M.Sc. (Econ. & Bus. Adm.) 1	2	6
MSIS-HARE	Internship for Master´s Programmes	M.Sc. (Econ. & Bus. Adm.) 2	1-4	3

Complementary Studies

Complementary studies must be completed in addition to the actual Master's level studies in business administration. They are not included in the Master's degree.

<u>Important!</u> Students who have received their education in Finnish or Swedish must demonstrate in studies included in education for a lower or higher university degree that they have attained proficiency in Swedish required by decree (Government Decree on University Degrees, section 6)

If the required proficiency in Swedish has not been demonstrated in a previous degree, it must be demonstrated in studies at LUT in addition to other complementary studies. However, this is not required of students who have been educated in a language other than Finnish or Swedish or who have been educated abroad. This rule applies to all degree programmes.

Master´s Degree in Strategy, Innovation and Sustainability (MSIS) - DD

All other students than students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory courses:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
A350A0050	Business Research Methods	1-2	6
	Language studies (Russian recommended)		6

Students, who have graduated as B.Sc. (Econ. & Bus. Adm.) in Finland:

Obligatory course:		*Per.*	*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master´s Students	1-2	3
	Language studies (Russian recommended)		6

6.11 Master´s Programme in Strategy, Innovation and Sustainability (MSIS) (Plekhanov – Double Degree)

Double Degree students at Ural Federal University (UrFU) follow this same curriculum.

The first autumn semester and the second spring semester of studies in Plekhanov Russian University of Economics; max 50 ECTS of Master-level studies done in Plekhanov will be transferred to the LUT degree.

LUT will accept max 50 ECTS of Master-level studies of Business administration for LUT degree, including a Master-level course in business research methods. If there is no suitable methodology course done in Plekhanov, the student must take course “Business Research Methods, 6 ECTS” in LUT. The transferred courses will be included in “Minor studies in Business administration” and “core studies” in the LUT degree, depending on the contents of the transferred courses.

The first spring semester and second autumn semester of studies in LUT: Minimum 40 ECTS of studies in LUT and 30 ECTS for Master’s seminar and thesis in LUT.
Students of Plekhanov University will study the MSIS obligatory core studies and specialisation studies of the academic year they are enrolled in LUT and Master’s Thesis (min. 70 ECTS of studies in LUT).

The number of the ECTS credits to be completed at LUT will be specified in personal study plans defined in the beginning of studies in LUT. The personal study plan consists of the credit transfers from Plekhanov University and the courses to be completed at LUT.

Degree Structure

Core Studies (transferred from Plekhanov/ In LUT)	54	*ECTS cr*
Specialisation Studies (in LUT)	42	*ECTS cr*
Minor Studies (transferred from Plekhanov)	24	*ECTS cr*
Credits	*120 (min.)*	*ECTS cr*

Core Studies (total 54 ECTS cr, 30 ECTS cr Obligatory studies, and 24 ECTS cr can be selected from any of the listed electives)

		year	per.	ECTS cr
Strategy:				
Obligatory				
A210A0200	Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 2	3-4	6
Electives				
A330A0100	International Business Strategies	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6
A210A0050	Comparative International Accounting: Theory and Practice	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6
A350A0250	Multivariate and Econometric Analysis Methods	M.Sc. (Econ. & Bus. Adm.) 1/2	3-4	6
A310A0500	Global Sourcing and Sub-Contracting	M.Sc. (Econ. & Bus. Adm.) 1	4	6
A310A0650	Cost and Risk Management in Supply Chain	M.Sc. (Econ. & Bus. Adm.) 1	4	6
CS30A1682	Advanced Course in Strategic Management	M.Sc. (Econ. & Bus. Adm.) 1/2	3-4	5
Innovation:				
Obligatory				
A350A0300	Technology and Innovation Management	M.Sc. (Econ. & Bus. Adm.) 1/2	1	6
A350A0601	Contemporary issues in Strategic Management and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	3	6
Electives				
A330A0010	Contemporary Issues in International Marketing	M.Sc. (Econ. & Bus. Adm.) 1/2	3, intensive	3
A330A0200	International Marketing of High Technology Products and Innovations	M.Sc. (Econ. & Bus. Adm.) 1/2	1-2	6
Sustainability:				
Obligatory				
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Econ. & Bus. Adm.) 1	1-4	3
Electives				
A350A0550	Project Course on Sustainable Business*	M.Sc. (Econ. & Bus. Adm.) 1	4,int.	3

*) Available for MSIS-students only.

Academic skills:				
Obligatory				
A365A0551	Master´s Transferable Skills	M.Sc.(Econ. & Bus. Adm.) 1	1	3
A350A8500	Master’s Thesis seminar, Strategy, Innovation and Sustainability	M.Sc.(Econ. & Bus. Adm.) 2	1-4	3

Specialisation studies (42 ECTS cr)				
Obligatory		*year*	*per.*	*ECTS cr*
A350A0110	Project Course on Strategy and Business Models	M.Sc. (Econ. & Bus. Adm.) 1	3-4	6
365A0300	Knowledge-based networks	M.Sc. (Econ. & Bus. Adm.) 1/2	2	6
A350A9100	Master's Thesis, Strategy, Innovation and Sustainability	M.Sc. (Econ. & Bus. Adm.) 1/2	1-4	30

Course Descriptions in Business Administration

Course Descriptions		*ECTS cr*
A130A0050	Introduction to Studies of Economic Sciences for Master's Students	3
A130A0120	International Students' Peer Tutoring	3
A210A0050	Comparative International Accounting: Theory and Practice	6
A210A0200	Empirical Strategy Research	6
A210A0350	Real Options and Managerial Decision-making	6
A210A0601	Information Systems in Corporate Management and Decision-making	6
A220A0000	Financial Econometrics	6
A220A0052	Investment and Business Analysis with Excel	3
A220A0101	Derivatives and Financial Risk Management	6
A220A0200	International Financial Management	6
A220A0400	Empirical Research in Finance	6
A220A0500	Contemporary Issues in Strategic Finance	3
A220A0550	Advanced Decision-making	6
A220A0600	Banking and Insurance Finance	6
A220A0650	Financial Theory and Valuation	6
A220A0750	Elective Special Course on Business Analytics or Decision-making	3
A220A8500	Master's Thesis Seminar, Strategic Finance	3
A220A9000	Master’s Thesis, Strategic Finance	30
A310A0101	Strategic Supply Management	6
A310A0201	External Resource Management	6
A310A0301	Supply Chain Improvement	6
A310A0401	Public Procurement	6
A310A0500	Global Sourcing and Sub-Contracting	6
A310A0601	Reading Course of Supplier Relationship Management	3
A310A0650	Cost and Risk Management in Supply Chain	6
A310A0700	Logistic Solutions, field trip for HSE DD	1
A310A0750	Logistics Outsourcing and Innovation	3
A310A8500	Master´s Thesis Seminar, Supply Management	3
A310A9100	Master's Thesis, Supply Management	30
A330A0010	Contemporary Issues in International Marketing	3
A330A0020	Asian Management	3
A330A0050	Customer Relationship Management	6
A330A0100	International Business Strategies	6
A330A0151	International Entrepreneurship Challenge	6
A330A0200	International Marketing of High Technology Products and Innovations	6
A330A0220	International Marketing of High Technology Products and Innovations: applications	3
A330A0250	Internationalization of the Firm and Global Marketing	6
A330A0300	Strategic Global Marketing Management	6
A330A0400	International Marketing Research	6
A330A0500	Brand Management	3
A330A5000	International Marketing of High Technology Products and Innovations	3
A330A5101	Creativity and Entrepreneurship in New Product Development from the Silicon Valley´s Perspectives	3
A330A5200	Frontiers in International Business, Transformations in the World Economy and Global Production Networks	3
A330A5300	Doing Business in China	2
A330A5600	Doing Business in Russia	4
A330A8500	Master’s Thesis Seminar, International Marketing Management	3
A330A9000	Master's Thesis, International Marketing Management	30
A350A0050	Business Research Methods	6
A350A0110	Project Course on Strategy and Business Models	6
A350A0200	Introduction to Economics	6
A350A0250	Multivariate and Econometric Analysis Methods	6
A350A0300	Technology and Innovation Management	6
A350A0500	Sustainable Strategy and Business Ethics	3
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A350A0601	Contemporary Issues in Strategic Management and Innovation	6
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A130A0050	*INTRODUCTION TO STUDIES OF ECONOMIC SCIENCES FOR MASTER'S STUDENTS* 3 ECTS cr
	Introduction to Studies of Economic Sciences for Master's Students
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, Information Specialist, M.Sc. (Tech.) Marja Talikka, N. N. Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi
Aims	After the course the students are aware of the requirements and goals of university studies in general and of LUT School of Business in particular. The student becomes familiar with the various tools needed in studying and assimilates information and skills required in making studying more efficient. The student: - is capable of using both internal and external databases of the university for acquiring scientific knowledge needed in their studies - identifies different styles of learning - is able to design and manage the time used for studying - has the basic knowledge of Excel - is able to plan a curriculum that meets their personal carrier goals and strengths
Content	Practical study-related information, learning styles, time management, library databases and information search, personal study plan and career plan, participation in the orientation day for international students in the 1st period.
Modes of Study	Lectures 8 h, 1st period. Participation in the orientation day for international students, 8 h, 1st period. Library introduction, 1 h, 1st period. Excel exercises, 6 h, 2nd period. Independent preparation of assignments 57 h. Total workload for student 80 h. Four assignments: 1. Personal study plan, 1st period 2. Library assignment (Moodle), 1st period 3. Excel exercises, 2nd period 4. Personal career plan, 2nd period Moodle is used in this course.
Evaluation	Accepted/failed
Study materials	1. Lecture slides 2. Other material informed in lectures
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

A130A0120	*INTERNATIONAL STUDENTS' PEER TUTORING* 3 ECTS cr
	International Students' Peer Tutoring **Students apply for being a tutor in spring semester and the exact application time will be informed separately. The course is meant for both Finnish and international students who are interested in international students’ tutoring. A student cannot include to his/her studies both courses A130A0100 Vertaistuutorointi and A130A0120 International Students´ Peer Tutoring.**
Year and Period	Period 4, 1-2
Teacher(s)	The course is taken care of by International Services in cooperation with the degree programmes and the Student Union. Person in Charge: Project Manager, MA Tanja Karppinen
Aims	The student understands the operational environment of studying at LUT and LUT’s study culture. The student is able to assist a new student, especially an international student in practical matters concerning studying at LUT and is

	able to support new students in the beginning of their studies. The student is able to act as a small group tutor. The student understands the basic concepts of intercultural communication.
Content	Culture, Identity, Stereotypes, Cultural Values (2 hours lectures), Cross-Cultural Interaction, Culture Shock, Adaptation (2 hours),Intercultural Communication, Intercultural Communication Competence, Intercultural Sensitivity (2 hours). The meaning of tutoring, small group tutoring and communication skills. The importance of motivation and controlling of time in studying. Acquainting new students to the university, studying and student community as well as the tools needed for studying.
Modes of Study	Students may apply for being a tutor in spring semester, the exact time will be informed separately. Tutors will be selected in March. The compulsory instruction of tutors begins in period 4 and will end in the end of period 2 in the next autumn semester. Training includes lectures on issues relating to studying and activities on small group tutoring, groupworks, online work and training in the degree programmes. Tutors will guide new students in their own tutoring groups during the first semester in autumn and meet the group about ten times. During the second semester tutors will submit a final report about the tutoring. Tutors will participate in a feedback meeting. Lectures and training 19 hours in period 4 (one intensive full day of international tutor training included), 2 hour lecture in the end of August. Online work, independent study and final report 19 hours. Tutoring in groups 30 hours. Feedback meeting 2 hours in period 1 and 2. Total 72 hours.
Evaluation	Pass/fail
Study materials	The needed material is handed out during the training and web material.

A210A0050	***COMPARATIVE INTERNATIONAL ACCOUNTING: THEORY AND PRACTICE*** ***6 ECTS cr***
	Comparative International Accounting: Theory and Practice
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Sanna Hämäläinen
Aims	At the end of the course a student is expected to be able to: -compare and analyze accounting practices and quality of accounting information in different parts of the world -assess the international harmonization of accounting standards -analyze the impact of different social, financial, legal and taxation systems on accounting -interpret the practical implications of international differences in accounting -develop the communication and social skills through working in multi-cultural groups for term paper and presentation
Content	The course is focused on international differences in accounting practices and quality of reported information associated with various social, legal and taxation systems. The harmonization of accounting standards and the practical implications of differences in accounting systems.
Modes of Study	Lectures: 20 h Preparation for lectures and exam: 104 h Term paper writing and presentation preparation: 28 h Seminar: 8 h Total workload: 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation on the basis of 0-100 points for the exam (80%) and term paper (20%). Students are required to achieve 50 percent of the maximum points in each task.
Study materials	1. Nobes and Parker: Comparative International Accounting, 2006 or later edition. 2. Handouts in the class and all additional material required by the lecturers.

Prerequisites	Compulsory bachelor's level courses in accounting and finance.

A210A0200	***EMPIRICAL STRATEGY RESEARCH 6 ECTS cr***
	Empirical Strategy Research
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 per 3-INT 17 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Kaisu Puumalainen, Professor, D.Sc. (Econ. & Bus. Adm.) Ari Jantunen
Aims	After taking the course the student - knows the basic empirical application types of strategy research - is familiar with the evolution, state-of-the art and future directions of research within four different central themes of empirical strategy research - can independently select a specific theme related to strategy, technology or innovation research and conduct a critical and systematic literature review on this theme - collect and analyze empirical data around this theme, and subsequently report, interpret and evaluate the results and their practical and theoretical implications
Content	Four specific themes of strategy, technology or innovation research: empirical testing of main theories, research strategies and designs and main results. The themes may include e.g. resource-based view, strategic orientations, innovation and sustainable competitiveness of the firm. The themes are related to current research projects at LUT School of Business, and may vary each year. Measurement of firm performance, specific methods of empirical research, e.g. event study, social network analysis, diffusion models. Important authors and publication forums of empirical strategy research
Modes of Study	Lectures 18 h , exercises 12 h and independent preparation for lectures + writing article reviews 40 h, 3rd period Seminar 12 h on intensive week 17 and pair assignment + preparing the presentation 78 h, 4th period Total workload 160 h.
Evaluation	Grade 0-5, evaluation 0-100 points. Article reviews 40% Written seminar report 40% Oral presentation of seminar assignment 20%
Study materials	Collection of articles
Prerequisites	Multivariate and econometric analysis methods or Quantitative research methods, recommended Basic course in econometrics

A210A0350	***REAL OPTIONS AND MANAGERIAL DECISION-MAKING 6 ECTS cr***
	Real Options and Managerial Decision-making
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 3
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan, Docent, D.Sc. (Econ. & Bus. Adm.) Lauri Frank Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	The aim of the course is to give extensive general knowledge about how to use the real options approach in the decision making of the firms and how to apply real options thinking under uncertainty. After the course the students are able to - know the mathematical foundations of real options and the connections between the real options approach and financial theory - know the research tradition of real options and are able to evaluate the limits of the approach - apply the real options approach in the managerial decision situations where it is suitable

	- analyze the role of uncertainty and risk in information providing and decision making - recognize the limitations when applying real options approach - build a real option model on Excel to make real option analysis with the pay-off method
Content	Real options vs. financial options, modeling the real options and the limits of modeling, the usability of real options in strategic decision making. The use of mathematical tools applied in the real options context. How to use the real options approach in managerial decision making situations exemplified by means of different real cases.
Modes of Study	Lectures 21 h, independent reading assignments (articles) and preparation for lectures 44 h. Written exam and preparation for the exam 55 h. Homework 40 h. Total workload for the student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 100%, passing the course conditional to accepted homework.
Study materials	Collan, M., 2012, The Pay-Off Method: Re-Inventing Investment Analysis – With numerical application examples from different industries, CreateSpace, Charleston, SC, USA (ISBN 978-14-782-3842-3) Lecture slides Assigned reading, collection of articles. Material available in the Moodle system (except for the course book)
Prerequisites	Required: Excel course or good enough Excel skills For 2nd year master's program students only

A210A0601	***INFORMATION SYSTEMS IN CORPORATE MANAGEMENT AND DECISION-MAKING*** ***6 ECTS cr***
	Information Systems in Corporate Management and Decision-making **Replaces course A210A0600 - Tietojärjestelmät taloushallinnon ja päätöksenteon tukena**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 2
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	The aim of the course is to give extensive general knowledge about corporate information systems and how they are used in corporate decision-making, business control, and as a driver of business development. After the course the students: have an understanding of the corporate information systems stack and the most common types of corporate information systems and where they are used; are able to view a business as a system and its parts as parts of a system; know how information systems can collect, summarize and analyze corporate information; understand what the practice of fact based management is based on and how it is connected to information systems; know the concept of intelligent systems and understand the types of results that they can provide, and the importance of such results for, for example, making the business more effective through optimization; can identify situations where information systems can be used to develop business practices.
Content	Corporate information stack, business intelligence. Controlling in a modern coporation based on IS, intelligent systems in business process development. Importance of visualizing knowledge.
Modes of Study	Lectures 20 h, independent reading assignments (articles) and preparation for lectures 45 h, exercises or excursion 10 h. Written exam and preparation for the exam 85 h. Total workload for the student 160 h.

	Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 100%.
Study materials	Lecture slides Assigned reading, collection of articles

A220A0000	***FINANCIAL ECONOMETRICS 6 ECTS cr***
	Financial Econometrics
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 2
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Elena Fedorova, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	At the end of this course a student is expected to be able to conduct empirical research by using: The MATLAB econometrics package and many models supported by the package including, for example: Classical linear regression models, univariate time series models, ARMA processes, multivariate time series models, models for simultaneous equations systems, vector autoregressive (VAR) model, and GARCH-type models. The idea is to get hands on knowledge about the models and to understand how to judge which types of models are usable in different types of situations.
Content	This course deepens students' knowledge on empirical research methods in financial econometrics. The focus is on the empirical techniques used most often in the analysis of financial markets and how they are applied to actual market data. The course is designed to give advanced-level (Master) knowledge of financial econometrics. The course covers four different areas in econometrics: 1) univariate and multivariate statistical analyses, 2) time series models, 3) modeling volatility and correlation, 4) modeling long-run relationships in financial markets. The students will use MATLAB econometrics package to run analyses.
Modes of Study	Lectures & exercises: 20 h, period 1 Preparation for lectures and exam: 40 h, period 1 home assignments: 60 h, period 1 Total workload: 160 h Moodle is used in this course.
Evaluation	Grade 0-5, on the basis of 0-100 points for the exam (50%) and home assignments (50%). Students are required to achieve 50 percent of the maximum points in both.
Study materials	1. Brooks, Chris: Introductory econometrics for finance. Cambridge, 2002 or newer (Text book) 2. Handouts in class and all additional material required by the lecturer 3. MATLAB materials available on the mathworks www-site
Prerequisites	Required: BM20A4301 Johdatus tekniseen laskentaan or BM20A5001 Principles of Technical Computing Suggested: Compulsory Bachelor's level courses in finance and economics.

A220A0052	***INVESTMENT AND BUSINESS ANALYSIS WITH EXCEL 3 ECTS cr***
	Investment and Business Analysis with Excel
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	The aim of the course is to give the students a general understanding of how spreadsheet software can be used in diverse analyses connected to corporate finance and practical skills to use spreadsheet software to independently create and use analysis tools After the course the students:

	- Can plan and create simple analysis tools with spreadsheet software and perform analyses related to corporate finance - Know selected in-built tools of spreadsheet software, e.g., for optimization and for statistical analysis and are able to use them - Are able to use classification and ordering capabilities of spreadsheet software to find relevant information from data.
Content	Spreadsheet software functionality, planning and constructing spreadsheet tools for analyses relevant to corporate finance. Using selected built-in optimization and statistical tools. Importing data into the spreadsheet from other programs, using reporting graphics.
Modes of Study	Lectures and exercises 20 h, reading materials and preparation for the test 25 h, course work 35 h. Total workload for the student 80 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 50%, tutorials 50%
Study materials	Lecture materials, assigned reading Beginning Excel What-If Data Analysis Tools: Getting Started with Goal Seek, Data Tables, Scenarios, and Solver, Paul Cornell, 2006, Apress – available as an eBook in the library database.

A220A0101	***DERIVATIVES AND FINANCIAL RISK MANAGEMENT*** 6 ECTS cr
	Derivatives and Financial Risk Management **Replaces course A220A0100 - Financial Risk Management**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1- INT 43
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Eero Pätäri, M.Sc. (Econ. & Bus. Adm.) Ville Karell Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Eero Pätäri
Aims	The aim of the course is to deepen the students' knowledge about the use of derivatives for hedging purposes. At the end of the course a student is expected: - to understand the interrelationships of spot markets and derivative markets and their arbitrage relations - to understand the internal arbitrage relations within the derivative markets - to be able to form and implement the optimal hedging strategy for different hedging needs (including the choice of the most appropriate derivative for the particular purpose) - to be familiar with the standard methods of derivative pricing and to be able to apply these methods in the pricing of exotic derivatives - to know the principles of risk management practices of derivative market makers - to know the basic methods of Value at Risk calculations - to understand the practices followed in credit risk management and the causality between default risk and the risk premium of fixed-income securities - to know the most commonly used credit derivatives
Content	Pricing of standard derivatives (i.e. forwards, futures, swaps and options), hedging strategies and practices. Value at Risk, credit risk management, credit derivatives. Applied methods for pricing of exotic derivatives, risk management practices of derivative market makers.
Modes of Study	Lectures and exercises 24 + 18 h, preparation for exercises 54 h. Written exam and preparation for the exam 64 h. Total workload for the student 160 h. Moodle is used in this course.
Evaluation	Graded 0-5 on the basis of the exam and exercise performance. Evaluation 0-100 points, written exam 90-100% and exercises 0-10% depending on the student's activity in exercises.

Study materials	1. Hull, John C.: Options, Futures, and Other Derivatives, 2006 or newer edition. 2. Lecture handouts.
Prerequisites	Only for the second-year MSF students or other M.Sc. students that have comparable financial skills

A220A0200	***INTERNATIONAL FINANCIAL MANAGEMENT 6 ECTS cr***
	International Financial Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed
Aims	After successful completion of the course, the student will be able to: - understand the structure and functions of MNCs - analyze country level risks and international capital flows - measure the relationship between exchange rates and macro-level determinants of forex market - evaluate the different legal environments, tax considerations and business risks involved in the financial management of MNCs - assess the impacts of exchange rates on the profitability, growth and valuation of MNCs - understand the risk management strategies used by multinational corporations
Content	The course is designed to give advanced-level (Master) knowledge of multinational financial management. The course covers four different areas in international financial management: 1) currencies exchange rates risks and exposures 2) multinational capital budgeting analysis and decision making, 3) International capital flows and country risks for investing/financing and 4) long-term and short-term asset and liability management.
Modes of Study	Lectures: 24 h Preparation for lectures and exam: 104 h Writing a term paper: 32 h Total workload: 160 h Moodle is used in this course.
Evaluation	Grade 0-5, on the basis of 0-100 points. Exam (80%) Term paper (20%) Students are required to get 50 percent of the maximum points in each task. Bonus points can be earned from active participation in in-class quizzes, exercises and case studies.
Study materials	1. Madura and Fox: International Financial Management, European edition 2. Handouts in class and all additional material required by the lecturer
Prerequisites	Compulsory Bachelor’s level courses in finance and economics.

A220A0400	***EMPIRICAL RESEARCH IN FINANCE 6 ECTS cr***
	Empirical Research in Finance **This course is highly recommended before starting the Master’s Thesis in Strategic Finance.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 4
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, N. N. Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed
Aims	After successful completion of this course, the student will be able to: - interpret the results of recent and relevant research in finance - extend and deepen his/her knowledge in the areas of empirical asset pricing and corporate finance - use appropriate models and techniques to solve empirical problems in finance

	- develop a research plan on an empirical topic for master thesis - conduct an empirical analysis in master thesis in strategic finance
Content	This advanced level course provides overview of the quantitative methods used in empirical research in finance. An important part of this course is to review the empirical literature on classical as well as recent topics in Finance. Main topics to cover during the course are: asset pricing models, volatility modeling, impact of macroeconomic indicators on stock markets returns and volatility, corporate finance, investments, mergers and acquisitions, ownership structure, payout policy, corporate governance, financial accounting and earnings disclosures. The course helps students to understand the implications and limitations of the statistical and mathematical models and to use them with proper assumptions in the empirical analysis of master's thesis.
Modes of Study	Lectures, 20 h Presentation seminar: 4 h Preparation for lectures & exercises: 28 h Assignment # 1 & preparation for presentation: 40 h Assignment # 2 (Research proposal): 68 h Total workload: 160 h Moodle is used in this course.
Evaluation	Grade 0–5 on the basis of two assignments and class participation. Summary of a selected research paper (30%) Research proposal (50%) Class participation & tutorials (20%) Evaluation scale: 0-100 points.
Study materials	All journal articles provided by the lecturer. Reference book for methodology: Brooks, Chris: Introductory Econometrics for Finance, Cambridge University Press. Reference book for theory: Copeland T E, Weston J F & Shastri K: Financial theory and corporate policy. Pearson Education Inc.
Prerequisites	Compulsory B.Sc. courses in Accounting and/or in Finance (except Bachelor's thesis). A350A0250 Multivariate and Econometric Analysis Methods and/or A220A0000 Financial Econometrics

A220A0500	***CONTEMPORARY ISSUES IN STRATEGIC FINANCE*** 3 ECTS cr
	Contemporary Issues in Strategic Finance **This course is offered only if the availability of lecturer is ensured. Intensive teaching by a team of local(s) and International visiting lecturer(s). The participation in this course is limited according to the topic and requirements.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3-4 or intensive
Teacher(s)	N. N. Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	The students: - Develop capacities of synthesizing and evaluating the special topics (which may change on yearly basis) of contemporary finance. - Get enhanced knowledge and skills on a topic of corporate finance, behavioral finance, entrepreneurial finance, or financial accounting. - Learn to demonstrate learning and personal development skills in a multinational environment based on the course contents and focus
Content	The specific contents of this course change on the basis of the topic, but the main theme of the course remains within the broader scope of strategic fi-

	nance. The selected topics may vary among International finance, Security derivatives and risk management, corporate governance, behavioral finance, venture capital, entrepreneurial finance, and accounting.
Modes of Study	Total workload: 80 h Moodle is used in this course.
Evaluation	Grade 0–5 based on total points 0-100. Evaluation according to the specific course contents.
Study materials	The study material varies according to the topic. The relevant material will be provided before and during the course.
Prerequisites	Basic knowledge of economics, accounting and finance.

A220A0550	***ADVANCED DECISION-MAKING 6 ECTS cr***
	Advanced Decision-making
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 3
Teacher(s)	Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	The students learn principles of some modern methods for multiple criteria decision-making, decision analysis, and about systems for supporting decision-making. Students learn about the history of decision-support and operational research and understand that there is a constant evolution in decision support methods. Students are able to understand the benefits of modern decision-support methods in real world business situations. Students can put some models and analysis methods into use with MATLAB.
Content	Multiple criteria decision-making (MCDM) methods (TOPSIS, AHP), decision analysis methods (DEA), decision-making under uncertainty, history of operational research. Fuzzy logic in decision-making, decision-support systems (DSS), expert systems, optimization. Multiple expert decision-making and reaching consensus, Delphi method, MATLAB application.
Modes of Study	Lectures and exercises approximately 20 h, reading materials and preparation for the lectures & the test. Course work, which will reduce the number of hours needed for lecture & test preparation. Total workload for the student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points – Grade is determined based on the test; if there is a course work it will account for 30% of the grade.
Study materials	Lecture materials, assigned reading and course books. MATLAB/Octavia materials available on the mathworks www-site
Prerequisites	Required BM20A4301 Johdatus tekniseen laskentaan or BM20A5001 Principles of Technical Computing Suggested A210A0601 Information Systems in Corporate Management and Decision-making

A220A0600	***BANKING AND INSURANCE FINANCE 6 ECTS cr***
	Banking and Insurance Finance
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	This course provides a comprehensive introduction to theoretical and applied issues related to banking and insurance underwriting. By the end of the course, students will have a general knowledge of the following topics: - the role of banks in the economy - central banking and bank regulation - business lines and risk management in banking - insurance underwriting, risks and insurances - asymmetric information, moral hazard and adverse selection - management and monitoring tools used by banks and insurers - international bank-like organizations (IMF, World Bank, BIS and others)

Content	The content of the course consists of selected theories and applications related to banking and insurance underwriting. The topics include the role of banks in the economy, especially as providers of liquidity and payment services, transforming assets, managing risks, processing information, and monitoring borrowers. Coverage includes introduction to central banking and bank regulation as well as basic concepts of risks and insurances. International financial players (IMF, World Bank, BIS, and others). The course provides an overview of selected management and monitoring tools used by banks and insurance companies. Visiting lecturers.
Modes of Study	Lectures 24 h, independent reading assignments, exercises and preparation for lectures 56 h. Written exam and preparation for the exam 80 h. Total workload 160 hours. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 100%
Study materials	Course book(s) Lecture material Additional readings

A220A0650	***FINANCIAL THEORY AND VALUATION 6 ECTS cr***
	Financial Theory and Valuation
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed
Aims	After successful completion of this course, the student will be able to: - demonstrate advanced level skills in describing corporate finance theories - examine the empirical applications of asset-pricing models - apply financial models needed for valuation and to make good business decisions - understand the determinants of financing needs and optimal capital structure - know key issues related to agency theory, managerial incentives and contracting theory - analyze the empirical aspects of corporate finance and asset valuation
Content	This course introduces the core theory of modern corporate finance and financial management, with a focus on capital markets and investments. The course presents the insights of corporate finance theory, but emphasizes the application of theory to real business decisions. Topics include functions of capital markets, corporate finance theory, asset valuation, fixed-income securities, common stocks, capital budgeting, capital structure, cost of capital, dividend policy, agency theory, contracting theory, equilibrium asset pricing under uncertainty, and theory of efficient markets.
Modes of Study	Lectures: 24 h Preparation for lectures and exam: 80 h Exercises and case study: 28 h Term paper: 28 h Total workload: 160 h Moodle is used in this course.
Evaluation	Grade 0-5, on the basis of 0-100 points Exam (60%) Term paper (20%) Exercises/quizzes/case study (20%) Students are required to get 50 percent of the maximum points in each task. Bonus points for active participation.(optional)
Study materials	1. Ross S.A., Westerfield R.W. and Jaffe J: Corporate Finance, 8th ed. or later, McGraw Hill Higher Education. (Chapters specified by lecturer) 2. Copeland T.E., Weston J.F. & Shastri K: Financial theory and corporate policy. 4th ed. or later; Pearson Education Inc. (chapters specified by lecturer) 3. Handouts in class and all additional material required by the lecturer.
Prerequisites	Compulsory Bachelor’s level courses in accounting and finance.

A220A0750	ELECTIVE SPECIAL COURSE ON BUSINESS ANALYTICS OR DECISION-MAKING 3 ECTS cr
	Elective Special Course on Business Analytics or Decision-making
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2
Teacher(s)	N. N. Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	The student will learn to deeply understand a topic in the focus area of the course: - to assess contemporary concepts and latest issues related to BA or DM - to synthesize and evaluate special topics
Content	Content is specific to the different possible selectable courses that can be selected to fulfill the course requirements and change on the basis of the topic, but the main theme of the course is within the broader scope of BA or DM.
Modes of Study	Total workload 80 h, according to the selected content. This course is a placeholder for multiple selectable courses that aim to deepen the student’s knowledge about either Business Analytics or Decision-making. One course out of the possible can be selected to fulfill the requirements of this course. Course contents can be fulfilled by a MOOC (on-line course), in which case the student has to have the MOOC approved before the fact by the person in charge of the course. Course contents can be fulfilled by participation in the Global Investment Research Challenge competition Moodle is used in this course.
Evaluation	Grade 0-5, depending on the choice, details to be announced later. Evaluation 0-100 points.
Study materials	Lecture materials, assigned reading, video materials, course book

A220A8500	MASTER'S THESIS SEMINAR, STRATEGIC FINANCE 3 ECTS cr
	Master's Thesis Seminar, Strategic Finance **Similarity tests of all ready theses will be performed in order to check for plagiarism.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2/3-4
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan, Professor, D.Sc. (Econ. & Bus. Adm.) Eero Pätäri, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Elena Fedorova Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Eero Pätäri, Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed
Aims	Upon completion of the course, students will be able to delimit and define the purpose and topic of their research. They will know the theory and research methods relevant to their main subject and understand the importance of the theoretical framework in their research and in solving empirical research problems. Students will be able to justify and explain the main points of their research both orally and in writing. Students will be able to assess, evaluate and analyze reports written by other students and defend their own choices relating to their research in the seminar sessions. Students will be able to collect and choose relevant literature based on critical evaluation. They will demonstrate the ability to compare and combine information based on literature and empirical material.
Content	Students familiarize themselves with the structure of a Master’s thesis and the standards related to the thesis, and plan their own thesis work. During the course, students will: - participate in the introductory lecture - prepare and present an analysis of their research topic

	- prepare and present the research plan in seminar - draw up and present the intermediate version of the thesis (60-70% completed, including introduction, literature review, research design and preliminary findings) - act as a discussant (opponent) of another student´s interim report - analyze a completed Master's thesis (free choice)
Modes of Study	- Prepare/Discuss idea of M.Sc. thesis with a potential supervisor (3h) - Introductory lecture (3 h) - Topic confirmation phase: each student goes through the topic confirmation with the supervisor and writes a short topic analysis, in which the background, the importance, and the used material are described and discussed. Without an approved topic the student cannot advance to the research plan phase. (3h) - Seminar I: Introduction to data-bases (4 h) - Seminar II: presentation of the research plan (5 h). - Seminar III: presentation of the intermediate (60-70% ready) version of the thesis and prepare/present discussion on another interim report (5 h). - Preparing for the topic and seminars and drawing up the first preliminary version of the manuscript (57 h). Total workload 80h. Moodle is used in this course.
Evaluation	Pass/fail. In order to pass the course, the student is expected to participate actively in the seminars and proceed in his/her own research work according to the course schedule. Student submits seminar reports and copy of presentation for evaluation. Note: Similarity tests of all interim reports will be performed in order to check plagiarism.
Study materials	Lecture notes and other assigned reading.
Prerequisites	Completed approximately 30 ECTS cr. in Strategic Finance core studies.

A220A9000	***MASTER'S THESIS, STRATEGIC FINANCE 30 ECTS cr***
	Master's Thesis, Strategic Finance **Students wanting to start working on their master´s thesis should contact one of the teachers irrespective of the timetable of the Master´s Thesis seminars to discuss their topic and to get guidance. The seminars are obligatory, but the discussion must be made as the first step of starting the process. This way students will also be appointed to a supervisor who best matches the thesis topic.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2/3-4
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan, Professor, D.Sc. (Econ. & Bus. Adm.) Eero Pätäri, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Associate Professor, D.Sc. (Tech.) Pasi Luukka, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Elena Fedorova Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan, Professor, D.Sc. (Econ. & Bus. Adm.) Eero Pätäri, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed
Aims	Upon completion of the course, students should be able to carry out a research project independently and to report the research in written format according to scientific practices.
Content	The student applies the knowledge and skills acquired in the Master's Thesis Seminar course in drawing up the Master's thesis. The student will outline the research process and prepare a schedule.
Modes of Study	Master's thesis: carrying out the research and reporting it in written format (800 h). Moodle is used in this course.
Evaluation	Thesis: improbatur-laudatur

	All thesis submitted for evaluation will undergo an automated similarity check for plagiarism.
Study materials	Master's thesis instructions, lecture notes and other assigned reading during the Master’s Thesis Seminar course.
Prerequisites	Participation in the Master’s Thesis Seminar and approximately 30 ECTS cr. MSF studies.

A310A0101	***STRATEGIC SUPPLY MANAGEMENT 6 ECTS cr***
	Strategic Supply Management **Replaces the course A310A0100 Strateginen hankintatoimi**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Veli-Matti Virolainen, Doctoral Student, M.Sc. (Tech.) Henna Järvi Person in Charge: Professor, D.Sc. (Tech.) Veli-Matti Virolainen
Aims	Upon completion of the course, students will understand the strategic meaning of supply management and will be able to develop the supply function as part of the business development of an entire organization. Students will be able to apply TCE in supply strategy formulation, recognize different types of business relations, explain the motives of supply chain integration and partnerships, and apply these in practice. After taking the course, students should be able to: 1. develop and evaluate supply management strategies in a global context 2. analyze purchasing and supply management processes as a part of a business strategy 3. explain the motives for the integration of supply chains and business partnerships 4. distinguish the modes of collaboration in supply management 5. analyze different types of collaboration 6. apply transaction cost theory and game theory in strategy assessment 7. produce an analytical written report based on the current academic literature.
Content	Supply management as a source of competitive advantage. Purchasing and supply management as a part of a business strategy. Transaction cost theory and game theory. Different relationships with suppliers. Partnerships and their motives. Risk management related to partnerships. Value creation.
Modes of Study	Lectures 12 h, independent reading assignments and preparation for lectures 10 h, 1st period. Case assignment including written reports and class presentations. Writing of reports and preparation for presentations 20 h, 1st period. Independent literature review and reading the literature and articles 46 h, 1-2 period. Tutorials for literature review 4 h, 2nd period. Written exam and preparation for exam 68 h. Total workload for student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 60%, written assignment 25%, case assignment 15%. All assignments must be passed to obtain the final grade.
Study materials	Cox, A.: Business Success, 1997. Earlsgate Press. Hughes et al.: Transform Your Supply Chain.1998. International Thomson Business Press. Mazzucato M. (ed.): Strategy for Business, 2002. Sage Publications Lecture materials and journal articles Assigned reading
Prerequisites	B.Sc. (Econ. & Bus. Adm.) studies

A310A0201	***EXTERNAL RESOURCE MANAGEMENT 6 ECTS cr***
	External Resource Management **Replaces the course A310A0200 Ulkoisten resurssien hallinta**

Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 2
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas
Aims	Upon completion of the course, students will know the main elements of supply strategies and be able to form supply strategies in different contexts. Students will understand the role of supply management in value creation, be able to analyze supplier relationships and know the theoretical background of relationship management. They will understand the importance of responsible supply management as a focal interface of business and be able to apply the principles of responsible purchasing and supply management. After completing the course, students will be able to 1. analyze and categorize the supply base 2. apply various strategies for managing supplier relationships 3. assess business problems in a global context 4. apply and justify green/sustainable supply management actions 5. understand the role of supplier networks and business relationships in value creation.
Content	The elements of supply strategy, supplier relationship management, value creation by utilizing an external supplier network. Theories of supplier relationship management. Responsible supply management. The course is related to sustainability.
Modes of Study	Lectures 8 h, simulation 4 h, class presentations 4 h. Company case assignment. Preparation for lectures and simulation 7 h, company interviews, written case assignment and preparation of presentations 60 h, 2nd period. Independent reading assignments, preparation for exam and written exam 77 h. Total workload for student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 60%, written assignment 40%, simulation pass/fail. All assignments must be passed to obtain the final grade.
Study materials	1. Gadde, Håkansson & Pearsson (2010), Supply network strategies. 2. Other literature will be announced 3. Selection of journal articles 4. Assigned reading
Prerequisites	Bachelor´s studies of the master programme, A310A0101 Strategic supply management

A310A0301	***SUPPLY CHAIN IMPROVEMENT 6 ECTS cr***
	Supply Chain Improvement **The number of participants may be limited. Students of Supply Management program have first priority to participate. Own laptop is required during the lectures and Minitab software should be installed. Replaces the course A310A0300 LEAN-lähestymistavat toimitusketjun kehittämisessä.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Jukka Hallikas
Aims	Upon completion of the course, students will be familiar with the methods of the development and improvement of supply chain processes by exploiting the Six Sigma and Lean principles. Students will be able to connect customer requirements to supply chain process design and analyze waste and risks related to business processes in supply chains. Students will also be able to exploit tools and methods related to supply chain business development.
Content	Lean and Six Sigma approaches in supply chain and service process development. Principles of creative problem solving in process development. Supply

	chain and value stream mapping. Customer needs analysis and linkage to the development work. Identification and elimination of waste in value chains and processes. Business process mapping and improvement. Process lead time analysis. Risk management of supply chain and business processes.
Modes of Study	Lectures and workshops 14 h, independent reading assignments and preparation for lectures 28 h. Active participation for class discussions 14 h, 3rd period. Written assignments 42 h. Essay assignment including written essay and reading literature and articles 62 h, 4th period. Total workload for student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written assignments 100 points.
Study materials	1. Lecture material. 2. Other course material will be announced.
Prerequisites	Bachelor's studies, A310A0101 Strategic supply management

A310A0401	*PUBLIC PROCUREMENT* 6 ECTS cr
	Public Procurement **Replaces the course A310A0400 Julkiset hankinnat.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 INT 9
Teacher(s)	Professor, D.Sc. (Tech.) Jukka Hallikas, Visiting lecturer Timo Kivistö Person in Charge: Professor, D.Sc. (Tech.) Jukka Hallikas
Aims	Upon completion of the course, students understand the special features and implications of public-private cooperation. Students are able to exploit their special knowledge related to the public procurement process and can plan the phases of the procurement process. Students are familiar with the legislation related to public procurement.
Content	Public procurement and purchase process. The characteristics of public procurement and future challenges. The current topics such as the state-of-the-art of the public procurement in Europe. The course is related to sustainability.
Modes of Study	Lectures 14 h, independent reading assignments and preparation for lectures 28 h. Active participation in class discussions 14 h, 3rd period. Essay assignment including written essay and reading related literature and articles 42 h. Exam and preparation for the exam 62 h. Total workload for student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 80 points, essay 20 points.
Study materials	1. Lecture material 2. Other course material will be announced.
Prerequisites	Bachelor level studies
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

A310A0500	*GLOBAL SOURCING AND SUB-CONTRACTING* 6 ECTS cr
	Global Sourcing and Sub-Contracting
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas, Guest lectures Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas
Aims	The aim of the course is to familiarize students with the strategic planning of global sourcing and the management of global supply networks and the execution of supply strategies in globally active firms. After taking the course, students should be able to - identify and generate global sourcing strategies

	- recognize the risks and challenges of global sourcing - analyse multinational business environments - assess the outsourcing, sub-contracting, technology and production transfer opportunities, challenges and sustainability in supply chains - develop supplier relationship management and supplier selection and assessment tools and methods.
Content	Global sourcing strategies, opportunities and challenges. Sustainability in global supply networks and the transparency of supply chains. Outsourcing and subcontracting, technology and production transfer. Supplier selection and assessment, relationship management, collaboration and partnerships in global supply networks. The course is related to sustainability.
Modes of Study	Interactive lectures 8 h, seminar and presentations of group assignments, written report, independent reading assignments 8 h. Written exam, 4th period. Preparing for lectures 10 h, preparation of the group assignment, presentations and written report 64 h, preparation for the exam 70 h. Total workload 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 70%, case reports 30%, all assignments must be passed to obtain the final grade.
Study materials	Assigned reading (collection of articles) Lecture slides Other materials will be announced at the beginning of the course

A310A0601	***READING COURSE OF SUPPLIER RELATIONSHIP MANAGEMENT*** ***3 ECTS cr***
	Reading Course of Supplier Relationship Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas
Aims	The course includes independent reading assignment focusing on supplier relationship management (SRM). Students can deepen their knowledge of SRM by getting familiar with current academic literature in the field and further analyze the content through a term paper. After completing the course the students are able to critically assess and analyze the literature and topics related to supplier relationship management and know the recent trends and development of SRM. Students can produce analytical written report and contribute to discussion in class.
Content	Current literature and topics related to supplier relationship management.
Modes of Study	2 h introductory lecture, 4 h class discussion seminar. Independent reading assignment, term paper 4th period. 2 h for preparing for the lectures,28 h preparing of term paper presentations and class discussion seminar, 44 hours for reading assignment and writing of term paper. Total workload 80 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, term paper 100%
Study materials	Assigned readings in the beginning of the course.

A310A0650	***COST AND RISK MANAGEMENT IN SUPPLY CHAIN*** ***6 ECTS cr***
	Cost and Risk Management in Supply Chain
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Professor, D.Sc. (Tech.) Veli-Matti Virolainen, Guest lecturer Dr. Michael Henke Person in Charge: Professor, D.Sc. (Tech.) Veli-Matti Virolainen

Aims	The aim of the course is to familiarize students with the total cost thinking, and cost and risk assessment in supply chains. During the course the students apply methods and tools of cost and risk assessment in hands-on assignments. After completing the course, students will be able to - risk assessments in supply chains - evaluate the cost factors in supply decisions - apply tools, methods and applications in risk and cost assessment - utilize cost and risk information in decision-making in supply chains.
Content	Cost and risk assessment in supply chains. Tools, methods and applications of risk and cost assessment. Decision making in a supply chain. Financial supply management.
Modes of Study	9 h interactive lectures and assignments, 2 independent assignments, both including written report, 4th period. 18 h for preparing for the lectures, 133 h for preparation the assignment and written report. Total workload 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, 2 independent assignment both including written report 50% and 50%, respectively; total 100%.
Study materials	Assigned reading (collection of articles). Lecture slides. Other materials will be announced at the beginning of the course.

A310A0700	***LOGISTIC SOLUTIONS, FIELD TRIP FOR HSE DD 1 ECTS cr***
	Logistic Solutions, field trip for HSE DD
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 INT 43
Teacher(s)	Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Sirpa Multaharju Person in Charge: Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Sirpa Multaharju
Aims	The course includes a field trip to a logistical site or a logistic expert lecture. The specific content of this course may vary depending on the amount of HSE DD students and available resources, i.e.,visiting lecturers at the time of course. The course aim to familiarize the students to modern logistics management, infrastructure of distribution channels and transportation.
Content	The specific content of this course may vary depending on the amount of HSE DD students and available resources, i.e.,visiting lecturers at the time of course. Modern logistics management, infrastructure of distribution channels and transportation.
Modes of Study	4 h introductory lecture, site visit or visiting lecturer (logistics expert). Essey of the topic, 1st period. 2 h for preparing for the lectures/field trip, 21 hours for preparing the essey. Total workload 27 h. Moodle is used in this course.
Evaluation	Accepted/fail. In order to pass the course, the student is expected to participate actively in the field trip and/or lecture and prepare and return the essay concerning the topic.
Study materials	Will be announced in the beginning of the course.

A310A0750	***LOGISTICS OUTSOURCING AND INNOVATION 3 ECTS cr***
	Logistics Outsourcing and Innovation
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 INT 43
Teacher(s)	Docent, Dr. Pietro Evangelista, Senior Researcher in Logistics and SCM, Institute for Service Innovation and Development (IRSS), National Research Council (CNR) and Dept. of Industrial Engineering, University of Naples Fererico II

	Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas
Aims	The main aim of the course is to transfer to the students the knowledge about the changing role of logistics service providers in the supply chain as result of the evolving trends that are influencing logistics and SCM. In particular, the course will describe how logistics service providers are reacting to these pressures through innovation processes namely in the area of information technology and environmental sustainability. After attending the course the students should be able to: - recognise basic principles of logistics and SCM - identify and analyse major evolving trends in logistics and SCM - recognise different type of logistics service providers and assess their development stage - analyse information technology innovation in logistics service providers - analyse environmental sustainability innovation practices in logistics service providers
Content	Foundation concepts of logistics and SCM, evolving trends in logistics and SCM, the role and importance of logistics outsourcing and the changing nature of logistics relationships, sourcing transport and logistics services, structure and main changing forces in the developments of the logistics service industry, ICT innovation diffusion in logistics service provider industry, the environmental impact of transport and logistics, the importance of environmental sustainability dimension in the strategy of logistics service providers. The course is related to sustainability.
Modes of Study	16 hours of lectures, case studies and assignments 34 hours for preparing for the lectures and assignments 30 hours for preparing for the exam Total workload 80 h. Moodle is used in this course.
Evaluation	Final grade 0-5, evaluation 0-100 points: 70% written exam; 30% case reports. All assignments must be passed to obtain final grade.
Study materials	1. Book chapters 2. Collection of international journal articles 3. Lecture slides 4. Other materials will be announced in the beginning of the course.

A310A8500	***MASTER´S THESIS SEMINAR, SUPPLY MANAGEMENT*** **3 ECTS cr**
	Master´s Thesis Seminar, Supply Management **If all of the students attending to the course are Finnish, the course will be lectured in Finnish.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2/3-4
Teacher(s)	Professor, D.Sc. (Tech.) Jukka Hallikas, Professor, D.Sc. (Tech.) Veli-Matti Virolainen, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Anni-Kaisa Kähkönen Person in Charge: Professor, D.Sc. (Tech.) Jukka Hallikas
Aims	Upon completion of the course, students will be able to delimit and define the purpose and the topic of their research. They will know the theory and research methods relevant to their major subject. They will understand the importance of a theoretical framework in own research and in solving empirical research problems. Students are able to justify and explain the main points of the research both in oral presentation and in written format. Students can assess, evaluate and analyze reports written by other students and defense their own choices relating to the research in the seminars. Students can collect and choose relevant literature based on critical evaluation. They demonstrate the ability to compare and combine information based on literature and empirical material.

Content	Student familiarizes him/herself with the structure of Master's thesis and the standards related to the thesis, and plans his/her own thesis work. During the course the student will: - participate in the introductory lecture - analyze a completed Master's thesis (free choice) - prepare the analysis of the research topic - prepare and present the research plan - draw up and present the preliminary version of the thesis (70-80% completed, includes introduction, literature review, research design and preliminary findings) and act as a discussant for another student's thesis.
Modes of Study	Seminars, Periods 1-4. Two alternative groups, one starting in the fall and the other in the spring. Introductory lecture (3 h). Seminar I: presentation of the research plan and analysis of the research topic (6 h). Seminar II: presentation of the preliminary version of the thesis and acting as a discussant for another student's thesis (6 h) - Preparing for the seminars and drawing up the first preliminary version of the manuscript (65 h). Total workload 80 h. Moodle is used in this course.
Evaluation	Accepted / failed. In order to pass the course, the student is expected to participate actively in the seminars and proceed in his/her own research work according to the course schedule. Similarity tests of all ready theses will be performed in order to check for plagiarism.
Study materials	Lecture notes and other assigned reading.
Prerequisites	Before the seminar begins, the student must have an idea about the topic of the thesis and he/she has discussed it with a potential supervisor. Approximately 30 ECTS cr. Supply Management master's studies.

A310A9100	***MASTER'S THESIS, SUPPLY MANAGEMENT 30 ECTS cr***
	Master´s Thesis, Supply Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2/3-4
Teacher(s)	Professor, D.Sc. (Tech.) Jukka Hallikas, Professor, D.Sc. (Tech.) Veli-Matti Virolainen, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Anni-Kaisa Kähkönen Person in Charge: Professor, D.Sc. (Tech.) Jukka Hallikas
Aims	Upon completion of the course, students should be able to carry out a research project independently and to report the research in written format according to scientific practices.
Content	The student applies the knowledge and skills acquired in the Master's Thesis Seminar course in drawing up the Master's thesis. The student will outline the research process and prepare a schedule.
Modes of Study	Master's thesis: carrying out the research and reporting it in written format (800 h). Moodle is used in this course.
Evaluation	Thesis: improbatur-laudatur. All theses submitted for evaluation will undergo similarity check for plagiarism.
Study materials	Master's thesis instructions, lecture notes and other assigned reading during the Master's Thesis Seminar course.
Prerequisites	Participation in the Master's Thesis Seminar and approximately 30 ECTS cr Supply Management master´s studies.

A330A0010	CONTEMPORARY ISSUES IN INTERNATIONAL MARKETING 3 ECTS cr
	Contemporary Issues in International Marketing **The course has intensive teaching 11. - 15.1.2016. A student can include this course many times in his/her studies, because the course has different contents every year.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3, intensive
Teacher(s)	Visiting professor Rudolf Sinkovics (Manchester Business School) Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli
Aims	The learning outcomes of the course are the following: 1. To assess the contemporary concepts and issues (“hot topics”) in international marketing. 2. To synthesize and evaluate contemporary international marketing phenomena. 3. To discuss and debate on special topic of international marketing (specified later) 4. To be able to collaborate in a cross-cultural teams.
Content	The specific content of this course will vary depending on the visiting international professor. However, the course covers chosen contemporary concepts and issues affecting international marketing today.
Modes of Study	30 hours of intensive integrated lectures and exercises (assignments and cases) by the international guest lecturer 20 hours of preparation for lectures and exercises 30 hours of preparation for written exam Course total 80 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Exam (50 points) In-class assignments (30 points) Class participation (20 points)
Study materials	Material to be assigned in the class.
Prerequisites	Basic knowledge of international marketing

A330A0020	ASIAN MANAGEMENT 3 ECTS cr
	Asian Management **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1
Teacher(s)	Ph. D. Francis Piron Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo
Aims	To familiarize the students with the emergent Asian paradigm of business management, the particularities of selected Asian countries, and the main cultures of Asia.
Content	It is not an overstatement to claim that Asia is now one of the main driving forces of the global economy and will conceivably sustain its growth for the foreseeable future. Therefore, managers across the world now feel a need to assert and champion their particular belief systems, values and principles. The contents of this course include: Asian Management in a changing world: Fundamental concepts and historical key points. The management challenges of large Asian nations: China, India and Japan.

	The management challenges of small and dynamic Asian nations: South Korea, Malaysia, Vietnam and Singapore. Importantly, a new development model, that of China, and to a certain extent Singapore, is thoroughly investigated as some suggest that it may be the course that developing countries may adopt: A strong government leading national development through a network of SOEs, rather than the free and competitive market advocated by Western powers.
Modes of Study	30 hours of Intensive integrated lectures and exercises (assignments and cases) by the international guest lecturer 26 hours of preparation for lectures and assignments 24 hours of preparation for written exam Course total 80 h.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Group assignments (40 points) Personal assignment (20 points) Exam (30 points). Class participation (10 points).
Study materials	Chatterjee, Samir R. & Nankervis, Alan R. (2007) Asian Management in Transition – Emerging Themes. Palgrave Macmillan. List of readings distributed in the class
Prerequisites	Basic knowledge of international marketing

A330A0050	***CUSTOMER RELATIONSHIP MANAGEMENT 6 ECTS cr***
	Customer Relationship Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi
Aims	The aim of the course is to familiarize the students with the theory of relationship marketing, customer relationship management, related concepts and models. After completing the course the students: - are able to define the main concepts and know the principles of relationship marketing theory - are able to define and explain the building blocks of long-term customer relationships - are familiar with customer relationship management as an organization-wide strategic approach to managing customer relationships both in B2C and B2B markets - are able to describe and assess different options to attract and retain customers both in B2B and B2C environments - are able to evaluate the performance of customer relationships - are able to analyze the customer base and apply various strategies for managing customer relationships General aim of the course is to improve following personal skills of the students: - ability to utilize high-quality sources in written assignments - problem solving project management skills for completing the customer analysis assignment in a given timeline - ability to produce fluent and analytical written report and contribute to discussion in class - ability to participate in teams and evaluate social interaction and the contribution of individual team members
Content	Relationship marketing as a novel marketing paradigm, the development and categorization of customer relationships, specific features and building blocks of long-term customer relationships, customer value creation and measurement of customer life-time value, the strategic framework for customer relationship management.

	The characteristics of a customer-relationship oriented firm, specific features of large customer management, challenges of CRM system implementation. Technical characteristics of front- and back-office CRM applications, call-centre management, loyalty schemes.
Modes of Study	18 hours of lectures, 4th period. Preparation for lectures 12 h, 4th period. 10 hours of exercises. Preparation for term paper and case studies, 52 h, 4th period. Written exam and preparation for exam 68 h. Total workload for student 160 h.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 60%, term paper 30%, case assignments 10%, all assignments must be passed to obtain final grade.
Study materials	1. Payne, Adrian (2006): Handbook of CRM: Achieving Excellence through Customer Management, Butterworth-Heinemann 2. Gupta, Sunil & Lehmann, Donald (2005), Managing Customers as Investments: The Strategic Value of Customers in the Long Run, Wharton School Publishing 3. Godson, Mark (2009), Relationship Marketing, Oxford Unversity Press. 4. Assigned readings 5. Lecture slides 6. Additional material distributed in class
Prerequisites	Basic knowledge of international marketing. A330A0300 Strategic Global Marketing Management recommended.

A330A0100	***INTERNATIONAL BUSINESS STRATEGIES 6 ECTS cr***
	International Business Strategies **The number of students attending the course may have to be limited based on a pre-exam if the number of students exceeds 80. In registration, priority is given to LUT School of Business and Management, Business Administration Master's students and foreign exchange students with earlier knowledge of international business.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Anssi Tarkiainen
Aims	The aim of the course is to familiarize students with strategic planning for international business in general and the management and execution of international business strategies within the context of multinational corporations in particular; To help the students to develop an understanding of various international or global strategies and their advantages and disadvantages. The assignment aims to expose the students to actual management challenges in an international context. After completing the course the students should be able to: - analyze technology intensive international marketing environment, and to generate and carry out properly justified international business strategies. - decompose the corporate strategy into functional strategies (e.g. marketing or production strategy), and to coordinate and critically evaluate the implemented strategies, by interpreting key financial indicators of performance; - plan, communicate, and carry out a group research project applied to a firm in a simulation, - work in a multi-cultural team; - be able to interpret new information critically and systematically and be able to develop ideas and projects based on this information; - be able to apply knowledge gained from the course, in addition to that provided by additional reading, analysis and discussion, to the events, activities and/or strategies of an actual firm or organisation. - participate in discussion on topics of international business interest, and to stimulate and answer questions from a knowledgeable audience;

	- develop a mindset that fosters sustainability, and global, market and technology orientation in a global business environment
Content	The skills and application of critical inquiry into your reading, discussions, and situations and experiences that you encounter with regard to international business, both inside and outside the classroom setting. The international business planning process and its content especially related to international marketing. International and global business strategies. Strategic tools for analyzing the internal and external environment, for example resource and product positions. Organization of resources, capabilities and knowledge within a multinational corporation. Implementation methods of an international business strategy. International finance, international HRM, international production and sourcing strategies, corporate social responsibility. OLI paradigm, institutional theory, international technology strategy, real-life firm strategy examples (provided by a guest lecturer). The course is related to sustainability.
Modes of Study	18 h of interactive lectures, 1st period. 10 h of interactive lectures, 2nd period. Group assignment/project work based on simulation exercises in international groups (incorporating online simulation and written group assignments: a strategic plan and a reflective report) 97 h Mid-term tutorial (each group independently with tutors) 1 h Mental map assignment 2 h Preparation for lectures and exam 32 h Written exam. Total course 160 h.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Active class participation Assignment(s): oral and written project work in groups, 70 points Exam, 30 points All assignments (including the exam) must be passed.
Study materials	Lasserre, P: (2012). Global Strategic Management (3rf edition). Peng, M.W. (2009). Global Strategy (2nd edition). Assigned reading (collection of articles). Guide manual for the simulation. Slides from the lectures.
Prerequisites	A330A0300 Strategic Global Marketing Management, A330A0250 Internationalization of the Firm and Global Marketing, A350A0300 Technology and Innovation Management

A330A0151	***INTERNATIONAL ENTREPRENEURSHIP CHALLENGE*** ***6 ECTS cr***
	International Entrepreneurship Challenge
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo, Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen, Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Heini Vanninen, visiting lecturers / mentors
Aims	The learning outcomes of the course are the following: 1. to be able to analyze the processes of international entrepreneurship both from theoretical and practical standpoints. 2. to be able to evaluate the main characteristics of successful international entrepreneurs. 3. to be able to outline the nature, benefits and drawbacks of an international expansion strategy in entrepreneurial firms. 4. to be able to assess the actual opportunities and challenges that entrepreneurs have to deal with when internationalizing their businesses. 5. to be able to evaluate the variety of international marketing strategies available to organizations in a range of environmental contexts.

	6. to be able to develop internationalization plan 7. to be able to apply the knowledge on entrepreneurial firm internationalization in knowledge and technology-intensive environments 8. To be able to collaborate in cross-cultural teams 9. To be able to design and deliver various kinds of presentations focusing on international entrepreneurship and marketing for a corporate audience
Content	Evolution of international entrepreneurship as a field of study, development of internationalization plan, competitive strategies and international business operations for small and medium-sized firms: e.g. marketing, human resources, R&D and financing, managing entrepreneurial ventures in the global marketplace, tools and frameworks in analysis of a particular international entrepreneurial opportunity and creation of a business plan. Characteristics of successful international entrepreneurs, specific features of knowledge-intensive, high tech and software industries, project management The course is related to sustainability.
Modes of Study	12 hours of lectures 3 hours of case narrative presentations 12 hours of field project presentations 0,5 hours of group tutorials 26 hours of preparation for lectures 13 hours of preparation for case narrative 59 hours of preparation for field project 1,5 hours of preparation for group tutorial 7 hours of preparation for field project presentation 26 hours of preparation for oral group exam and exam Total course 160 h
Evaluation	Final grade 0-5. Evaluation 0-100 points: Active class and tutorial participation International Entrepreneurship Challenge, consisting of three assignments: Assignment 1a: Case narrative of chosen firm/ entrepreneur (10 points) Assignment 1b: Project plan (Pass-Fail) Assignment 2: Planned field project & Presentation (50 points) (Peer evaluation in the group work has an effect on the grade) Oral group examination (40 points) All assignments must be passed to acquire the final grade.
Study materials	1. Äijö Toivo, Kuivalainen Olli, Saarenketo Sami, Lindqvist Jani & Hanninen Hanna (2005) Internationalization Handbook for the Software Business, Centre of Expertise for Software Product Business, Espoo 2005. 2. Hisrich Robert D. (2009) International Entrepreneurship – Starting, Developing, and Managing a Global Venture, SAGE Publications. 3. Additional reading and material assigned in class.
Prerequisites	A330A0300 Strategic Global Marketing Management, A350A0300 Technology and Innovation Management, A330A0250 Internationalization of the Firm and Global Marketing (or similar type of courses)

A330A0200	***INTERNATIONAL MARKETING OF HIGH TECHNOLOGY PRODUCTS AND INNOVATIONS***	***6 ECTS cr***
	International Marketing of High Technology Products and Innovations **The number of students attending the course is limited to 80. In registration, priority is given to LUT degree students followed by exchange students with earlier knowledge on marketing/international business/technology management**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2	
Teacher(s)	Professor, Ph.D Sanjit Sengupta, Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen Person in Charge: Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen	

Aims	After the course, student should be able to: 1. distinguish the special characteristics of high technology marketing environment and evaluate relevant opportunities and threats for a global business. 2. develop and evaluate marketing strategies in high technology environments 3. make marketing decisions in high technology environments 4. solve real life high technology marketing problems 5. apply and develop skills in theory application, information acquisition, analyses, and communications. 6. develop social and intercultural competence by working in intercultural groups Course aims to provide a deep understanding of the functions of marketing regarding challenges and opportunities in high technology products and markets; assist the participants to understand the virtue and limitations of traditional marketing thinking and tools in emergent high technology markets.
Content	Contingency model of high technology marketing. Special characteristics of high technology markets. Strategy and Corporate Culture in High-Tech firms. Partnerships and Alliances. Marketing Research in High-Tech Markets. Understanding High-Tech Customers. Product development and Management issues in High-Tech markets. Pricing Considerations in High-Tech Markets. Advertising and Promotion in High-Tech Markets. New product launch strategies. The course is related to sustainability.
Modes of Study	Lectures, assignments, seminars, exam. In-class hours: 2 h introductory lecture, 1.period 20 hours of lectures, 1.period 12 hours of seminars, 2.period 1 hour of case method introduction, 1. period Total in-class: 35 hours Out-class hours: 30 hours of exam preparation 5 hours for preparing for lectures 65 hours for doing assignments 20 hours for solving the business case Total out-class: 125 hours Exam: 3 hours Total workload for student 160 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Exam (35 points) Case assignments (groupwork) (30 points). NOTE: Peer evaluation of the group work may effect on the grade. Business case (groupwork) (15 points) Lecture activity (10 points) Seminar activity (10 points)
Study materials	1. Mohr, Jakki, Sanjit Sengupta, and Stanley Slater (2010) Marketing of High-Technology Products and Innovations. Third Edition. Pearson Prentice Hall. Web site http://marketinghightech.net/ 2. Assigned reading.
Prerequisites	A330A0300 Strategic Global Marketing Management, A350A0300 Technology and Innovation Management, A330A0250 Internationalization of the Firm and Global Marketing

A330A0220	INTERNATIONAL MARKETING OF HIGH TECHNOLOGY PRODUCTS AND INNOVATIONS: APPLICATIONS 3 ECTS cr
	International Marketing of High Technology Products and Innovations: applications **Only for students who have taken A330A5000 International Marketing of High Technology Products and Innovations, 3 ECTS cr, in summer school.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Sanjit Sengupta, Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen Person in Charge: Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen
Aims	After the course, student should be able to: 1. solve real life high technology marketing problems 2. apply and develop skills in theory application, information acquisition, analyses, and communications. 3. develop social and intercultural competence by working in intercultural groups. Course aims to provide a deep understanding of the functions of marketing regarding challenges and opportunities in high technology products and markets; assist the participants to understand the virtue and limitations of traditional marketing thinking and tools in emergent high technology markets.
Content	Contingency model of high technology marketing. Special characteristics of high technology markets. Strategy and Corporate Culture in High-Tech firms. Partnerships and Alliances. Marketing Research in High-Tech Markets. Understanding High-Tech Customers. Product development and Management issues in High-Tech markets. Pricing Considerations in High-Tech Markets. Advertising and Promotion in High-Tech Markets. New product launch strategies.
Modes of Study	Assignments, seminars and introductory lecture. In-class hours: 12 hours of seminars, 2. period 1 hour of case method introduction, 1. period Total in-class: 13 hours Out-class hours: 42 hours for doing assignments 5 hours for preparing presentation 20 hours for business case Total out-class: 67 hours Total workload for student 80 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Case assignments (groupwork) (55 points). NOTE: Peer evaluation of the group work may effect on the grade. Business case (groupwork) (30 points) Seminar activity (15 points)
Study materials	1. Mohr, Jakki, Sanjit Sengupta, and Stanley Slater (2010) Marketing of High-Technology Products and Innovations. Third Edition. Pearson Prentice Hall. Web site http://marketinghightech.net/ 2. Assigned reading.
Prerequisites	A330A0250 Internationalization of the Firm and Global Marketing, A330A0300 Strategic Global Marketing Management, A350A0300 Technology and Innovation Management

A330A0250	*INTERNATIONALIZATION OF THE FIRM AND GLOBAL MARKETING* 6 ECTS cr
	Internationalization of the Firm and Global Marketing
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 2
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli
Aims	After completing the course the student will understand the processes of firm internationalization and global marketing. The learning outcomes of the course are the following: 1. To recognize the characteristics of the international market environment 2. To assess and criticize the essential theories and frameworks of firm internationalization. 3. To analyze the key management decisions connected with the internationalization of the firm and global marketing: Whether to internationalize, deciding which markets to enter, deciding how to enter the foreign market, designing the global marketing programme. 4. To be able to collaborate in cross-cultural teams 5. To create and deliver a group presentation focusing on the mentioned internationalization decisions in a given Finnish company.
Content	Chain of strategic decisions related to internationalization of the firm and global marketing, internationalization motives and barriers, Internationalization theories (Uppsala model, Network approach, Born Global), international market selection process, factors influencing entry mode choice, characteristics of various entry modes (export modes, intermediate entry modes, hierarchical modes), designing the global marketing programme. Concept of value chain in internationalization, comparison of SMEs and LSEs in internationalization and global marketing, environmental analysis in deciding which market to enter (political, economic, sociocultural, and technological environment). Principles of transaction cost analysis.
Modes of Study	18 hours of lectures with interactive mini-case studies, 2nd period. 14 hours of exercises including case study and group assignment (written report and class presentations), 2nd period. 4 hours of preparation for case exercise, 28 hours of preparation and writing for group assignment, 5 hours of preparation for group presentation, 88 hours of preparation for lectures and exam, 3 hours of writing the exam Total course 160 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: written exam 70 points group assignment / case work 30 points All assignments must be passed to acquire the final grade.
Study materials	1. Hollensen, S. (2007) Global Marketing – A decision-oriented approach (other editions apply as well), Prentice Hall. 2. Welch, L. Benito, G., and Petersen, B. (2008) Foreign operation methods: Theory, analysis, strategy, Edward Elgar Publishing. 3. Additional reading and material assigned in class.
Prerequisites	Basic knowledge of international marketing.

A330A0300	*STRATEGIC GLOBAL MARKETING MANAGEMENT* 6 ECTS cr
	Strategic Global Marketing Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen, Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen, Doctoral student M.Sc. (Tech.) Mohamadali Ahi, visiting lecturers

	Person in Charge: Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen
Aims	After taking the course the students should to be able to: 1. identify the underlying concepts and theoretical perspectives of marketing management strategy, 2. assess firm's internal and external environments from strategic marketing management perspective 3. describe and assess the range of marketing strategies available to organizations in a range of environmental contexts 4. describe and assess marketing programmes 5. understand the basics in marketing performance measurement 6. develop a marketing plan 7. design and deliver a professional presentation of a marketing plan.
Content	Assessment of the competitiveness of the firm, assessment of the external marketing situation, STP-process, developing marketing strategies and programmes, standardization versus adaptation, relationships in value chain, budgeting, controlling, marketing plan, marketing performance measurement. Corporate social responsibility strategy, customer behavior, customer relationship management. The course is related to sustainability.
Modes of Study	Lectures, assignments, workshop, seminar, exam. In-class (36 hours): 2 hour introductory lecture 4 hour workshop 20 hours of lectures 10 hours of term paper presentations in a seminar meeting Out-class (124 hours): 10 hours for lecture preparation 42 hours for exam preparation 67 hours for preparing term paper 5 hours for preparing a presentation Course total: 160 hours Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Assignments (50 points): a) term paper (a group work) (40 points). b) presentation of term paper (10 points). c) personal presentation skills within the term paper presentation (pass/fail) Exam (50 points). All assignments (including the exam) must be passed to acquire the final grade. NOTE: Peer evaluation of the group work may have an effect on the grade.
Study materials	1. Hollensen, Svend (2010) Marketing Management. A Relationship Approach. Second Edition. FT Prentice Hall. 2. Assigned readings.

A330A0400	***INTERNATIONAL MARKETING RESEARCH 6 ECTS cr***
	International Marketing Research **NOTE: Participants are expected to master basics in qualitative and quantitative research methods.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 INT 1-INT 17 The course is suitable also for doctoral studies.
Teacher(s)	Honorary professor, Ph.D John W. Cadogan, Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen, Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Kristiina Herold Person in Charge: Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen
Aims	After the course, student should be able to:

	1. understand the basic concepts and challenges in conducting international marketing research 2. formulate research questions and develop a research design and instruments 3. apply either qualitative or quantitative research methods (data collection, analyses) 4. report professionally results of empirical research 5. analyze the quality, reliability and validity of qualitative or quantitative research 6. apply and develop skills in theory application, information acquisition, data analyses, and communications.
Content	The specific features of international marketing research. Data collection and analyses in international marketing research. Reporting of international marketing research. International marketing information systems. Alternative types of international marketing research. Online marketing research. This focus of the course is on international marketing research project done mainly in pairs.
Modes of Study	Lectures, assignments. In-class hours: 2h introductory lecture (attendance compulsory), 3.period 15 hours of lectures, 3.period 10 hours of seminars, 3.period 6 hours of lectures, 4. period 11 hours of seminars, 4. period Total in-class: 44 hours Out-class hours: 6 hours for preparing for lectures 105 hours for doing assignments 5 hours for preparing presentations Total out-class: 116 hours Total workload for student 160 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Assignments (100 points).
Study materials	1. Craig, S. and Douglas, S.P. (2005) International Marketing Research. 3rd edition. John Wiley & Sons, Ltd. 2. Assigned reading.
Prerequisites	A330A0250 Internationalization of the Firm and Global Marketing, A330A0300 Strategic Global Marketing Management, A350A0300 Technology and Innovation Management. In addition to forementioned skills and knowledge: basics in quantitative research

A330A0500	***BRAND MANAGEMENT***	***3 ECTS cr***
	Brand Management	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 INT 16	
Teacher(s)	Visiting Professor Peter Spier Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen	
Aims	The aim of the course is to familiarize students how companies manage 'brand equity', clearly a major strategic issue. Few would deny the importance of brands as valuable assets and a potential source of sustainable competitive advantage. Brands provide a short cut for customers when making a purchasing decision, seeking to avoid risk and obtain value for money. Brands provide a relevant, exciting experience. Brands connote a certain life style, values or attitude. Brands can become objects of affection: 'Lovemarks', even. Buying a brand is an integral part of an individual's quest for identity and meaning. After completing the course the students should be able to: - Understand how companies manage 'brand equity' and describe and assess different brand management strategies - Analyze and explain reason, affect and decision-making related to brands	

	- Familiarize themselves with the social meaning and cultural rooting of brands - Describe current trends and issues in branding
Content	This course provides a comprehensive introduction to strategic brand management, covering such areas as the building of brand equity, brand identity, brand extension, brand portfolios etc. in national, regional and global markets. Indicative and subject to change topics: 1. Introductory session - branding exercise. Brand basics. 2. Brand overview - Dyson : the man, the brand, the product, the market. Understanding codes, discourses and the potential for renewal and disruption. Sponges and hedgehogs. Mums, kids and washing liquid. The importance of consumer insight: Got milk? Fathers and whiskies 3. More about brands and how we relate to them: reason, affect and decision-making. Brand personality, brand archetypes. Brand endorsement and meaning transfer. 4. Branding people and experience. Service and experiential branding. 5. Brands in context. The social meaning of brands. What consumer studies and anthropology teach us. 6. A diamond is forever, beer is for men: the cultural rooting of brands. How brands become icons. 7. Brands & communities: Harley Davidson and Jones Soda. Tribal marketing & social networks. 8. Brand placement, brand content, brand events 9. Conclusion: current issues in branding The course is related to sustainability.
Modes of Study	The course will balance theory and practical application, with considerable use of case studies and student project work. 30 h of interactive lectures and cases, 4rd period (intensive format). 50 h of preparation for lectures and assignments and individual research report Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Individual research report (100 points) Active class participation, including in-class assignments (accepted – fail) All assignments must be passed.
Study materials	Readings and assignments to be announced before / in the class
Prerequisites	A330A0300 Strategic Global Marketing Management, or equivalent basic marketing course
Further Information	The course is an intensive course taught by an international visiting professor. This course has 1-5 places for open university students. More information on the web site for open university instruction.

A330A5000	***INTERNATIONAL MARKETING OF HIGH TECHNOLOGY PRODUCTS AND INNOVATIONS*** ***3 ECTS cr***
	International Marketing of High Technology Products and Innovations **LUT Summer School (intensive course 27.-31.7.2015)**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2
Teacher(s)	Professor, Ph.D Sanjit Sengupta, San Francisco State University Person in Charge: Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen
Aims	After the course, student should be able to: 1. distinguish the special characteristics of high technology marketing environment (like the type of innovation, market and technology uncertainties, network externalities) and assess external high technology environments (e.g. relating to competitive landscape, consumer behavior, markets) in global scale. 2. evaluate and justify marketing strategies in high technology environments. 3. make up marketing decisions in high technology environments.

Content	Course aims to provide a deep understanding of the functions of marketing regarding challenges and opportunities in high technology products and markets; assist the participants to understand the virtue and limitations of traditional marketing thinking and tools in emergent high technology markets. Strategy and corporate culture in high tech firms. - Partnerships and alliances. - Marketing research in high tech markets. - Understanding high tech customers. - Product development and management issues in high tech markets. - Pricing considerations in high tech markets. - Advertising and promotion in high tech markets. The course is related to sustainability.
Modes of Study	Lectures, in-class assignments, exam. In-class hours: 30 hours of lectures and in-class assignments Total in-class: 30 hours Out-class hours: 25 hours of exam preparation 25 hours for preparing for lectures Total out-class: 50 hours Total workload for student 80 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Exam (50 points). In-class assignments (30 points). Class participation (20 points).
Study materials	1. Mohr, Jakki, Sanjit Sengupta, and Stanley Slater (2010) Marketing of High-Technology Products and Innovations. Third Edition. Pearson Prentice Hall. Web site http://marketinghightech.net/ 2. Assigned reading.
Prerequisites	For summer school students: Previous studies in business recommended. For MIMM degree students: Internationalization of the Firm and Global Marketing, Strategic Global Marketing Management, Technology and Innovation Management.

A330A5101	***CREATIVITY AND ENTREPRENEURSHIP IN NEW PRODUCT DEVELOPMENT FROM THE SILICON VALLEY´S PERSPECTIVES*** ***3 ECTS cr***
	Creativity and Entrepreneurship in New Product Development from the Silicon Valley´s Perspectives **LUT Summer School (intensive course 20. - 24.7.2015)**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2
Teacher(s)	Associate Professor of Marketing Subin Im, Yonsei University, Korea Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen
Aims	The objectives for this course are as follows: - To understand important elements of marketing strategy that is related to product management. - To develop an in-depth understanding of new product/service development and management. - To understand and utilize a process-oriented framework for making new product/service development decisions. - To enhance business communication skills through preparation and presentation of new concepts for products and services via prototyping as well as its marketing plan.
Content	This course is designed to explore two critical business topics related to product management strategy in marketing: (1) the design and development of new ideas for product/service innovations, and (2) the management of new

	and existing products and services for sustainable business. First, topics in new product development include idea generation and screening, design, planning, and prototyping, and new product roll-out, as well as the development of marketing strategies and implementation plans for new products and services. Second, management of new and existing products involves in integration of new products into the product line, management of the marketing mix, quality of service, and customer development strategies. Throughout this project-based course, the importance of creativity, innovation and entrepreneurship will be emphasized as the sources of initiating and managing new products and innovation. The course is related to sustainability.
Modes of Study	28 hours of lectures and in-class learning activities and assignments 30 hours of preparation for lectures and assignment 22 hours of preparation for the exam, and exam Total workload for student 80 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Final exam 30% Group project 20% In-class projects 5% Group case studies 10% Individual projects 20% Class-participation 15%
Study materials	- Main Textbook: C. Merle Crawford and C. Anthony Di Benedetto, New Products Management, 10th ed. Irwin McGraw-Hill. - The additional reading materials from academic and business press articles (i.e., case, magazine, newspaper, and journal articles) will be distributed through the class time prior to the class discussion.
Prerequisites	Previous studies in marketing recommended.

A330A5200	***FRONTIERS IN INTERNATIONAL BUSINESS, TRANSFORMATIONS IN THE WORLD ECONOMY AND GLOBAL PRODUCTION NETWORKS*** ***3 ECTS cr***
	Frontiers in International Business, Transformations in the World Economy and Global Production Networks **LUT Summer School (intensive course 20. - 24.7.2015)**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2
Teacher(s)	Professor, Dr. Rudolf R. Sinkovics, University of Manchester/Manchester Business School, UK Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen
Aims	On successful completion of the course unit, students are expected to: - Knowledge and understanding: Demonstrate an insight into the theoretical and managerial field of international business, and in particular to appreciate the distinctive characteristics of managerial processes within the international business environment. - Intellectual skills: Understand how companies are managing in today's volatile environments, what type of analysis is needed to enter foreign markets, how companies manage foreign operations and with what economic and non-economic outcomes. - Practical skills: Appreciate issues of international trade, trading blocs, transformations in the world economy and in particular international issues of economic geography and global production networks. At the company level students are expected to understand how companies handle such contemporary issues.

	- Transferrable skills and personal qualities: See the importance of strategic issues of companies; the entry strategies, export-related issues, strategic alliances and global marketing and research issues and work with others constructively in a group context.
Content	As their operating environment becomes more multidimensional, complex and uncertain, managers around the world are realising that they need to recognise and respond to this complexity by developing a deeper contextual understanding of the social, cultural, political and technological forces influencing and transforming the competitive landscape of the global economy. This course presents international business opportunities and challenges in the context of a deeper understanding of growing globalisation in the spheres of culture, economics, politics, technology and the natural environment. It poses important questions about modern life, work, and the management of human effort in a global context. Specifically this course aims to: i. Introduce key management concepts and their application in an international context ii. Develop strategic thinking in and for global businesses iii. Critically analyse the impact of information technology and the internet on the global economy iv. Expose students to the diversity of business systems and cultures in the international arena and the effect of this diversity on business practices The course is related to sustainability.
Modes of Study	30 hours of lectures and in-class assignments / discussion of case studies 50 hours of preparation for lectures and assignments Total course 80 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Class participation 10 points Individual research report 30 points Sector study group presentation (SSP) 30 points Firm strategy group presentation (FSP) 30 points The overall pass mark is 50%
Study materials	Recommended: - Dicken, Peter (2011), Global Shift: Mapping the Changing Contours of the World Economy (6th ed.). London: The Guilford Press. (ISBN: 9781609180065). - Peng, Mike W. (2013), Global Business (3rd ed.). Mason, Ohio: South-Western Cengage Learning. (ISBN: 9781133584506 1133584500). Optional supplementary reading: - Other international business books may be used as reference, e.g. Peng and Meyer (2011), Rugman and Collinson (2006), Czinkota, Ronkainen and Moffett (2011), Hill (2013) - Further supplementary reading, especially journal articles, are indicated in the detailed program syllabus
Prerequisites	Previous studies in business recommended.

A330A5300	***DOING BUSINESS IN CHINA 2 ECTS cr***
	Doing Business in China **LUT Summer School (intensive course, 27. - 29.7.2015)**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2
Teacher(s)	Professor Dominique R. Jolly, Skema Business School, France Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen
Aims	The aim of the course is to help students: To make their own essential knowledge about doing business in China, i.e.: - To obtain an understanding of the most important country socio-political reengineering that has occurred in the world during the last 30 years, and the current political, economic and sociological environment in China;

	- To learn about companies that make China, both Chinese and foreign; - To learn about important public bodies in China. To develop practical competences, i.e.: - To develop abilities to recognize the key success factors (KSF) of different businesses, to identify the best practices regarding suppliers, customers, staff and networks, and to implement appropriate policies; - To develop practical abilities that can be used later in their professional life in the screening of suppliers or the search for customers; - To build research capacity employable in a business context to better understand the challenges and overcome obstacles – students have to learn to become more autonomous and takeover knowledge by themselves (passiveness is not accepted) ; To foster specific attitudes, i.e.: - To get used to talk in front of a business audience; - To adopt the appropriate state of mind to work in China, to develop attitudes toward identifying challenges and obstacles, to increase the probability of success and to develop profitable relationships in China; - To develop understanding of differences to avoid being afraid of China.
Content	The socialist market economy in the center of the world - China corporation: A new legitimacy for the state apparatus - the place for economic records Strategies of foreign companies in China - Modes of development used by foreign companies - The areas of foreign penetration: opened businesses - A focus on the amazing journey of the automotive sector - implementation issues Paradigm shifts in business - Changes in the legal environment - The creation of technology in China - Chinese companies going abroad: The desire to outpace the borders of China Gaps, dark side and political challenges The course is related to sustainability.
Modes of Study	17 hours of lectures and in-class assignments 36 hours of preparation for lectures and assignment (please note that the course assignment will be given approx. one month before the intensive teaching dates and shall be presented during the intensive days) Total workload for student 53 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Active class participation: pass - fail Case assignment and presentation 100% Peer review may have an effect on grade. All assignments must be passed to acquire the final grade.
Study materials	Readings and assignments to be announced before / in the class.
Prerequisites	Previous studies in business recommended.

A330A5600	***DOING BUSINESS IN RUSSIA*** ***4 ECTS cr***
	Doing Business in Russia **LUT Summer School (intensive course 29.7. - 2.8.2015)**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen, Professor, D.Sc.(Tech.) Juha Väätänen, Associate Professor, Ph.D. Tatiana Andreeva (GSOM; St. Petersburg State University), N.N. visiting lecturers Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen

Aims	The global arena of today mandates that managers develop the skills necessary to conduct effective cross-national interactions. This requires a deep understanding of how culture affects organizations, managerial processes and behaviours. A number of countries that significantly differ from the West in their ways of doing business have recently gained a lot of attention in the economic arena – with Russia being among them. The main focus of this course is the development of intercultural competencies for doing business in Russia. The key theoretical learning outcomes are that after the successful completition of the the course the students should possess: - Knowledge of frameworks which can be used to analyze different cultures - Capability to analyze cultural context using variety of analytical tools Contextually, after taking the course the students should to be able to: - describe what is the context of Russia as a potential target market as a leading emerging economy - identify what are specific strategies and key challenges for foreign firms in entering and organizing their activities in Russia. - understand Russia as a cultural context; e.g. to illustrate the Russian business and cultural environment and analyze the Russian business practices and suitability of the Western business practices in Russia - compare Russian business practices with other international business practices - build research capacity employable in a Russian business context to better understand opportunities, challenges and obstacles foreign firms endeavour while conducting business in Russia - apply problem solving skills to a Russian business case(s)
Content	Russia as a business context: - Russian economy and important industries - Strategies of foreign companies in Russia - Paradigm shifts in business in Russia Russia as a cultural context: - Frameworks and tools for analysis of different cultures: advantages and disadvantages - Russia as a cultural context: specifics and challenges. - Applying various methods to understand Russian culture - Culture of Russian business organizations Excursion to Russia: The excursion trip consists of lectures/interactive sessions given by experts in Russian business, and case-example(s). Cultural programme. The excursion lasts three and half days and the costs are covered by the participants. The price covers travelling, accommodation, the course dinner in St. Petersburg, and a sightseeing trip on Saturday, and lectures/interactive sessions. Participants are responsible for their own visa costs.
Modes of Study	The teaching methodology mixes lectures with various types of activities that stimulate student's thinking and develop his/her cultural skills, such as self-reflection, group discussions, case analysis, role plays and student presentations (group projects). All these interactive tools are aimed to enable the student to pull out his/her own learning points from these experiences. Therefore, active participation is strongly encouraged. In addition to the in-class activities there will be hands on 'Russian cultural experience' as part of the course will take place in St. Petersburg, Russia. This second leg of the course consists of lectures/case(s) and cultural programme. A reflective learning diary shall be written individually by all the participants after the excursion to St. Petersburg. Lectures at LUT (29.-30.7.2015): - 14 hours of lectures and in-class assignments 'In class' programme in St. Petersburg (30.7. -2.8.2015): - interactive sessions/case(s) 7 hours - cultural programme 7 hours Independent out of the class study in Lappeenranta, St. Petersburg and after the intensive teaching period:

	Preparation of the in-class assignment and the learning diary (returned approx. three weeks after the excursion): 79 hours Total course 107 hours. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: Active class participation and in-class assigments (including the programme both in Lappeenranta and in St. Petersburg): 30 % Learning diary 70 % All assignments (including the organized programme in St. Petesburg) to fulfill the active participation criteria must be passed to acquire the final grade.
Study materials	Selection of the articles and materials distributed in the class. The readings to be announced before / in the class.
Prerequisites	Previous studies in business recommended.

A330A8500	***MASTER'S THESIS SEMINAR, INTERNATIONAL MARKETING MANAGEMENT*** ***3 ECTS cr***
	Master's Thesis Seminar, International Marketing Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2/3-4
Teacher(s)	Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen, Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen, Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo, Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo (Autumn 2015) Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio (Spring 2016)
Aims	The aim of the research seminar course is to support students' process of writing a thesis and conducting scientific research. Upon completion of the course, students will be able to delimit and define the purpose and the topic of the research. The students know the theory and research methods relevant to their main subject. They understand the importance of theoretical framework in own research and in solving empirical research problems. Students are able to justify and explain the main points of the research both in oral presentation and in written format. Students can assess, evaluate and analyze reports written by other students and defense their own choices relating to the research in the seminars. Students can collect and choose relevant literature based on critical evaluation. They demonstrate the ability to compare and combine information based on literature and empirical material.
Content	The research seminar consists of the following phases: 1. Introductory lectures & analyses of completed Master's Thesis 2. Presentations of topic analyses 3. Presentations of research plans; acting as discussants for other's work 4. Presentations of intermediate version of the thesis (60-70 % complete, including literature review, research design and preliminary findings)
Modes of Study	Seminar execution 2 times per year. (Autumn 2015/Spring 2016) Compulsory participation for one session of each seminar phase. - Introductory lecture, presentations of analyses of completed Master's Thesis, discussion on topic choice (7 h). - Seminar I: presentation of the topic analysis (7 h). - Seminar II: presentation of the research plan and acting as a discussant for another student's report (7 h). - Seminar III: presentation of the intermediate version of the thesis (7 h). - Preparing for the seminars and drawing up the first preliminary version of the manuscript (52 h). Total seminar workload 80h. Moodle is used in this course.
Evaluation	Accepted / failed.

	In order to pass the course, the student is expected to participate actively in the seminars and proceed in his/her own research work according to the course schedule. Similarity tests of all ready theses will be performed in order to check for plagiarism.
Study materials	Lecture notes and other assigned materials.
Prerequisites	Thesis project idea that has been preliminary approved by the thesis supervisor. (returned in Moodle) Approximately 30 ECTS cr. MIMM studies.

A330A9000	***MASTER'S THESIS, INTERNATIONAL MARKETING MANAGEMENT*** ***30 ECTS cr***
	Master's Thesis, International Marketing Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-2/3-4
Teacher(s)	Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen, Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo, Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen, Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio
Aims	The overall goal of the thesis is for the student to display the knowledge and capability required for independent work as a Master of Science in Economics and Business Administration and especially in the area of international marketing management. After completing the thesis, students will be able to carry out independently a scientific research project and will thus be able to: delimit and define a research topic and tasks; demonstrate an ability to independently identify and formulate issues and to plan and, using appropriate methods, carry out advanced tasks within specified time limits; demonstrate knowledge and understanding in their main field of study, together with insight into current research; demonstrate deeper methodological knowledge in their main field of the study; demonstrate an ability to integrate knowledge and to analyse, assess and deal with complex phenomena, issues and situations; demonstrate an ability to report scientific research in written academic format; clearly present and discuss conclusions and the knowledge and arguments behind them.
Content	The student applies the knowledge and skills of previous studies and the Master’s Thesis Seminar course in conducting Master’s Thesis research and reporting it. The student performs and schedules different phases of research and reporting.
Modes of Study	Master’s Thesis: research execution and written reporting (800 h)
Evaluation	Thesis: laudatur (best grade), eximia cum laude approbatur, magna cum laude approbatur, cum laude approbatur, non sine laude approbatur, lubenter approbatur, approbatur, improbatur (failed). All theses submitted for evaluation will undergo similarity check for plagiarism.
Study materials	Master’s Thesis – instructions, materials available in Noppa.
Prerequisites	Participation in Master’s Thesis Seminar; approximately 30 ECTS cr. MIMM studies.

A350A0050	***BUSINESS RESEARCH METHODS*** ***6 ECTS cr***
	Business Research Methods **The course is arranged in both fall and spring semesters. The fall semester is for students in MSM and MSIS programmes. The spring semester is for students in MIMM and MSF programmes.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2/3-4

Teacher(s)	Fall semester: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Mika Vanhala, Post-doctoral researcher, D.Sc. (Econ. & Bus.Adm.) Jyri Vilko Spring semester: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Mika Vanhala, Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Argyro Almpanopoulou Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Mika Vanhala
Aims	After completing the course, the students are able to - understand the basic concepts of philosophy of science and research - understand the specific features of qualitative and quantitative research - define and plan research objectives and choose the research approach based on those objectives - apply focal methods of qualitative and quantitative research on gathering and analysis of empirical material - report the methods and research results related to qualitative and quantitative research - analyze the quality, reliability and validity of qualitative and quantitative research
Content	- Basic principles of philosophy of science - The objectives of doing research - Research process - Choice of research methods - The specific features of qualitative and quantitative research - Data gathering, methods, analysis and reporting - Assessing the quality of research
Modes of Study	Lectures and seminars 28 h, independent reading assignments and preparation for lectures 20 h Exercises on quantitative data gathering and analysis 12 h Group work for two assignments 100 h Total workload for student 160 h Moodle is used in this course.
Evaluation	Grading 0-5, evaluation 0-100 points Assignments in groups 2 x 50 points Both assignments must be passed with acceptable evaluation
Study materials	Lecture slides and other distributed material Saunders, M, Lewis, P. and Thornhill, A. (2009). Research methods for business students, 5th ed., FT/Prentice Hall.

A350A0110	***PROJECT COURSE ON STRATEGY AND BUSINESS MODELS*** ***6 ECTS cr***
	Project Course on Strategy and Business Models **NOTE: Lectured twice during the academic year**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-2/3-4
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, N.N. Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, (autumn 2015), Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli (spring 2016)
Aims	Learning outcomes: 1. To analyse the real-life situation and context of a given case organisation. 2. To select appropriate strategy tools and frameworks for the given case problem. 3. To apply the frameworks and tools of strategy and business models to provide a concrete plan of action. 4. To outline a professional written project report. 5. To communicate the findings and recommendations in a convincing, professional way.

Content	This course applies problem-based learning to a concrete strategy development task from a real case organization. Students work in groups with the given project that starts with a situational analysis and continues with both strategy development and business model description activities, resulting in a concrete strategic action plan for the organization. Each group gets individual coaching from a project supervisor. During the course students also develop their teamwork, project management, presentation and other communication skills. Core content: Tools and frameworks for strategic situational analysis. Tools and frameworks for business model description. Strategy project management skills. Additional content: Case-specific additional conceptual tools. Information collection and problem solving skills. Effective presentation skills.
Modes of Study	22 h of prework: returning an article summary in Moodle 8 hours of introductory lectures 16 hours of seminars, including final presentations of the projects to the representatives of the case organisations 6 h of project coaching meetings with the project supervisor Independent project work in teams: 100 h (finding literature, group meetings, Information gathering, analysis, writing the report) Written final report, presentation of the project work (preparation 8 h) Total student workload: 160 h Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points. Article summary: pass/fail. Max 100 points from project work. Grading of projects: 70 % supervisors 30 % firm representative
Study materials	Handout materials Other material depending on the project work

A350A0200	***INTRODUCTION TO ECONOMICS*** ***6 ECTS cr***
	Introduction to Economics **For MSIS and exchange students of the School of Business and Management**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1/2/3/4
Teacher(s)	Associate Professor, Ph.D. Jorma Sappinen
Aims	By the end of the course, students will be able to describe the principles of modern market economy. Students will be able to explain the basic concepts of microeconomics and macroeconomics and can apply models of consumer, firm, markets and economy in simple situations. In addition, students can analyse the role and consequences of monetary and fiscal policy.
Content	Principles of microeconomics and macroeconomics. Demand, supply and market equilibrium, production and markets for the factors of production, economics of the public sector. Economic growth, unemployment, inflation, economic fluctuations, monetary and fiscal policy.
Modes of Study	Independent preparation for written exam 160 h. Total workload for student 160 h.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam in the exam aquarium.
Study materials	1. Mankiw, N.G. - Taylor, M.P.: Economics, 1st or 2nd ed. or older edition of the same book Mankiw, N.G.: Principles of Economics, 3rd ed.

A350A0250	MULTIVARIATE AND ECONOMETRIC ANALYSIS METHODS 6 ECTS cr
	Multivariate and Econometric Analysis Methods **In registration, priority is given to degree students, followed by students, who are applying as post-graduate students.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3-4 The course is suitable also for doctoral studies.
Teacher(s)	Professor, D.Sc. (Tech.) Kaisu Puumalainen, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Heli Arminen, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sanna Sintonen Person in Charge: Professor, D.Sc. (Tech.) Kaisu Puumalainen
Aims	The aim of the course is to give extensive general knowledge about the main econometric and multivariate analysis methods. After completion of the course students: - understand the role of multivariate analysis in scientific research - can evaluate and compare the applicability of various multivariate methods - are able to collect numerical data about the market environment in different countries - can apply multivariate analysis methods for cross-sectional, panel and time series data - can conduct the analyses with SAS software - can interpret and evaluate the results of the analyses - can report the results according to good scientific practice General aim of the course is to improve following personal skills of the students: - written and oral communication - group work skills in a multicultural team context - problem solving and project management skills
Content	Measure development and factor analysis, linear regression, linear models, logistic regression, autocorrelation, stationarity, panel data regression. Use of SAS software, use of international databases of statistical data. Special features of countries.
Modes of Study	Lectures 18 h, exercises 18 h (first two times of exercises are compulsory), independent data collection and analysis using the SAS software 58 h, 3rd period. Seminar 8 h, independent analysis, writing of report and preparing for presentation 58 h, 4th period. Total workload for student 160 h.
Evaluation	Final grade 0-5, evaluation 0–100 points, written report 75%, oral presentation 25%.
Study materials	Hair, Joseph Jr. et al.: Multivariate data analysis. Prentice Hall, 1998. Hill, R.C. - Griffiths, W.E. - Judge, G.G.: Undergraduate Econometrics, 2nd edition, 2001 or newer edition: Hill, R.C. - Griffiths, W.E. - Lim, G.C.: Principles of Econometrics, 3rd or 4th edition, 2008 or 2012.
Prerequisites	Basic courses in statistics and economics.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

A350A0300	TECHNOLOGY AND INNOVATION MANAGEMENT 6 ECTS cr
	Technology and Innovation Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, Professor, Ph.D. Karl-Erik Michelsen Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio
Aims	1. To recognize different types and sources of innovations

	2. To interpret how technology changes and how technologies and society interact 3. To characterize the key features of an innovative organization 4. To assess how firms manage both technological and business innovations 5. To analyze the evolutionary process of innovation development 6. To synthesize and critically evaluate the commonly available information
Content	The course explores the concept of innovation from various points of view: What are innovations, how they are made and how they affect company's strategy and performance. In modern large scale corporations innovations are necessary instruments for growth and competitive edge. Yet, innovation process must be managed and maintained and this requires strategic thinking, vision and courage as well as a particular kind of organizational culture. This course explores how core technologies are created and how they are developed further to serve the needs of company business strategy. Global companies use transparent innovation process in order to facilitate to serve the customers. This course also explores how users affect innovations and what is the role of customer in innovation process. Finally, innovations are not made in isolation, but rather in a context that is affected by regional, national and trans-national innovation systems. After completing the course, the students know how a firm manages its R&D and creates core technologies which are bases for innovation strategy, wow the R&D is organized in-house and how it is connected to the regional, national and trans-national innovation systems. Core content: What is an innovation and how innovations are made Innovation typologies: e.g. incremental vs. radical/discontinuous/disruptive innovations. Technological and business innovations. How technology changes and what are the causes of change. The role of R&D and innovations in established firms The role of R&D in new start-up firms Role of innovations in business strategy Process of new product development Commercialization of new innovations Technology adoption life cycle Additional knowledge: Value creation through technology partnerships and networks Innovations and business models The role of customers and users in R&D process. Innovation, technology and growth.
Modes of Study	In-class hours: Lectures: 24 h; Seminars: 8 h Out-class hours: Preparation for term paper: 60 h; Preparation for lectures:16 h; Preparation for exam:52 h. Total student workload: 160 h Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points, individual online exam in Moodle 60 points, term paper 40 points. All assignments must be passed to get the final grade.
Study materials	Tidd, J. & Bessant, J. (2010) Managing Innovation: Integrating Technological, Market and Organizational Change. 4th Edition. John Wiley & Sons Ltd. Selected articles.

A350A0500	***SUSTAINABLE STRATEGY AND BUSINESS ETHICS*** ***3 ECTS cr***
	Sustainable Strategy and Business Ethics
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 2
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Professor, Ph.D. Karl-Erik Michelsen, guest lecturers

Aims	This course concentrates on the topical phenomena and concepts related to the creation and development of sustainable strategy, shared value creation and business ethics in organisations. The concepts will be investigated both from the viewpoints of academic research and practical relevance. Students will learn to discuss and synthesize the recent literature, examine the links of contemporary topics to previous research and assess the practical relevance of the issues through concrete examples. The learning outcomes of the course are the following: 1. To assess the contemporary topics of sustainable strategy and business ethics from both academic and practitioner perspectives. 2. To discuss and debate on the conflicting perspectives of sustainability and ethics in business.
Content	The content of the course is based on topical issues related to sustainable strategy and business ethics from different approaches. The core content includes: - Basics of sustainability and ethics in business context - Recent trends and developments of sustainable strategy and corporate responsibility - Sustainability issues in the supply network - Key business ethics challenges The course is related to sustainability.
Modes of Study	The modes of study are based on active student participation, group work and discussion in the class-room. In-class hours: 2. period: 12 hours of lectures (weeks 1-2); 14 hours of interactive theme sessions and seminars (weeks 4-6). Out-class hours: Preparation for the theme sessions and seminars: 14 h. Course assignment in groups 40 h Total hours: 80 h Moodle is used in this course.
Evaluation	No written exam. Final grade 0-5. 100 points based on course assignment conducted in groups.
Study materials	Academic and practitioner-oriented articles on sustainability and business ethics. Readings list distributed in Moodle.

A350A0550	***PROJECT COURSE ON SUSTAINABLE BUSINESS*** ***3 ECTS cr***
	Project Course on Sustainable Business **This course is mainly offered for students of MSIS-programme in LUT School of Business and Management.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 per 3, INT 9
Teacher(s)	Visiting Professor, D. Sc. Laura Albareda, Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala
Aims	This project course focuses on sustainable business from a chosen case company perspective. Students will learn to assess and analyze sustainability elements of a case company, as well as to create suggestions for improvements and solutions in this regard. The learning outcomes of the course are the following: 1. To assess and analyze the sustainability of business and strategy of a chosen case company 2. To create suggestions and guidelines for improving sustainability in various elements of a chosen case company's business and strategy
Content	The course is designed around an independent research project, conducted for a chosen case company. Students are free to choose case company from

	Finland or internationally, and they will receive help in this process if needed. The project involves theory-based work, data collection and analysis, and creation of concrete solutions for different aspects of sustainable business for the case company. During the course, different frameworks and tools regarding sustainable business are introduced, and they are utilized to analyze case companies. Before the course, students will contact the case companies in pairs or individually. During the intensive week, students will work with the lecturers and by themselves related to the collecting data from and analyzing the case companies. After the intensive week, students will return an individually conducted report using one of the analysis tools introduced in the course. The course is related to sustainability.
Modes of Study	Contacting and finding a case company before the course lectures 10 h Mandatory readings before the course lectures 10 h Lectures and seminars during the intensive week 18 h Field research 12 h Writing a project report 30 h Total hours: 80 h Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points. Evaluation is based on individually conducted and written project report (60 points) and as well as in-class activity (20 points) and seminar presentation (20 points).
Study materials	Assigned via Moodle.

A350A0601	***CONTEMPORARY ISSUES IN STRATEGIC MANAGEMENT AND INNOVATION*** ***6 ECTS cr***
	Contemporary Issues in Strategic Management and Innovation
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio
Aims	This course focuses on the topical phenomena and concepts related to strategic management and innovation, which will be investigated from different viewpoints of academic research and business practice. Students will learn to asses, debate and synthesize the recent literature and examine the links of contemporary topics to previous research. The learning outcomes of the course are the following: 1.To assess and synthesize the contemporary concepts in strategic management and innovation. 2.To discuss and debate on specific topics of the course.
Content	The specific content of the course is based on current topics of strategic management and innovation, such as sustainable strategy, corporate responsibility, crowdsourcing, crowdfunding, open innovation, business model innovation, and business and innovation ecosystems. The course syllabus with detailed contents will be distributed in the beginning of the course. The course will utilize online methods and tools for student-driven content creation and discussion. The course will be conducted virtually within the 3 period, and is concluded with a live panel discussion session.
Modes of Study	3. period, virtual course + final panel discussion Independent familiarization with literature 36 h Independent content production 60 h Online work: blog-thread moderation, commentary and discussion, 60 h Panel discussion 4h Total hours: 160 h Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points. Content creation 50 % Online activity points 50 %

Study materials	There is no written final exam. Independent content creation based on academic and practical sources and familiarization of other students' input.

A350A8500	***MASTER'S THESIS SEMINAR, STRATEGY, INNOVATION AND SUSTAINABILITY*** ***3 ECTS cr***
	Master's Thesis Seminar, Strategy, Innovation and Sustainability
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-4
Teacher(s)	Professor, D.Sc. (Tech.) Kaisu Puumalainen, Professor, D.Sc. (Econ. & Bus. Adm.) Hanna-Kaisa Ellonen
Aims	Upon completion of the course, students will be able to delimit and define the purpose and the topic of the research. They know the theory and research methods relevant to their main subject. He/she understands the importance of theoretical framework in own research and in solving empirical research problems. Students are able to justify and explain the main points of the research both in oral presentation and in written format. Students can assess, evaluate and analyze reports written by other students and defense his/her own choices relating to the research in the seminars. Students can collect and choose relevant literature based on critical evaluation. They demonstrate the ability to compare and combine information based on literature and empirical material.
Content	Student familiarizes him/herself with the structure of Master's thesis and the standards related to the thesis, and plans his/her own thesis work. During the course the student will: - participate in the introductory lecture / workshop - prepare and present the analysis of the research topic - prepare and present the research plan - draw up and present the intermediate version of the thesis (60-70% completed, includes introduction, literature review, research design and preliminary findings) The course is related to sustainability.
Modes of Study	Seminars, 1-4 periods. - Introductory lecture, presentations of analyses of completed Master's Thesis, discussion on topic choice (7 h). - Seminar I: presentation of the topic analysis (7 h). - Seminar II: presentation of the research plan and acting as a discussant for another student's report (7 h). - Seminar III: presentation of the intermediate version of the thesis (7 h). - Preparing for the seminars and drawing up the first preliminary version of the manuscript (52 h). Total workload 80h. Moodle is used in this course.
Evaluation	Accepted / failed. In order to pass the course, the student is expected to participate actively in the seminars and proceed in his/her own research work according to the course schedule and return all the required documents in time. Similarity tests of all ready theses will be performed in order to check for plagiarism.
Study materials	Lecture notes and other assigned reading.
Prerequisites	Before the seminar begins, the student will have to have an idea about the topic of the thesis and find and analyze a competed LUT Master's Thesis related to the topic. Instructions will be given before the introductory lecture.

A350A9100	***MASTER'S THESIS, STRATEGY, INNOVATION AND SUSTAINABILITY*** ***30 ECTS cr***
	Master's Thesis, Strategy, Innovation and Sustainability
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1-4

Teacher(s)	Professor, D.Sc. (Tech.) Kaisu Puumalainen, Professor, D.Sc. (Econ. & Bus. Adm.) Hanna-Kaisa Ellonen
Aims	Upon completion of the course, students should be able to carry out a research project independently and to report the research in written format according to scientific practices.
Content	The student applies the knowledge and skills acquired in the Master’s Thesis Seminar course in drawing up the Master’s thesis. The student will outline the research process and prepare a schedule.
Modes of Study	Master’s thesis: carrying out the research and reporting it in written format (800 h).
Evaluation	Thesis: improbatur – laudatur All theses submitted for evaluation will undergo similarity check for plagiarism.
Study materials	Master’s Thesis instructions, and lecture notes and other assigned reading during the Master’s Thesis Seminar course.
Prerequisites	Participation in the Master’s Thesis Seminars and approximately 30 ECTS cr. of master’s studies.

A365A0100	*ORGANIZATION THEORY* 6 ECTS cr
	Organization Theory
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Iiro Jussila
Aims	After taking the course a student will be familiar with fundamental perspectives to organization theory, to compare these and contrast them. The student is able to explain theory building and application. In addition, the student is able to analyze and evaluate knowledge from organization theory perspective.
Content	The background, metaphors, and perspectives of organization theory. Organization and environment. Organizational social structure. Technology. Organizational culture. The physical structure of organizations. Organizational power, control, and conflict. New directions in organization theory. Theorizing and conclusions. Research process and the generation of scientific knowledge. Dissemination and use of scientific knowledge. Scientific journals and their evaluation practices. Co-operation as a form of organizing. The course is related to sustainability.
Modes of Study	Lectures 30 h. Pre-lecture reading of the subject to be learned (the study book), 30 h. Post-lecture recap (lecture materials + study book), 30 h. Written exam and preparation for the exam, 70 h, 1. period. Total workload for the student 160 h. Moodle is used in this course.
Evaluation	Final grade 0–5. Evaluated on scale 0–100 points. Examination 100%.
Study materials	1. Hatch, M. J. & Cunliffe, A. L. (2006). Organization Theory: Modern, Symbolic, and Postmodern Perspectives. Oxford University Press 2. Handouts 3. Other assigned readings
Prerequisites	B.Sc. studies.

A365A0300	*KNOWLEDGE-BASED NETWORKS* 6 ECTS cr
	Knowledge-based Networks **The maximum amount of students attending this course is 60 and the priority is given to degree students to whom this course is obligatory.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 per 2-INT 51
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Kirsimarja Blomqvist, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Kaisa Henttonen
Aims	Students will be able to - understand theoretical background of knowledge management and networks

	- identify and analyze knowledge management challenges and best practices in knowledge-intensive networks - collect data on, analyze and interpret the structure of knowledge-intensive networks
Content	- Knowledge as a key production factor - Key concepts related to knowledge and networks - Various forms of knowledge-intensive intra- and inter-firm collaboration, innovation ecosystems - Alliance, collaboration and network orchestration capability - Case assignments on knowledge intensive network collaboration - Social network analysis in theory and practice The course is related to sustainability.
Modes of Study	Lectures 28 h, 2. period, Independent preparation for lectures 32 h Course assignment work (case study) 50 h Course assignment work (group assignment) 50 h Total workload for student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points Case study and social network analysis, conducted as a group assignment 100%.
Study materials	Distributed during lectures.

A365A0551	***MASTER´S TRANSFERABLE SKILLS 3 ECTS cr***
	Master´s Transferable Skills
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2
Teacher(s)	Professor, Ph.D. Karl-Erik Michelsen
Aims	The objective of this course is to increase the students' abilities to carry out Master's level courses and future business duties successfully. Upon completing the course, the student is able to participate in the scientific discussions relating to his/her own field of specialization. Students understand the basics of scientific method, how academic texts are produced and critically reviewed and documented. The student has sufficient abilities to organize independent research work (project) and conduct project work with others.
Content	The course covers the following themes: - What is science and what is scientific method - Academic argumentation - Scientific writing - Basics of project work and project management - Basics of team work
Modes of Study	Compulsory intensive lectures 4 hours total done in one day. No exceptions allowed. Four personal assignments each 20 hours of time. Total workload between 80 to 100 hours. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluated on scale 0 - 100 p. Lectures are compulsory, assignments each 1 - 25 points.
Study materials	Selected materials, available in Moodle.
Prerequisites	Bachelor´s Degree

HARE	***INTERNSHIP FOR MASTER´S PROGRAMMES 2 - 10 ECTS cr***
	Internship for Master´s Programmes **This course concerns students in MIMM, MSF, MSIS and MSM master´s programmes. Registration for the course directly to the teacher any time during the academic year but before the planned practical training. The instructions for the training are given by the teacher. NB! Bachelor's and**

	Master's degrees can include a total of 10 credits of practical training. The student can divide the credits in both of the degrees or the training can be included in its entirety in one of the degrees. The student is free to find a suitable company / organization of his/her choice. The planned internship (organization, time, content, tasks) needs to be agreed by the internship coordinator in advance. It is advisable that Master´s programmes´ students would have an international element in their internships.Please note, that there are programme specific regulations on the amount of ECTS credits accepted to the degree. Only the internship, which the student does during his/her studies at LUT, is acceptable. The internship can be accepted only if the working hours are an average of 10 hours per week. In MSF, MSM and MIMM programme; maximum of 6 ECTS points are acceptable as electives in core studies. In MSIS programme; maximum of 3 ECTS points are acceptable.
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-4
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Katrina Lintukangas
Aims	The aim of the internship for Master's Programmes is to provide the students an opportunity to put their theoretical knowledge into practice, and to build networks in the job market. The student applies the knowledge learned in the university studies to complete the work tasks in a target organization and to write a report of the training. The student also develops skills in order to apply knowledge in his/her future career. In addition, the student gains new experience-based knowledge that can be utilized in studies, for example in assignments and in Master's Thesis. The student is able to write a well-written report about the target organization, its business, the student's work tasks and work experiences. In the report, the student is able to critically reflect and synthesize his/her experiences, especially related to gained knowledge / competence / skills during the internship.
Content	Applying previously learned knowledge Gaining experience-based knowledge Writing a report
Modes of Study	The practical training period in the target company 4 – 20 weeks, writing of the report and reading of the literature needed to write the report. Periods 1 – 4. Total work load in study hours 52 – 260 h (in work hours 160 – 800 h). NB! Bachelor's and Master's degrees can include a total of upto 10 credits of practical training. The student can divide the credits in both of the degrees or the training can be included in its entirety in one of the degrees. Note also programme specific regulations on the amount of ECTS credits accepted to the degree.
Evaluation	Accepted / failed, report of the training and internship application
Study materials	Instructions from the coordinator. See also UNi > Studies and services > LUT School of Business > Application forms and instructions > Internship
Prerequisites	For MIMM students: A330A0300 Strategic Global Marketing Management A330A0250 Internationalization of the Firm and Global Marketing A350A0300 Technology and Innovation Management For MSF students: A220A0200 International Financial Management A220A0650 Financial Theory and Valuation A220A0101 Derivatives and Financial Risk Management For MSM students: A310A0101 Strategic Supply Managment

6.12 Internship Instructions in Business Administration Studies

- Aims
    - To apply knowledge and skills learned prior to the internship to professional duties and the internship report.
    - To acquire new, experiential knowledge to support the learning outcomes of the degree and/or specialisation/programme (major subject).
    - To write a carefully prepared and finished internship report.
- Types of internship accepted
    - **Only internships carried out during the course of B.Sc. or M.Sc. studies can be included in the degree!**
    - Elective studies may include professional duties in a business enterprise that support Bachelor's or Master's level studies in business and the development of professional competencies.
    - Alternative studies in the student's specialisation field/programme (major subject) may only include an internship that supports the learning outcomes of the field in question (e.g. financial or human resource management, or planning and development of marketing and purchasing).
- Extent of the internship and placement in the degree
    - The internships for the degrees of Bachelor and Master of Science in Economics and Business Administration combined may be worth no more than 10 ECTS credits.
    - Students may divide the credits between the degrees, or place them entirely in one degree.
    - One working week in the internship corresponds to 40 hours, and two working weeks correspond to one ECTS credit.
- Internship abroad
    - The faculty may grant credits for language studies based on an internship carried out abroad.
    - For an internship of one semester (3-6 months), the student may receive 3 ECTS credits to substitute language studies.
    - For an internship of one academic year, students can be granted 6 ECTS credits to substitute language studies.
    - Language credits can be awarded for an internship approved in the degree by the student's specialisation field/programme (major subject).
- Remember before the internship!
    - Have a discussion with the internship coordinator in your specialisation field/programme (major subject) well in advance on whether the internship you are planning is suitable for your degree/specialisation/programme (major subject).
    - Read the instructions on the internship report below with care.
- Remember after the internship!
    - Fill out the internship application form and give it to the coordinator in your specialisation field/programme (major subject). The coordinators are listed and the form is available at Uni-portal.
    - Prepare your internship report according to the instructions and submit it along with your internship application.
    - In addition, enclose a photocopy of your employment certificate.

Internship report

- Topics to be discussed in the report
    - Introduction of the business enterprise: general information, mission and values.
    - Analysis of the external operating environment (e.g. business sector, market and competition).
    - Analysis of the internal operating environment (e.g. resources and competencies, organisation, systems and processes).

    - Analysis of the strategies and competitive edge of the business and their sources.
- Pay special attention to the following details
    - Your duties in the business and how they related to the points above.
    - Application of knowledge and skills acquired in studies to your professional duties (e.g. how specific models and frameworks helped you).
    - The impact of the internship on your professional development.
    - How both you and the business profited from your internship.
    - Development ideas for the business enterprise (only M.Sc. level).
- Organisation of the report
    - Cover page (name of the course, title of the report, date, author, student ID number)
    - Table of contents
    - Introduction
    - Discussion divided into chapters
    - Conclusions
    - References (Harvard system)
- Layout and presentation
    - The general instructions on writing reports issued by the LUT School of Business apply to the layout and presentation
    - Min. 10 and max. 20 pages
    - Arial 12, spacing 1.5
    - Margins left/right 2.0 cm, top/bottom 2.5 cm
    - Page numbers in the upper right hand corner
    - Body of text justified, one empty row between paragraphs
    - In Finnish or English
- Grade and assessment
    - Pass/fail
    - Comprehensiveness of the presentation of the business enterprise and professional duties, and knowledge on the matter
    - Comprehensiveness of the description and analysis of the business activities and knowledge of the matter
    - Application of knowledge learned during studies
    - Practical utilisation of theory and analysis tools
    - Coherence and readability of the report
    - Layout and presentation of the report
    - Personal touch and effort made
    - Creating a strong and interesting learning experience and evaluation of one’s own learning
    - Report submitted either along with the internship application or by e-mail to the contact person of the specialisation field/programme

7. MINOR SUBJECTS IN ENGLISH

There may be restrictions to selecting a minor subject in certain Master's degree programmes. These limitations are listed in this study guide in the section dedicated to the Master's degree programmes. Additional information is provided by the study guidance staff of each degree programme.

The minor subjects taught in English at LUT are:

LUT School of Energy Systems

Bio-Energy Technology

Obligatory Studies (16 op)		*year*	*per.*	*ECTS cr*
BH50A1200(*	Energy Systems Engineering	M.Sc. (Tech.) 1	1-2	6
BH50A1300	Maintenance Management	M.Sc. (Tech.) 2	1-2	4
BH50A1400(*	Steam Boilers	M.Sc. (Tech.) 2	1-2	6
BH50A1500	Bioenergy Technology Solutions	M.Sc. (Tech.) 1-2	2-3	6

*) Alternative to each other

List of selectable courses, choose enough credits to attain 20 ECTS cr		*year*	*per.*	*ECTS cr*
BH30A0701	Reliability Engineering	M.Sc. (Tech.) 1	1-2	4
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 2	2	5
BH60A1600	Basic Course on Environmental Management and Economics	B.Sc. (Tech.) 2	2	5
BL20A0401	Electricity Market	M.Sc. (Tech.) 1	1	5

Design

Compulsory Studies (23 ECTS cr)		*per.*	*ECTS cr*
BK60A1000	Control of Mechatronic Machines	1-2	6
BK70A0000	Simulation of a Mechatronic Machine	1-2	6
BK70A0500	Machine Dynamics	1-2	6
BK80A1200	FE-analysis Course	3-4	5

Green Chemistry

Obligatory Studies (15 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4020	Methods in Green Chemistry	M.Sc. (Tech.) 1	4	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5

List of selectable courses, choose enough credits to attain 20 ECTS cr		*year*	*per.*	*ECTS cr*
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1-2	2	6
BJ02A3030	Solid-Liquid Separation	M.Sc. (Tech.) 1	3	5

Industrial Embedded Systems

Obligatory Studies (22 ECTS cr)		*year*	*per.*	*ECTS cr*
BL40A1000	Real-time Operating Systems and Programs	M.Sc. (Tech.) 2	1-2	5
BL40A1201	Digital Control Design	M.Sc. (Tech.) 1	1-2	5

BL40A1811	Introduction to Embedded Systems	B.Sc. (Tech.) 3	3-4	6
BL50A1300	Advanced Course in Electronics	M.Sc. (Tech.) 1	3-4	6

Manufacturing

Compulsory Studies (22 ECTS cr)		*per.*	*ECTS cr*
BK30A0600	Laser Based Products and Production Technology	3-4	5
BK30A0901	Additive Manufacturing - 3D Printing	3-4	5
BK50A0701	Advanced Production Engineering	1-2	6
BK50A2700	Selection Criteria of Structural Materials	3-4	6

Modelling of Energy Systems

Obligatory Studies (21 ECTS cr)		*year*	*per.*	*ECTS cr*
BH40A1500	Turbulence Models	M.Sc. (Tech.) 2	3-4	4
BH70A0001	Numerical Methods in Heat Transfer	M.Sc. (Tech.) 1	1-2	6
BH70A0101	Advanced Modeling Tools For Transport Phenomena	M.Sc. (Tech.) 1	3-4	5
BH70A0200	Advanced Topics in Modelling of Energy Systems	M.Sc. (Tech.) 1	1-2	6

Packaging Technology

Compulsory Studies (23 ECTS cr)		*per.*	*ECTS cr*
BK50A1401	Packaging Lines and Machinery	3-4	7
BK50A2100	Printing and Package Design	1-2	6
BK50A2400	Packaging Materials	1	5
BK50A2600	Principles of Chemistry, Paper Technology and Food Technology	1-4	5

Power Electronics and Electrical Drives

Select a minimum of 20 ECTS cr		*year*	*per.*	*ECTS cr*
BL30A1200	Numerical Methods in Electromagnetism	M.Sc. (Tech.) 2	3	4
BL40A1100	Embedded System Programming	M.Sc. (Tech.) 1	1-2	4
BL40A1811	Introduction to Embedded Systems	B.Sc. (Tech.) 3	3-4	6
BL50A0600	Electromagnetic Compatibility in Power Electronics	M.Sc. (Tech.) 1	1	2
BL50A1300	Advanced Course in Electronics	M.Sc. (Tech.) 1	3-4	6

Renewable Energy and Energy Efficiency

Select a minimum of 20 ECTS cr		*year*	*per.*	*ECTS cr*
BL10A8400(*	Solar Economy and Smart Grids	M.Sc. (Tech.) 1-2	INT.	3
BL20A1300(**	Energy Resources	M.Sc. (Tech.) 1	1-2	6
BL20A1400	Renewable Energy Technology	M.Sc. (Tech.) 2	1-2	6
BL20A1500(***	Energy Scenarios	M.Sc. (Tech.) 2	3-4	6
BL40A2301	Energy Efficiency	M.Sc. (Tech.) 1	3	6
BL40A2401	Electrical Engineering in Wind and Solar Systems	M.Sc. (Tech.) 2	3-4	6

*) LUT Summer School-course (10.-14.8.2015)
**) will be lectured every other year, next during the academic year 2016-2017
***) will be lectured every other year, next during the academic year 2015-2016

Sustainable Technology and Business

Obligatory Studies (22 ECTS cr)		*year*	*per.*	*ECTS cr*
BH60A1600(*	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1	2	5
BH60A4700	Climate Finance and Carbon Markets	M.Sc. (Tech.) 1	3-4	3
BH60A2101	Advanced Course in Life Cycle Assessment	M.Sc. (Tech.) 2	3-4	7
BH60A2200(*	Air Pollution Control	M.Sc. (Tech.) 1	3-4	3
BH60A2401(*	Energy Recovery from Solid Waste	M.Sc. (Tech.) 2	1-2	4

*) The student must have completed this course (or corresponding knowledge) before attending BH60A2101 Advanced Course in Life Cycle Assessment

LUT School of Engineering Science

Green Process Technology

Obligatory studies		*year*	*per.*	*ECTS cr*
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4020	Methods in Green Chemistry	M.Sc. (Tech.) 1	4	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5
BJ02A4040	Processing of Biomaterials	M.Sc. (Tech.) 2	1-2	7
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1	3	3

Intelligent Computing

Compulsory Studies		*per.*	*ECTS cr*
BM40A0700	Pattern Recognition	1-2	7
BM40A1200	Digital Imaging and Image Preprocessing	1-2	7

Select enough courses to attain 20 ECTS cr together with obligatory courses. If some obligatory course is included in the degree somewhere else, select enough courses from the following studies to attain enough minor studies.

List of elective courses		*per.*	*ECTS cr*
BM20A1901	Statistics II	2	4
BM20A2500	Linear Algebra and Normed Spaces	1	3
BM20A2701	Numerical Methods II	3	3
BM20A2800	Nonlinear Optimization	3	4
BM20A3001	Statistical Analysis in Modelling	2	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	1-2	6
BM20A3203	Fuzzy Engineering and Decision Making	3-4	6
BM20A3401	Design of Experiments	4	4
BM20A3602	Fuzzy Data Analysis	3-4	6
BM20A3801	Advanced Mathematical Methods	1-4	3-6
BM20A4500	Evolutionary Computation	2-3	5
BM20A5001	Principles of Technical Computing	1	4
BM20A5600	Inverse Problems and Sparse Transforms	2-3	6
BM40A0600	Introduction to Computer Graphics	2	5
BM40A0800	Machine Vision and Digital Image Analysis	3-4	7
BM40A0900	Computer Vision	3-4	7

Separation Technology

Obligatory studies (25 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1	2	6
BJ02A3030	Solid-Liquid Separation	M.Sc. (Tech.) 1	3	5
BJ02A3040	Crystallization	M.Sc. (Tech.) 2	1	5
BJ02A3050	Hydrometallurgy	M.Sc. (Tech.) 1	4	4

Sustainability

Obligatory studies (8 ECTS cr)		*year*	*per.*	*ECTS cr*
BH60A1600	Basic Course on Environmental Management and Economics	B.Sc. (Tech.) 2	2	5
BH60A4400	Introduction to Sustainability	M.Sc. (Tech.) 1	1	3

Min. 17 ECTS credits should be selected from below to attain 25 ECTS credits for the minor.

Vaihtoehtoiset opinnot		*vsk*	*per.*	*op*
A350A0500	Sustainable Strategy and Business Ethics	DI 1-2	2	3
BH61A0600	Bioenergy	DI 1-2	1	3
BJ02A1050	Biopolymeerit	DI 1-2	4	5
BJ02A1060	Prosessi- ja ympäristöanalytiikka	DI 1-2	per 1-INT 43	5
BJ02A1070	Bioprosessitekniikan perusteet	DI 1-2	INT 17	4
BJ02A2050	Process Intensification	DI 1-2	4	4
BJ02A3010	Membrane Technology	DI 1-2	1	5
BJ02A3020	Chemical Separation Methods	DI 1-2	2	6
BJ02A4010	Industrial Water Treatment	DI 1-2	2	5
BJ02A4030	Green Chemistry	DI 1-2	1	5
BJ02A4040	Processing of Biomaterials	DI 1-2	1-2	7
BK90C1800	Green Fiber Materials	DI 1-2	4	5
CS10A0770	Cleaner Technologies and Markets	DI 1-2	3-4	5
CS30A1690	Social Sustainability	DI 1-2	4	5

Technical Physics

Minor in Technical Physics can be studied by students of other Master’s degree programmes.

Minimum 20 ECTS credits should be selected.

Minor Studies min. 20 ECTS cr		*per.*	*ECTS cr*
BM30A0500	Applied Optics	2	6
BM30A1500	Advanced Topics in Material Science	2	6
BM30A1600	Microelectronics	1	6
BM30A1701	Physics of Semiconductor Devices	1-2	6
BM30A2100	Microelectronics Processing Technology	1-2	2
BM30A2200	Semiconductor and Superconductor Physics	1-2	6
BM30A2500	Nanophysics	1-2	6

Technomathematics

Minor in Technomathematics can be studied by students of other Master’s degree programmes. However, suitable background knowledge is needed. This means basic knowledge about matrix calculation, optimization, statistics, numerical analysis and especially mathematical programming with some procedural language (preferably Matlab/Octave).

A minimum of 20 ECTS credits should be selected from the courses below:

Minor Studies min. 20 ECTS cr		*per.*	*ECTS cr*
BM20A1901	Statistics II	2	4
BM20A2000	Simulation	1	4
BM20A2500	Linear Algebra and Normed Spaces	1	3
BM20A2701	Numerical Methods II	3	3
BM20A2800	Nonlinear Optimization	3	4
BM20A2901	Discrete Optimization	4	5
BM20A3101	Fuzzy Sets and Fuzzy Logic	1-2	6
BM20A3203	Fuzzy Engineering and Decision Making	3-4	6
BM20A3401	Design of Experiments	4	4
BM20A3602	Fuzzy Data Analysis	3-4	6
BM20A3801	Advanced Mathematical Methods	1-4	3-6

BM20A4500	Evolutionary Computation	2-3	5
BM20A5001	Principles of Technical Computing	1	4
BM20A5100	Scientific Computing and Numerics for PDEs	4	6
BM20A5400	Computational Modeling of Materials	1-2	6
BM20A5600	Inverse Problems and Sparse Transforms	2-3	6

School of Business and Management

Industrial Engineering and Management

Business and Technology in Russia

Elective studies (min. 20 ECTS cr)		*per.*	*ECTS cr*
BH60A2801	Energy and Environmental Challenges in Russia	3	3
FV14A1200(1(*	Venäjä 1	1-2/3-4	3
FV14A1400(1	Venäjä 2	1-2/3-4	3
FV14A1801(1	Venäjän sijamuodot	1-2	3
FV14A4200(1	Nykyvenäjän kieltä ja maantuntemusta	1-2	3
CS10A0270	Economic Challenges in Russia	1	3
CS10A0651	Management of Innovations in Russia	4	5
CS10A0760	Business in Russia	3	6

1) Exchangeable

*) Only one Russian language course can be included to the minor. Language courses are alternative to each other and should be selected according to the student's language skills.

Business Technology

Obligatory studies (10 ECTS cr)		*per.*	*ECTS cr*
CS30A1390	Systems Engineering	3-4	5
CS35A0152	Product Lifecycle Management	4	5

Elective studies (min. 10 ECTS cr)		*per.*	*ECTS cr*
CT30A5110	Gamification - from Concepts to Implementations	1-4	3
CT30A8920	Sustainable Innovation by Design: A User Experience Perspective	1-2	5
CT60A7201	Architecture in Systems and Software Development	3-4	7
CT60A7400	Fundamentals of Information Systems	1-2	7
CT10A7001(*	Green IT and Sustainable Computing	3-4	5
CT60A7001(*	Critical Thinking and Argumentation in Software Engineering	3-4	5

*) Exchangeable

Entrepreneurship

Elective studies (min. 20 ECTS cr)		*per.*	*ECTS cr*
CS30A1661	Open Innovation	3-4	6
CS30A1690	Social Sustainability	4	5
CS30A1371	Creative Design and Problem Solving	1-2	5
CS34A0301	Theory of the Entrepreneurship	1	5
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	INT 43	5
A330A5101	Creativity and Entrepreneurship in New Product Development from the Silicon Valley’s Perspectives		3

Business Administration

These minors are for the students who study as M.Sc. (Econ. & Bus.Adm.) at School of Business and Management.

MIMM-programme´s Master´s students cannot study the minor International Marketing
MSM-programmes´s Master´s students cannot study the minor Supply Management
MSIS-programmes´s Master´s students cannot study the minor Knowledge and Innovation Management
MSF-programme´s Master´s students must study the obligatory minor Business Analytics

Knowledge and Innovation Management

Obligatory courses (24 ECTS cr)		*per.*	*ECTS cr*
A365A0300	Knowledge-based Networks		6
A365A0250	Organizational Learning in Knowledge Management	1	6
A350A0601	Contemporary Issues in Strategic Management and Innovation	3	6
CS30A1661	Open Innovation	3-4	6

Sustainability

Obligatory courses (13 ECTS cr)		*per.*	*ECTS cr*
BH60A4400	Introduction to Sustainability	1	3
CS10A0770	Cleaner Technologies and Markets	3-4	5
CS30A1690	Social Sustainability	4	5

Electives (choose at least 11 ECTS cr of the following)		*per.*	*ECTS cr*
A350A0500(*	Sustainable Strategy and Business Ethics	2	3
BH60A4500(*	Corporate Responsibility and Management 1	1-4	3
BL40A2600	Tuuli- ja aurinkovoimateknologia ja liiketoiminta	3-4	5
BH60A1600	Basic Course on Environmental Management and Economics	2	5
BH60A2801	Energy and Environmental Challenges in Russia	3	3
BH61A0600	Bioenergy	1	3
CT10A7001	Green IT and Sustainable Computing	3-4	5
FV11A9503	Independent Study in English		1-4

*) recommended, if these courses are not included in the degree somewhere else

International Marketing

Electives (choose at least 24 ECTS cr of the following)		*per.*	*ECTS cr*
A330A0010	Contemporary Issues in International Marketing	3, intensive	3
A330A0050	Customer Relationship Management		6
A330A0250	Internationalization of the Firm and Global Marketing	2	6
A330A0300	Strategic Global Marketing Management	1	6
A330A5000(*	International Marketing of High Technology Products and Innovations		3
A330A0220(**	International Marketing of High Technology Products and Innovations: applications	1-2	3
A330A0500	Brand Management		3
A330A0020(***	Asian Management		3

*) Summer School course
**) This course can be in this minor only with the course A330A5000
***) The course is not lectured 2015-16

Business Analytics

Obligatory (13 op)		*per.*	*ECTS cr*
A220A0000	Financial Econometrics	1	6
A220A0052	Investment and Business Analysis with Excel	4	3
BM20A5001	Principles of Technical Computing	1	4

Choose at least 11 ECTS cr of the following studies:		*per.*	*ECTS cr*
A210A0601	Information Systems in Corporate Management and Decision-making	2	6
A220A0550	Advanced Decision-making	1	6
A220A0750	Elective Special Course on Business Analytics or Decision-making		3
CS30A1371	Creative Design and Problem Solving	1-2	5
CS30A1390	Systems Engineering	3-4	5
CS30A1551	System Dynamics and Industrial Management	2, INT. 43	5

Supply Management

Electives, select at least 24 ECTS cr of the following:		*per.*	*ECTS cr*
A310A0101	Strategic Supply Management	1-2	6
A310A0401	Public Procurement		6
A310A0500	Global Sourcing and Sub-Contracting	4	6
A310A0601	Reading Course of Supplier Relationship Management	4	3
A310A0650	Cost and Risk Management in Supply Chain	4	6
A310A0750	Logistics Outsourcing and Innovation		3

International Business and Management -minor

This minor is for the students who study as M.Sc. (Tech.) in English programmes at LUT. Business Administration –students cannot study this minor.

International Business and Management min. 20 ECTS cr

Electives, (choose at least 20 ECTS cr of the following courses)		*per.*	*ECTS cr*
A330A6010	Buyer-Seller Relationship Management	4	4
A380A0000(1	Cross-Cultural Issues in International Business	3	6
A380A0200	Promotion and Sales Management	4	6
A380A6000(1	Cross-Cultural Encounters	3	3
A380A6050	Introduction to International Business and Planning	1 int.	3
A370A0401	Case-Course of Business	1-2/3-4	6

(1 Exchangeable

Notice! The number of students attending to the courses in the minor International Business and Management can be limited. In these cases the priority is given to the students who have these courses in their compulsory studies.

8. LANGUAGE CENTRE COURSES 2015–2016

The LUT Language Centre offers courses in eight languages: Finnish, English, German, Spanish, French, Russian, Chinese and Swedish. A number of courses in Finnish, English, German, Spanish, French, Russian and Chinese do not require Finnish skills from participants and are available to international students. The language of instruction is mentioned in the course descriptions.

You must register for language courses through WebOodi before they begin. Please make sure that your e-mail adress in WebOodi is correct so that teachers can contact you if it is necessary.

Remember to register for courses and exams separately.

		ECTS cr
FV11A2201	Technical English Reading Course	2
FV11A2600	Business English Reading Course	2
FV11A4401	English Communication for Engineering Professionals	4
FV11A4801	English Communication for Business and Management	4 - 5
FV11A6206	English for Professional Meetings and Discussions	4
FV11A6500	Presenting in English	2
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FV11A2201	*TECHNICAL ENGLISH READING COURSE 2 ECTS cr*
	Technical English Reading Course **Period 1,2,3,4: Online Lecturers**
Year and Period	B.Sc. (Tech.) 1-3, M.Sc. (Tech.) 1 Period 1/2/3/4
Teacher(s)	Lecturer, M.A. Jukka Taipale
CEF Level	The course will be taught at a B2/B2+ level according to the Common European Framework.
Aims	By the end of the course, students are expected to be able to demonstrate the ability to learn and master general technical vocabulary and the ability to read quickly and effectively.
Content	Vocabulary exercises, skimming, scanning and affixes, reading comprehension exercises. The language of instruction is English.
Modes of Study	Period 1,2,3,4, online: 52 hours for self study and exercise completion. Course instructions and background material in Moodle. Moodle is used in this course.
Evaluation	Pass/Fail. Students are expected to complete all assignments according to a timetable. Marks are based on a reading comprehension exam (duration 90 minutes). There is no online exams. All assignments must be completed in time to be eligible to sit the exam.
Study materials	Provided by the teacher through Moodle. Noppa will not be used.
Prerequisites	Students with a matriculation exam grade of A, B, C or a short course in English may enroll for the course. Students who have taken FV11A2600 Business English Reading Course are not eligible for this course.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV11A2600	*BUSINESS ENGLISH READING COURSE 2 ECTS cr*
	Business English Reading Course **Period 1,2,3,4: Online Lecturers**
Year and Period	B.Sc. (Econ. & Bus. Adm.) 1 Period 1/2/3/4
Teacher(s)	Lecturer, M.A. Jukka Taipale
CEF Level	The course will be taught at B2/B2+ level according to the Common European Framework.
Aims	By the end of the course, students are expected to be able to demonstrate the ability to learn and master general business vocabulary and the ability to read quickly and effectively.
Content	Vocabulary exercises, skimming, scanning and affixes, reading comprehension exercises. The language of instruction is English.
Modes of Study	Period 1,2,3,4, Online: 52 hours for self study and exercise completion. Course instructions and background material in Moodle. Moodle is used in this course.
Evaluation	Pass/Fail. Students are expected to complete all assignments. Marks are based on a reading comprehension exam (duration 90 minutes). All assignments must be completed according to a time table to be eligible to sit the exam. There is no online exams.
Study materials	Provided by the teacher through Moodle. Noppa will not be used.
Prerequisites	Students who have taken FV11A2201 Technical English Reading Course are not eligible for this course.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV11A4401	*ENGLISH COMMUNICATION FOR ENGINEERING PROFESSIONALS*	*4 ECTS cr*
	English Communication for Engineering Professionals	
Year and Period	Period 1-2/3-4	
Teacher(s)	Lecturer, B.A. Hwei-Ming Boey	
CEF Level	B2 - C1	
Aims	To develop and maintain speaking, listening and reading skills, focussing on themes related to engineering. On completion of the course, students should be able to read and understand written texts related to engineering issues, understand spoken texts, and discuss topical engineering issues with a degree of fluency permitting active participation in study and work.	
Content	Engineering-related issues, such as energy, the environment, the digital world, machines, and materials. Language of instruction: English.	
Modes of Study	49 contact hours (over 2 periods) + at least 51 hours independent study. (Please note that according to the European Commission, 1 ECTS credit = 25-30 hours of work.) Active communication practice in class, based on authentic written and spoken texts. Assessment: 1) in-class continuous assessment 2) reading comprehension test A minimum of 75 % attendance required.	
Evaluation	Pass / Fail.	
Study materials	Provided by the teacher.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

FV11A4801	*ENGLISH COMMUNICATION FOR BUSINESS AND MANAGEMENT*	*4 - 5 ECTS cr*
	English Communication for Business and Management	
Year and Period	B.Sc. (Tech.) 1-3, B.Sc. (Econ. & Bus. Adm.) 1-3 Period 1-2/3-4	
Teacher(s)	EFL Instructor, B.A. Riitta Gröhn Lecturer, M.A. Jukka Taipale University Lecturer, M.A. Tarja Kovalev Self-study option in one group per semester	
CEF Level	Entry level must be at least B2.	
Aims	Learning outcomes: Upon completion of the course, students should be able to communicate effectively and with confidence on topical issues in professional contexts, and demonstrate ability to use various learning tools and strategies to further their own learning.	
Content	The contents of the course will be updated in Moodle. Noppa will not be used.	
Modes of Study	The course uses multiple modes of study, including contact, online, individual and group work. Students can earn either 4 or 5 points from this course. Contact lessons - 20 h, independent learning - 36 h, case study, small group work, small group meetings with tutor - 36 h, final presentations - 4 hours, final report 26 hours -80% attendance is required for contact lessons. Independent learning options are also available. Moodle is used in this course.	
Evaluation	Pass / Fail. For 4 ECTS, students are assessed based on continuous assessment and a final presentation. If students wish to earn 5 ECTS altogether, a written report must also be submitted. This will be explained in further detail during the orientation session.	
Study materials	Various sources of information will be used, including (but not limited to), books, the Internet, journals, etc., as well as handouts provided by the teacher, Moodle. Noppa will not be used. Course instructions in Moodle.	

Prerequisites	FV11A2600 Business English Reading Course or FV11A2201 Technical English Reading Course.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV11A6206	***ENGLISH FOR PROFESSIONAL MEETINGS AND DISCUSSIONS*** ***4 ECTS cr***
	English for Professional Meetings and Discussions **Intensive course: weeks 43, 9 and 16-17**
Year and Period	
Teacher(s)	Lecturer, B.A. Hwei-Ming Boey
CEF Level	B2 and above
Aims	By the end of the course, students will be able to communicate more fluently in all kinds of meetings and discussions.
Content	Discussion and practice of the language for effective oral communication, participation in simulations of meetings. Language of instruction: English.
Modes of Study	49 contact hours + at least 51 hours independent study. (Please note that according to the European Commission, 1 ECTS credit = 25-30 hours of work.) Compulsory pre-course preparation required. (Material will be sent to participants two weeks before the course begins.) Active participation in class, and self-study of language of meetings. Assessment: in-class continuous assessment Regular attendance (80%) required.
Evaluation	Pass / Fail.
Study materials	Provided by the teacher.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV11A6500	***PRESENTING IN ENGLISH*** ***2 ECTS cr***
	Presenting in English **Periods 1,2,3,4 (Two online groups periods 2/4) Intensive 43, 10**
Year and Period	B.Sc. (Tech.) 2-3, B.Sc. (Econ. & Bus. Adm.) 2-3 per 1/ INT 43/per 2/per 3/INT 10 /per 4
Teacher(s)	University Lecturer, B.Sc. Olesya Kullberg EFL Instructor, B.A. Riitta Gröhn Two online groups
CEF Level	B2 and above
Aims	By the end of the course, students will be able to deliver carefully constructed, clear and effective presentations for academic and professional purposes.
Content	The language of presentations: Effective introductions and endings, delivery techniques, rapport building techniques, visual aids, handling questions. Peer and self-feedback. Language of instruction: English.
Modes of Study	Contact lessons: 24 h, individual study: 24 h Classroom exercises, presentation practice, and homework. Moodle will be used for distributing materials and for communicating with students. Noppa will not be used. Classroom-based course. 80 % attendance required. A partial independent learning option is available in certain circumstances. This is to be negotiated with the teacher on an individual basis. Course instructions in Moodle. Moodle is used in this course.

Evaluation	Pass/Fail based on the successful completion of all assignments and a final presentation.
Study materials	Provided by the teacher.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV11A9503	***INDEPENDENT STUDY IN ENGLISH***	***1 - 4 ECTS cr***
	Independent Study in English **This course is a self-study course in Moodle.**	
Year and Period	Period 1-2, 3-4	
Teacher(s)	University Lecturer, M. A. Kristiina Karjalainen EFL Instructor, B.A. Riitta Gröhn University Lecturer, M.A. Tarja Kovalev University Lecturer, B.Sc. Olesya Kullberg	
CEF Level	B2/C1	
Aims	The main aim of this course is provide an opportunity for students to work on language skills areas of their choosing. As such, students can work towards improving in one or two of the following skills areas: Grammar Critical reading and vocabulary building Writing Listening comprehension Secondary aims are a) to support students in working on their time-management skills and b) to provide opportunities to complete a small amount of credits in a short period of time to those who are unable to attend courses on campus.	
Content	There are specific tasks in the abovementioned areas from which students choose. In some cases students can choose the source material (e.g. from their own field of study), and in other cases the source material is provided.	
Modes of Study	Independent study (study materials, exercises, self-tests, etc.) in Moodle 26-104 hours. All course instructions are in Moodle. Teacher will send an info email before the start of the course. Moodle is used in this course.	
Evaluation	Pass/Fail	
Study materials	Study materials and exercises for each section provided by teacher in Moodle.	
Prerequisites	B2/C1	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

FV11A9800	***ACADEMIC WRITING IN ENGLISH COURSE 1***	***2 ECTS cr***
	Academic Writing in English Course 1	
Year and Period	B.Sc. (Tech.) 2-3, M.Sc. (Tech.) 1, B.Sc. (Econ. & Bus. Adm.) 2-3, M.Sc. (Econ. & Bus. Adm.) 3 Period 1/3	
Teacher(s)	University Lecturer, M.A. Tarja Kovalev, University Lecturer, M. A. Kristiina Karjalainen, EFL Instructor, B.A. Riitta Gröhn,	
Aims	At the end of the course, students are expected to be able to identify the characteristics of academic writing.	
Content	Students wills study features of academic and scientific writing based on which they will participate in small group discussion and/or complete assignments online.	
Modes of Study	The course is made up of 48 hours of work : Contact lessons: 24 hours, individual, group, and homework 24 hours. Attendance requirement is 80%.	

	Individual study: 48 hours of individual online study, including potential tutoring meetings with the teacher. Moodle is used in this course.
Evaluation	Pass/ Fail based on the successful l completion of assignments and online exam. PLEASE NOTE THAT: Attendance at the introductory orientation session is mandatory for both methods of study.
Study materials	Materials will be provided as needed in class and in Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV11A9900	*ACADEMIC WRITING IN ENGLISH COURSE 2 2 ECTS cr*
	Academic Writing in English Course 2
Year and Period	B.Sc. (Tech.) 3, M.Sc. (Tech.) 1, B.Sc. (Econ. & Bus. Adm.) 3, M.Sc. (Econ. & Bus. Adm.) 3 Period 2/4
Teacher(s)	University Lecturer, M.A. Tarja Kovalev, University Lecturer, M. A. Kristiina Karjalainen, EFL Instructor, B.A. Riitta Gröhn,
Aims	Based on the knowledge of Academic Writing Course 1 students will write a 6–page seminar paper on a topic of their own choice.
Content	Students will produce an academic paper to complete the course.
Modes of Study	The course is made up of 48 hours of work : Contact lessons: 12 hours, individual, group, online work 36 hours. Attendance requirement is 80%. Individual study: 48 hours of individual online study, including potential tutoring meetings with the teacher. Moodle is used in this course.
Evaluation	Pass/ Fail based on the successful completion of writing the paper. PLEASE NOTE THAT: Attendance at the introductory orientation session is mandatory for both methods of study.
Study materials	Materials will be provided as needed in class and in Moodle.
Prerequisites	Successful completion of Academic Writing in English Course 1 or equivalent information + an online exam.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV12A1210	*BASIC COURSE IN GERMAN 1 2 ECTS cr*
	Saksan peruskurssi 1 **Week 21 intensive course**
Year and Period	Period 1/2/3
Teacher(s)	Lecturer, M.A. Pirjo Rantonen Lecturer, Jörg Wunderlich
CEF Level	A1
Aims	By the end of the course, students are expected to understand spoken language when it is slow, clear and related to topics discussed during the course, to use simple sentences to talk about topics of the course, to write short and simple texts related to topics discussed during the course and to use polite phrases and expressions typical of the German communication culture.
Content	In this course, the emphasis is on communication in working life. Situations: personal data, introducing oneself, getting to know the working place. Structures: verbs in the present tense, word order, use of articles, accusative, numerals, personal pronouns. Languages of instruction: German, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact hours 28 of which 4 hours intensive at the end, (intensive weeks 43, 50, 9 and 21), independent study approx.

	24 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments, a written examination and an oral test required for a passing grade. Students who have passed the course FV12A1200 German 1 are not eligible for this course because of the similar contents of the courses. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	DaF im Unternehmen A1, chapters 1 to 3.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV12A1220	***BASIC COURSE IN GERMAN 2 — 2 ECTS cr***
	Saksan peruskurssi 2
Year and Period	Period 1/2/3/4
Teacher(s)	Lecturer, M.A. Pirjo Rantonen Lecturer, Jörg Wunderlich
CEF Level	Teaching level: A1.
Aims	By the end of the course, students are expected to understand spoken language when it is slow, clear and related to topics discussed during the course, to use simple sentences to talk about topics of the course, to write short and simple texts related to topics discussed during the course and to use polite phrases and expressions typical of the German communication culture.
Content	Period 1: Situations: making purchases and placing orders, giving directions, agreeing on schedules, family, greetings. Structures: modal verbs, ordinals, accusative and dative use of personal pronouns, possessive pronouns. Periods 2 to 4: In this course, the emphasis is on communication in working life. Situations: schedules, getting to know the company, food. Structures: negation, modal verbs, possessive pronouns, ordinals, accusative use of personal pronouns, haben and sein in simple past. Languages of instruction: German, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact hours 28 of which 4 hours intensive at the end, (intensive weeks 43, 50, 9 and 16), independent study approx. 24 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments, a written examination and an oral test required for a passing grade. Students who have passed the course FV12A1200 German 1 are not eligible for this course because of the similar contents of the courses. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Period 1: Alltag, Beruf & Co. 1, chapters 6 - 10. Periods 2 to 4: DaF im Unternehmen A1, chapters 4 to 6.
Prerequisites	FV12A1210 Basic Course in German 1 or corresponding skills.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

FV12A1410	***INTERMEDIATE COURSE IN GERMAN 1 — 2 ECTS cr***
	Saksan jatkokurssi 1
Year and Period	Period 1/2/3/4
Teacher(s)	Lecturer, M.A. Pirjo Rantonen Lecturer, Jörg Wunderlich
CEF Level	Teaching Level A1.

Aims	By the end of the course, students are expected to be able to discuss topics introduced during the course, to be able to write short texts on topics discussed during the course, to understand the main idea of texts on topics discussed during the course and to understand and apply the most important German customs.
Content	Periods 1 and 2: Situations: describing oneself, organisation and discussion of travels and meetings, talking about health. Structures: imperative, separable verbs, perfect tense, sein and haben in the past tense. Periods 3 and 4: In this course, the emphasis is on communication in working life. Situations: giving directions, tasks at work, company anniversary, business trip. Structures: separable verbs, imperative, perfect tense, demonstrative pronouns. Languages of instruction: German, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact hours 28 of which 4 hours intensive at the end,(intensive weeks 43, 50, 9 and 16), independent study approx. 24 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments, a written examination and an oral test required for a passing grade. Students who have passed the course FV12A1400 German 2 are not eligible for this course because of the similar contents of the courses. Moodle is used in this course in groups B, C and D.
Evaluation	Pass/Fail.
Study materials	Periods 1 and 2: Alltag, Beruf & Co. 2, chapters 1 - 5. Periods 3 and 4: DaF im Unternehmen A1, chapters 7 to 10.
Prerequisites	FV12A1220 Basic Course in German 2 or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV12A1420	***INTERMEDIATE COURSE IN GERMAN 2 — 2 ECTS cr***
	Saksan jatkokurssi 2
Year and Period	Period 1/2/3/4
Teacher(s)	Lecturer, M.A. Pirjo Rantonen Lecturer, Jörg Wunderlich
CEF Level	Teaching Level A1.
Aims	By the end of the course, students are expected to be able to discuss topics introduced during the course, to be able to write short texts on topics discussed during the course, to understand the main idea of texts on topics discussed during the course and to understand and apply the most important German customs.
Content	Situations: home and decorating, recycling, job interview, informal meetings, small talk. Structures: prepositions, subordinate clauses, adjective endings, possessive pronouns. Languages of instruction: German, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact hours 28 of which 4 hours intensive at the end, (intensive weeks 43, 50, 9 and 16), independent study approx. 24 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments, a written examination and an oral test required for a passing grade. Students who have passed the course FV12A1400 German 2 are not eligible for this course because of the similar contents of the courses. Moodle is used in this course in groups B, C and D.

Evaluation	Pass/Fail.
Study materials	Periods 1 to 3: Alltag, Beruf & Co. 2, chapters 6 - 10. Period 4: DaF im Unternehmen A2.
Prerequisites	FV12A1410 Intermediate Course in German 1 or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV12A1611	***GERMAN FOR WORKING LIFE 2 ECTS cr***
	Työelämän saksaa **Week 21 intensive course**
Year and Period	Period 1/2/3
Teacher(s)	Lecturer, M.A. Pirjo Rantonen Lecturer, Jörg Wunderlich
CEF Level	Teaching Level A2
Aims	By the end of the course, students are expected to be able to discuss topics introduced during the course, to be able to write texts on topics discussed during the course, to understand texts on topics discussed during the course and to understand the most important German customs in the world of work.
Content	Situations: introducing oneself and others, talking about one's career, duties at work, describing the weather, where you live and where you work. Structures: past tense, genitive, subordinate clauses, comparison, conditional, infinitive. Languages of instruction: German, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact lessons 28 of which 4 hours intensive at the end, (intensive weeks 43, 50, 9 and 21), independent study approx. 24 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments, a written examination and an oral test required for a passing grade. Students who have passed the course FV12A1610/FV12A1620 German for Working Life 1 or 2 are not eligible for this course because of the similar contents of the courses. Moodle is used in this course in groups A and C.
Evaluation	Pass/Fail.
Study materials	Periods 1 to 3: Alltag, Beruf & Co. 3. Period 5 (INT): DaF im Unternehmen A2.
Prerequisites	FV12A1420 Intermediate Course in German 2 or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV12A3300	***INFORMATION ON GERMANY 2 ECTS cr***
	Info Deutschland
Year and Period	Period 2/4
Teacher(s)	Lecturer, Jörg Wunderlich Lecturer, M.A. Pirjo Rantonen
CEF Level	Teaching level A2.
Aims	By the end of the course, students are expected to be able to recognise differences and similarities between his/her own and German culture, to know the basic information on Germany, to use their oral skills in cooperation with German partners, and to give presentations in German.
Content	Discussions on cultural differences, and on the following topics: geography, climate, culture, media, history, politics, green technology, economy and competitiveness. Students prepare a short presentation on a topic related to the country. Language of instruction: German.

Modes of Study	Contact lessons 28 of which 4 hours intensive at the end, (intensive weeks 50 and 16), independent work approx. 24 hours. Pair and group assignments, role play. Grade based on continuous assessment or an oral test. Continuous assessment requires 75% attendance and active participation. Moodle is used in this course in group A.
Evaluation	Pass/Fail.
Study materials	Materials provided by the teacher.
Prerequisites	German for Working Life or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV12A5202	***GERMAN INDEPENDENT STUDY***	***1 - 2 ECTS cr***
	Saksan itseopiskelukurssi **(contact teacher directly after closure of enrollment)**	
Year and Period	Period 1/2/3/4	
Teacher(s)	Lecturer, Jörg Wunderlich	
CEF Level	Teaching level: B1 - C2.	
Aims	Students can improve their German skills at their own pace and according to their own needs following a schedule agreed on with the teacher.	
Content	Independent work in German in the student's own field. Can be combined with the student's professional studies. Dependent on what is agreed between the student and teacher, e.g. goals, contents and schedule. Studypackages in the internet: - Environmental Engineering (http://u-002-segsv001.uni-tuebingen.de/entecnet/index.htm) - Mechanical Engineering (http://projects.ael.uni-tuebingen.de/deuma/deuma_overview.htm) - Forestry (http://www.uni-tuebingen.de/ael/ilegefos/ilegefos_overview.htm) - Business Writing in German Language of instruction: German.	
Modes of Study	Independent work approx. 26 or 52 hours. Assessment based on a learning journal and assignments.	
Evaluation	Pass/Fail.	
Prerequisites	Courses at the level A2 or equivalent skills.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

FV12A5600	***GERMAN AND ENGINEERING***	***1 - 2 ECTS cr***
	Deutsch und Technik **Group A: Structural Materials: This group is integrated with the course BK20A2100 Structural Materials. Group B: Enviromental Issues in German: Every second year, next 2014-2015. Group C: Deutsch und Maschinenbau. Every second year, next 2015-2016.**	
Year and Period	Period 4	
Teacher(s)	Lecturer, Jörg Wunderlich	
CEF Level	0-A2	
Aims	Group A: Structural materials: 1 ECTS cr: By the end of the course, students are expected to know how to search for study materials in German and use them in the assignments given in the course Structural Materials.	

	2 ECTS cr: By the end of the course, students are expected to know the basic terminology in the field, to know the grammatical structures needed in technical language and to be able to understand texts of the field to some extent. Group B: Environmental Issues in German By the end of the course, students are expected to know basic terminology in the field, be able to describe the environment orally and in writing, understand texts on nature's processes, know the necessary grammatical structures and be able to study in an international environment. Group C: Deutsch im Maschinenbau By the end of the course, students are expected to know basic terminology in the field, to be able to describe a technical process, to understand texts on mechanical engineering and to know grammar needed in technical language.
Content	Group A: Structural Materials: 1 ECTS cr: Learning the terminology on the topic of structural material and using it in the search of study material. Language of instruction: German/Finnish/English. 2 ECTS cr: Revision of grammar needed in technical language. Spoken and written exercises on structural materials. Language of instruction: German/Finnish/English. Group B: Environmental Issues in German Basic environmental issues, such as air, water, soil, waste. http://u-002-segsv001.uni-tuebingen.de/entecnet/index.htmmm Language of instruction: German. Group C: Deutsch im Maschinenbau Revision of grammatical structures for technical language. Written and spoken description of technical procedures and processes. Exercises in spoken language once a week during contact lessons. Language of instruction: German.
Modes of Study	Group A: Structural Materials 1 ECTS cr.: 10 hours lessons and independent work approx. 16 hours. 2 ECTS cr.: 18 hours lessons an independent work approx. 34 hours. Group B: Environmental Issues in German Contact lessons 14, independent work (online) approx. 38 hours. Spoken exercises during contact lessons once a week. Successfully completed written and spoken assignments or written and oral test. Continuous assessment requires 75% attendance and active participation.Possibility for independent study: a written examination and an oral test required for a passing grade. Group C: Deutsch im Maschinenbau Contact lessons 14, independent work (online) approx. 38 hours. Continuous assessment requires 75% attendance and active participation. Successfully completed written and spoken assignments or written and oral test. Self-study possibility: written examination and oral test. Briefing in the beginning of the course.
Evaluation	Groups A, B, C: Pass/Fail.
Study materials	Group A: Structural Materials: 1 ECTS cr.: Assignements given in the course BK20A2100 Structural Materials and some additional assignments in German. 2 ECTS cr.: Assignements given in the course BK20A2100 Structural Materials and additional assignments in German. Group B: Environmental Issues in German Online material and exercises: http://u-002-segsv001.uni-tuebingen.de/entecnet/index.htm Group C: Deutsch im Maschinenbau Online material and exercises: http://www.uni-tuebingen.de/ael/deuma/deuma_overview.htm
Prerequisites	Group A: Structural Materials 1 ECTS cr.: No knowlege in German necessary. 2 ECTS cr.: Courses at the level A2 or equivalent skills. Group B: Environmental Issues in German and Group C: Deutsch im Maschinenbau

	Courses at the level A2 or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV12A7113	***BUSINESS GERMAN*** ***4 ECTS cr***
	Wirtschaftsdeutsch **The course will be lectured every other year, next during the academic year 2016 - 2017.**
Year and Period	Period 3-4
Teacher(s)	Lecturer, M.A. Pirjo Rantonen
CEF Level	Teaching level B1.
Aims	By the end of the course, students will be expected to be able to tell about a company its activity and corporate finance.
Content	Fields: company forms, lines of business, business organization, sustainability, annual reports, describing development,. Grammar: passive voice, the use of verbs and nouns (stylistics), verbs with prepositions. Vocabulary, spoken, reading and writing exercises related to the field of the course. The course is suitable for students of all schools. Language of instruction: German.
Modes of Study	Individual, pair and group work. Contact lessons 28 of which 4 hours intensive at the end of period 3, in period 4 independent work (total amount approx. 76 hours). Continuous assessment and successfully completed written and oral assignments or a written and oral test. Continuous assessment requires 75% attendance and active participation. Students who have taken the course FV12A7600 Wirtschaftsprache Deutsch, FV12A7120 Wirtschaft 2: Unternehmen or FV12A5400 Selbststudiumkurs Wirtschaft are not eligible for this course because of the similar contents of the courses. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Provided by the teacher and on the web.
Prerequisites	Courses at the level A2 or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV14A1200	***RUSSIAN 1*** ***3 ECTS cr***
	Venäjä 1, Русский язык 1
Year and Period	B.Sc. (Econ. & Bus. Adm.) 1-3, M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-2/3-4
Teacher(s)	University Lecturer, B.Sc. Natalia Bagrova University Lecturer, M.A. Tarja Kovalev Lecturer, M.A. Pirjo Seppänen-Katajisto
CEF Level	Entry level: 0, target level: A1.
Aims	By the end of the course, students will be able to use basic structures, vocabulary and polite phrases needed in everyday communication.
Content	Grammatical structures: gender of nouns and adjectives, possessive pronouns, verb conjugation, cases (nominative, prepositional, accusative), numerals. Situations: getting to know people, family, introducing oneself, language skills, on the phone. Pronunciation. Learning the alphabet. Languages of instruction: Finnish, Russian and English.
Modes of Study	Exercises that support communication skills, some online and in Moodle.

	Contact hours 48 (24+24), independent work approx. 30 h. The course can be completed in three ways: 1) continuous evaluation (50% attendance and obligatory tasks); 2) written exam; 3) possibility for independent study: a written examination required for a passing grade. The information about self- studying should be added to the section marked “Further information" in the WebOodi enrollment. Information about the course is in Moodle (groups B, C, D) or Noppa (group A). Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Marjatta Alestalo: Кафе Питер 1 Venäjää taitotasolle A1, Kafe Piter 1. Moodle.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV14A1201	***RUSSIAN 1 FOR STUDENTS OF TECHNOLOGY***	***4 ECTS cr***
	Venäjä 1 tekniikan opiskelijoille, Русский язык для студентов технического профиля 1	
Year and Period	B.Sc. (Tech.) 1-3, M.Sc. (Tech.) 1-2 Period 1-2/3-4	
Teacher(s)	University Lecturer, B.Sc. Natalia Bagrova University Lecturer, B.Sc. Olesya Kullberg	
CEF Level	Entry level: 0, target level: A1	
Aims	By the end of the course, students will be able to use basic structures, vocabulary and polite phrases needed in everyday communication.	
Content	Grammatical structures: gender of nouns and adjectives, possessive pronouns, verb conjugation, cases (nominative, prepositional, accusative), numerals. Situations: getting to know people, family, introducing oneself, language skills, on the phone. Pronunciation. Learning the alphabet. Languages of instruction: Russian, Finnish, English.	
Modes of Study	Exercises that support communication skills, some online and in Moodle. Contact hours 48 (24+24), on-line Moodle tasks 8 (4+4), independent work approx. 40 h. The course can be completed in three ways: 1) continuous evaluation (50% attendance and obligatory tasks); 2) written exam; 3) possibility for independent study: a written examination required for a passing grade. The information about self- studying should be added to the section marked “Further information" in the WebOodi enrollment. Students who have passed the course FV14A1200 Russian 1 are not eligible for this course because of the similar contents of the courses. Information about the course is in Moodle. Moodle is used in this course.	
Evaluation	Pass/Fail.	
Study materials	Marjatta Alestalo: Кафе Питер 1 Venäjää taitotasolle A1, Kafe Piter 1. Moodle.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

FV14A1400	***RUSSIAN 2***	***3 ECTS cr***
	Venäjä 2, Русский язык 2	
Year and Period	Period 1-2/3-4	
Teacher(s)	Lecturer, M.A. Pirjo Seppänen-Katajisto University Lecturer, B.Sc. Natalia Bagrova University Lecturer, B.Sc. Olesya Kullberg	
CEF Level	Target level: A1.	

Aims	By the end of the course, students will have expanded the vocabulary they use in everyday situations, will know the basic Russian grammatical structures and will become familiar and be able to apply different features of Russian culture in various communication situations.
Content	Situations: travelling, society and culture, correspondence, hobbies, dining, shopping. Grammar: prepositions, past tense of the verbs and aspects, singular nous in cases (genitive, instrumental), pronouns, plural adjectives in nominative case. Languages of instruction: Russian, Finnish and English.
Modes of Study	Exercises that support communication skills, some online and in Moodle. Contact hours 48 (24+24). Independent work 30 h. The course can be completed in two ways: 1) 50% attendance and continuous evaluation based on written tasks or written exam. 2) possibility for independent study: a written examination required for a passing grade. Use for this information the section marked "Further information" in the WebOodi enrollment. Information about the course is in Moodle (groups A,B,D) or Noppa (group C). Moodle is used in this course (groups A,B,D) and Noppa (group C). Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Marja Jegorenkov, Sirpa Piispanen, Tuula Väisänen: Možno! 1 Venäjän alkeiskurssi Marjatta Alestalo: Кафе Питер 1 Venäjää taitotasolle A1, Kafe Piter 1. Moodle.
Prerequisites	Russian 1 or equivalent skills.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV14A1600	***RUSSIAN FOR WORKING LIFE*** ***3 ECTS cr***
	Työelämän venäjää, Бизнес по-русски
Year and Period	Period 1-2/3-4
Teacher(s)	University Lecturer, B.Sc. Olesya Kullberg University Lecturer, B.Sc. Natalia Bagrova
CEF Level	Entry level: A1, target level: A2.
Aims	By the end of the course, students will have expanded their knowledge of grammatical structures and vocabulary needed at work and improved their spoken business communication skills.
Content	Situations: knowledge of the Russian business culture (phone calls, presentation of a company, receiving and sending messages, business operations). Grammar: structures typical of business communication, expressing time, Russian names, aspects. Languages of instruction: Russian and Finnish.
Modes of Study	Exercises that support communication skills, some online and in Moodle. Contact hours 48 (24+24). Independent work 30 h. The course can be completed in two ways: 1) 50% attendance and continuous evaluation based on written and oral tasks or written and oral exam, or 2) possibility for independent study: a written examination and an oral test required for a passing grade. Use for this information the section marked "Further information" in the WebOodi enrollment. Information about the course is in Moodle. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Donner Virpi & Hyttinen Riitta: Перейдём к делу! Käydäänpä asiaan!
Prerequisites	Russian 1 and 2 or equivalent skills.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV14A1801	*CASES IN RUSSIAN* *3 ECTS cr*
	Venäjän sijamuodot, Русские падежи **Independent study course.**
Year and Period	Period 1-2
Teacher(s)	University Lecturer, B.Sc. Olesya Kullberg
CEF Level	Entry and target level: A2.
Aims	By the end of the course, students will recognise the Russian cases and be able to use them in a variety of phrases.
Content	Six grammar exercise packages. Improving and developing knowledge of grammar, especially cases in Russian texts (singular and plural nouns, adjectives and pronouns in the nominative, genitive, dative, accusative, instrumental and prepositional). The different meanings of Russian cases. Language of instruction: Russian.
Modes of Study	Independent work approx. 78 hours. Introductory lecture at the beginning of the 3rd period. The observation of schedules and deadlines is important. Continuous assessment based on online assignments or a written exam. Moodle is used in this course.
Evaluation	0 - 5.
Study materials	The study material will be provided in Moodle.
Prerequisites	Basic knowledge of cases in Russian.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV14A4200	*RUSSIA TODAY* *3 ECTS cr*
	Nykyvenäjän kieltä ja maantuntemusta, Россия сегодня
Year and Period	Period 1-2
Teacher(s)	University Lecturer, B.Sc. Natalia Bagrova
CEF Level	Entry level: A2, target level: B1.
Aims	By the end of the course, students will have learned about the Russian culture and current society and changes that are taking place in it and expanded their vocabulary.
Content	Oral communication exercises in pairs and groups. Homework includes reading texts on different topics which will be discussed in class. Language of instruction: Russian.
Modes of Study	Contact lessons 48, independent work approx. 30 h. Continuous assessment based on successfully completed written assignments during the course or a written exam. Continuous assessment requires 75% attendance and active participation. Moodle is used in this course.
Evaluation	0 - 5.
Study materials	Provided by the teacher and on Moodle.
Prerequisites	Russian for Working Life or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV14A4501	RUSSIAN FOR BUSINESS PEOPLE	1 - 3 ECTS cr
	Kaupallisen venäjän viestintää, Русский язык для делового общения **Independent study course**	
Year and Period	Period 3-4	
Teacher(s)	University Lecturer, B.Sc. Olesya Kullberg	
CEF Level	Entry level: A2, target level: B1.	
Aims	By the end of the course, students will have mastered the most typical situations in Russian business communication and will become familiar with vocabulary and structures of business correspondence.	
Content	Situations: introductions, choosing a project, phone calls, business correspondence, negotiations. Grammar: inflection of nouns, conjugation of verbs. Languages of instruction: Russian, English and Finnish.	
Modes of Study	Completed in the form of independent online studies during two periods. Independent work approx. 78 h. The observation of schedules and deadlines is important. Assignments online. Moodle is used in this course.	
Evaluation	Assignments graded on a scale of 0 - 5.	
Study materials	The study material will be provided in Moodle.	
Prerequisites	Russian for Working Life or equivalent skills.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

FV15A1210	BASIC COURSE IN FRENCH 1	2 ECTS cr
	Ranskan peruskurssi 1	
Year and Period	Period 1	
Teacher(s)	Lecturer, M.A. Vuokko Paakkonen	
CEF Level	Entry level: 0, target level: A1	
Aims	By the end of the course, students are expected to understand spoken professional language when it is slow, clear and related to topics discussed during the course, to use simple sentences to talk about themselves, to write a very simple text, to understand key words in a text related to topics discussed during the course and to use polite phrases and expressions typical of the French communication culture.	
Content	Communication: introducing and describing oneself, communicating on the phone and by e-mail (in a very simple way), basic differences between formal and informal communication, asking questions, expressing preferences. Structures: verbs in the present tense, articles, prepositions of place, prepositions à and de, personal pronouns, structures expressing ownership, negations, questions, numerals. Languages of instruction: French, Finnish and English.	
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Successfully completed written assignments. Oral test or grade based on continuous evaluation. Continuous evaluation requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments and an oral test required for a passing grade. Course instructions are in Moodle. Moodle is used in this course.	
Evaluation	Pass/Fail. Written assignments 50%, oral test or continuous evaluation 50%.	
Study materials	Béatrice TAUZIN, Anne-Lyse DUBOIS: Objectif Express (Nouvelle édition) units 1 - 3.	

Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV15A1220	*BASIC COURSE IN FRENCH 2* *2 ECTS cr*
	Ranskan peruskurssi 2
Year and Period	Period 2
Teacher(s)	Lecturer, M.A. Vuokko Paakkonen
CEF Level	Entry level: A1.1, target level: A1.2
Aims	By the end of the course, students are expected to understand spoken professional language when it is slow, clear and related to topics discussed during the course, to use simple sentences to talk about themselves and their work, to use and understand simple sentences on the phone, to write very simple texts, to understand key words in a text related to topics discussed during the course and to use polite phrases and expressions typical of the French communication culture.
Content	Communication: communication when travelling, describing residences, talking about working day, talking about plans, going to restaurant, talking about food, communication on the phone and by e-mail. Structures: articles, partitive, personal pronouns, verbs in the future tense, passé composé, construction and placement of adjectives, comparative forms, prepositions of location, prepositions à and de, demonstrative adjectives and pronouns, interrogative pronouns Languages of instruction: French, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Successfully completed written assignments. Oral test or grade based on continuous evaluation. Continuous evaluation requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments and an oral test required for a passing grade. Course instructions are in Moodle. Moodle is used in this course.
Evaluation	Pass/Fail. Successfully completed written assignments 50%, oral test or continuous evaluation 50%
Study materials	Béatrice TAUZIN, Anne-Lyse DUBOIS: Objectif Express 1 (Nouvelle édition), units 4 - 6.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV15A1410	*INTERMEDIATE COURSE IN FRENCH 1* *2 ECTS cr*
	Ranskan jatkokurssi 1
Year and Period	Period 3
Teacher(s)	Lecturer, M.A. Vuokko Paakkonen
CEF Level	Entry level: A1.2, target level: A2.1
Aims	By the end of the course, students are expected to cope in the work-related situations practised during the course, to be able to discuss topics introduced during the course using simple sentences, to write short texts on topics introduced during the course, to understand the main idea of texts on topics discussed during the course and to understand and apply the most important French customs.
Content	Communication: shopping, talking about work, the working place and conditions, presenting a company (very briefly), talking about products, communication related to job application: writing a CV, presenting (briefly) a production process.

	Structures: articles, prepositions, imperfect, passive forms, nominalization, personal pronouns, relative pronouns, Languages of instruction: French, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Successfully completed written assignments. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: succesfully completed written assignments and an oral test required for a passing grade. Course instructions in Moodle. Moodle is used in this course.
Evaluation	Pass/Fail. Successfully completed written assignments 50%, oral test or continuous assessment 50%
Study materials	Béatrice TAUZIN, Anne-Lyse DUBOIS: Objectif Express 1(Nouvelle édition) units 6 - 8.
Prerequisites	French 1 or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV15A1420	***INTERMEDIATE COURSE IN FRENCH 2 2 ECTS cr***
	Ranskan jatkokurssi 2
Year and Period	Period 4
Teacher(s)	Lecturer, M.A. Vuokko Paakkonen
CEF Level	Entry level: A2.1, target level: A2.2
Aims	By the end of the course, students are expected to cope in the work-related situations practiced during the course, to be able to discuss topics introduced during the course using simple phrases, to write a short and simple text related to topics discussed during the course, to understand the main idea of texts on topics discussed during the course and to understand and apply the most important French customs.
Content	Communication: talking about the working environment, giving and understanding instructions, prohibitions and suggestions, talking about failures and fixing them, going to the bank, going to a doctor, describing people, talking about the past and future. Structures: articles, imperfect and passé composé, future, conditional, gerund, objects of personal pronouns, relative pronouns, Languages of instruction: French, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Successfully completed written assignments 50 %. Oral test or grade based on continuous assessment 50 %. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: successfully completed written assignments and an oral test required for a passing grade. Course instructions are in Moodle. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Béatrice TAUZIN, Anne-Lyse DUBOIS: Objectif Express 1,(Nouvelle édition) units 9 - 10. The material will be announced later.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV15A5302	***FRENCH FOR ECONOMY AND BUSINESS***	***2 - 3 ECTS cr***
	Français de la vie économique et professionnelle	
Year and Period	Period 1-2	
Teacher(s)	Lecturer, M.A. Vuokko Paakkonen	
CEF Level	A2 – B2	
Aims	After completing the course the student is expected to be able to deal verbally and/or in writing with the working life and economy-related situations addressed on the course.	
Content	Communication: describing organizations, describing a process and products, giving instructions, giving a travelling report, talking about marketing, talking about past and future events; communicating by telephone and e-mail. Structures: articles, prepositions, pronouns, present, passé composé and imparfait, future tense and conditional, subjunctive, passive, direct and reported speech, connectors.	
Modes of Study	Exercises that support communication skills. Contact lessons 24 (as an intensive course), independent and tutored study in Moodle approx. 52 hours. Orientation session at the beginning of the course. Course instructions are in Moodle. Moodle is used in this course.	
Evaluation	Pass / Fail Successfully completed written and oral assignments. Intensive part of the course: 80 % attendance and active participation.	
Study materials	Provided by the teacher.	
Prerequisites	FV15A1420 Intermediate Course in French 2 or equivalent level of proficiency.	
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.	

FV15A6003	***INTERCULTURAL COURSE IN FRENCH***	***4 ECTS cr***
	Cours interculturel **This course is not available in 2015 - 2016.**	
Year and Period		
Teacher(s)	N.N.	
CEF Level	Teaching level: B1.	
Aims	By the end of the course, Finnish students are expected to be able to describe the Finnish people and culture to a French speaking person, paying attention to the characteristics of the French culture, and to apply the interactive skills practiced during the course when encountering a new culture. By the end of the course, French speaking students are expected to know the Finnish people and the Finnish culture in general terms and to pay attention to the characteristics of the Finnish culture when communicating with a Finn and to apply the interactive skills practiced during the course when encountering a new culture.	
Content	Subjects related to Finland that will be agreed upon with the students and discussed in small groups. Every task consists of the preparation phase, presenting the task and the following conversation.	
Modes of Study	Contact lessons 24. Independent study (incl. group work) approx. 80 hours. Approved exercises and continuous assessment, requires 75% attendance and active participation.	
Evaluation	Pass/Fail.	
Study materials	Provided by the teacher and the students.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

FV15A9301	FRENCH INDEPENDENT STUDY	1 - 4 ECTS cr
	Ranskan itseopiskelukurssi tekniikan ja kauppatieteiden opiskelijoille	
Year and Period	Period 1-2/3-4	
Teacher(s)	Lecturer, M.A. Vuokko Paakkonen	
CEF Level	A2 – C1	
Aims	By the end of the course, students must demonstrate having improved their independent study skills and attained the goals in their study plan for developing language and communication skills.	
Content	Students define the contents in their study plan in detail. Languages of instruction: French, Finnish or English.	
Modes of Study	Independent work following an individual study plan, approximately 26 - 104 hours. The course is completed in the form of tutored independent study; meetings with the teacher are discussed at the beginning of the course. The course can be integrated with business or technology studies or studies abroad. Course instructions are in Moodle. Moodle is used in this course.	
Evaluation	Pass/Fail based on assignments and a learning journal.	
Study materials	Chosen by the student.	
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.	

FV16A1210	BASIC COURSE IN SPANISH 1	2 ECTS cr
	Espanjan peruskurssi 1 **Intensive course weeks 9**	
Year and Period	per 1 /per 3/INT 9	
Teacher(s)	Lecturer, M.A., M.Sc. (Econ. & Bus. Adm.) Sari Pärssinen	
CEF Level	Entry level: 0	
Aims	By the end of the course, students are expected to be able to use simple structures and vocabulary in presentations both in studies and in the world of work and to introduce themselves both orally and in writing.	
Content	Introducing oneself, professions, presentations, hobbies. Structures: pronouns, nouns, adjectives and verbs in the present tense. Languages of instruction: Finnish and Spanish.	
Modes of Study	Exercises that support communication skills. Contact hours 24, independent study approx. 28 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: a written and an oral test examination required for a passing grade.	
Evaluation	Pass/Fail.	
Study materials	Mäkinen et al. ¿Qué tal? 1, units 1-6	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

FV16A1220	BASIC COURSE IN SPANISH 2	2 ECTS cr
	Espanjan peruskurssi 2	
Year and Period	Period 2/4	
Teacher(s)	Lecturer, M.A., M.Sc. (Econ. & Bus. Adm.) Sari Pärssinen	
CEF Level	Entry level: A1.1	
Aims	By the end of the course, students are expected to be able to use basic structures and vocabulary related to both studies and work, to describe a place of residence, to ask for directions, and to communicate in restaurants and shops.	
Content	Location, going to a restaurant, food, describing things.	

	Structures: pronouns, "to be" and irregular form of verbs in present tense. Languages of instruction: Finnish and Spanish.
Modes of Study	Exercises that support communication skills. Contact hours 24, independent study approx. 28 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: a written and an oral test examination required for a passing grade. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Mäkinen et al. ¿Qué tal? 1, units 6-8
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV16A1410	*INTERMEDIATE COURSE IN SPANISH 1 2 ECTS cr*
	Espanjan jatkokurssi 1
Year and Period	Period 1/3
Teacher(s)	Lecturer, M.A., M.Sc. (Econ. & Bus. Adm.) Sari Pärssinen
CEF Level	Entry level: A1.2
Aims	By the end of the course, students are expected to be able to use structures and vocabulary needed in communication situations both at work and in everyday life and to relate events from the recent past both orally and in writing.
Content	Spare time, everyday life, body parts, expressing opinions, making appointments, telling about the past, weather, describing places of residence. Structures: pronouns, gerund, reflexive verbs, adverbs, perfect tense. Languages of instruction: Finnish and Spanish.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Students who have passed the course FV16A1400 Spanish 2 are not eligible for this course because of the similar contents of the courses. Possibility for independent study: a written examination and an oral test required for a passing grade.
Evaluation	Pass/Fail.
Study materials	Mäkinen et al. ¿Qué tal? 1, units 9-13
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV16A1420	*INTERMEDIATE COURSE IN SPANISH 2 2 ECTS cr*
	Espanjan jatkokurssi 2
Year and Period	Period 2/4
Teacher(s)	Lecturer, M.A., M.Sc. (Econ. & Bus. Adm.) Sari Pärssinen
CEF Level	Entry level: A1.2+
Aims	By the end of the course, students are expected to be able to use the structures and vocabulary needed in communication situations both at work and in daily life and to describe the past both orally and in writing.
Content	Describing events and situations in the past, work history. Structures: pronouns, imperfect, preterite. Languages of instruction: Finnish and Spanish.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Students who have passed the course FV16A1400 Spanish 2 are eligible for this course because of the similar contents of the courses.

	Possibility for independent study: a written examination and an oral test required for a passing grade.
Evaluation	Pass/Fail.
Study materials	Mäkinen et al. ¿Qué tal? 1, units 14-17.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV16A1602	*SPANISH FOR WORKING LIFE* 3 ECTS cr
	Työelämän espanjaa
Year and Period	Period 1
Teacher(s)	Lecturer, M.A., M.Sc. (Econ. & Bus. Adm.) Sari Pärssinen
CEF Level	Entry level: A2.1
Aims	By the end of the course, students are expected to be able to use the structures and vocabulary needed in work-related communication situations, to express opinions, to present companies orally and written.
Content	Expressing opinions, presenting a company, organisational structure. Structures: subjunctive, imperative. Languages of instruction: Finnish and Spanish.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 54 hours. Written examination. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Possibility for independent study: a written examination and an oral test required for a passing grade.
Evaluation	Pass/Fail.
Study materials	Amate, Puranen. Colegas (units 1-5)
Prerequisites	FV16A1420 Intermediate Course in Spanish 2, FV16A1400 Spanish 2 or equivalent skills.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV16A3201	*BUSINESS SPANISH* 3 ECTS cr
	Español de negocios
Year and Period	Period 2
Teacher(s)	Lecturer, M.A., M.Sc. (Econ. & Bus. Adm.) Sari Pärssinen
CEF Level	Entry level: A2.2
Aims	By the end of the course, students are expected to be able to communicate in Spanish in basic business situations, to understand the business culture of the Spanish speaking countries.
Content	Business culture, business communication, meetings, banking, applying for a job in the Spanish-speaking world. Grammar contents: conditional, advanced subjunctive, future. Also suited for technology students. Language of instruction: Spanish.
Modes of Study	Exercises that support business communication. Contact lessons 24, independent work approximately 54 hours. The grade will be based either on the continuous evaluation of students or a written test.
Evaluation	Pass / Fail.
Study materials	Amate, Puranen, Colegas (units 6-10)
Prerequisites	Spanish for Working Life or equivalent skills.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV16A5202	*INTERCULTURAL SPANISH COURSE 4 ECTS cr*
	Curso intercultural entre Finlandia y España
Year and Period	Period 3
Teacher(s)	Lecturer, M.A., M.Sc. (Econ. & Bus. Adm.) Sari Pärssinen
CEF Level	Entry level: B1.
Aims	By the end of the course, students are expected to be able to describe Finns, Finland and the Finnish culture in Spanish, and to compare these issues to the corresponding Spanish ones.
Content	The cultural characteristics of Spain and Finland. Subjects include history, geography, culture and society. Students may suggest subjects of their own interest. The emphasis will be on cultural cooperation. Language of instruction: Spanish.
Modes of Study	The teacher will lead the discussion and comparison of the cultures together with Spanish exchange students. Students will give a presentation in pairs, in which they compare the Finnish and Spanish cultures. All students having knowledge of Spanish are welcome to the course. Contact lessons 24, independent study approx. 80 hours. Continuous assessment (requires 75% attendance and active participation).
Evaluation	Pass/Fail.
Study materials	Handouts in class.
Prerequisites	Español de negocios or equivalent skills.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

FV18A9101	*FINNISH 1 2 ECTS cr*
	Finnish 1
Year and Period	Period 1/3
Teacher(s)	Lecturer, M.A. Elina Häkkinen University Lecturer, M. A. Kristiina Karjalainen University Lecturer, M.A. Tarja Kovalev
CEF Level	A1.1
Aims	After the course students are expected to be able to tell about themselves in Finnish using very simple expressions, to use simple Finnish everyday phrases, to understand a very simple and slow Finnish conversation about topics dealt with during the course, to understand the main contents of a very simple text on concrete topics with the help of a dictionary, and to write very simple sentences on course topics with the help of a dictionary.
Content	Topics: greeting people, introducing oneself, asking simple questions, telling about one's plans and schedules, asking for the price, grocery shopping, family, telling time. Grammar: the Finnish phonetic and orthographic system, numbers, verb conjugation, negative sentences, questions, partitive, genitive, consonant gradation, i>e change. The languages of instruction: Finnish and English.
Modes of Study	Individual and group work that supports learning to communicate in Finnish. Contact lessons 24, homework approximately 28 hours. A written examination. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Course material booklet (in Moodle) and handouts given in class.
Prerequisites	No previous knowledge of the Finnish language is expected.

FV18A9201	*FINNISH 2* *2 ECTS cr*
	Finnish 2
Year and Period	Period 2/4
Teacher(s)	Lecturer, M.A. Elina Häkkinen University Lecturer, M. A. Kristiina Karjalainen
CEF Level	A1.1
Aims	By the end of the course, students are expected to be able to 1. take part in very simple and slow conversations on topics dealt with during the course, 2. cope orally in simple everyday situations which are dealt with during the course, 3. understand directions, 4. relate what happened in the past.
Content	Topics: location, travelling, shopping, clothes, weather, seasons, hobbies, telling what you like, asking for directions. Grammar: locative cases, postpositions, object cases, 3rd infinitive, singular imperative, past tense. Languages of instruction: Finnish and English.
Modes of Study	Simple written texts and tasks will be studied both in class and as homework. In the classroom, the newly learnt language material will be practiced by working in pairs and groups, and through other similar activities. Contact lessons 24, homework approximately 28 hours. A written examination.
Evaluation	Pass/Fail.
Study materials	Course material booklet (in Moodle) and handouts given in class.
Prerequisites	Finnish 1 or equivalent knowledge.

FV18A9301	*FINNISH 3* *2 ECTS cr*
	Finnish 3
Year and Period	Period 3-4
Teacher(s)	Lecturer, M.A. Elina Häkkinen
CEF Level	A1.2
Aims	By the end of the course, students are expected to be able to discuss simple issues that are dealt with during the course, talk about the past more elaborately, cope orally in a simple situation involving health care, and understand the main contents of a simple newspaper article on concrete topic with the help of a dictionary, understand and write short and simple e-mails.
Content	Topics: profession and work, living-related and household issues, opinions, emotions, health, phone conversations, simple e-mails. Grammar: present perfect tense, translative, essive, expressing necessity, more advanced sentence types, adjective comparison, some pronouns, conjunctions. Languages of instruction: Finnish and English.
Modes of Study	Texts and tasks with some new vocabulary and grammatical structures will be studied in class and as homework. Different kinds of spoken situations will be practiced. There will be lectures on grammar as well as different written grammar exercises. Contact lessons 28, homework approximately 24 hours. A written exam.
Evaluation	Pass/Fail.
Study materials	Course material booklet (in Noppa) and handouts given in class. Course instructions in Noppa.
Prerequisites	Finnish 1 and 2 or equivalent knowledge.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

FV19A1000	*CHINESE 1* 3 ECTS cr
	Chinese 1 **More details about New HSK levels at http://blogs.helsinki.fi/confucius-institute/study/hsk-testing/ and http://www.chinesecio.com/**
Year and Period	Period 1-2
Teacher(s)	Part-time Untenured Teacher, Matina Ma
CEF Level	A1
Aims	By the end of the course students should be able to pass the international standardized Chinese Proficiency Test (New HSK Level 1). Students should be able to understand and use simple Chinese phrases, meet basic needs for communication and possess the ability to further their Chinese language studies. They should be able to master 150 commonly used words and basic grammatical rules.
Content	From learning phonetics to applying Chinese language in real life, students will learn three basic levels of Chinese language: pronunciation, word and sentence. Students will work on speaking, listening, reading and writing. Language of instruction: Mandarin Chinese, Finnish and English.
Modes of Study	56 contact lessons 80 % attendance is required. Students who do not meet the attendance requirement and course exam but have passed New HSK Level 1 may receive a grade. Moodle is used in this course.
Evaluation	0 - 5. Exams (100%).
Study materials	1. Curriculum of HSK level 1
Prerequisites	The course is meant for beginners.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

FV19A2000	*CHINESE 2* 3 ECTS cr
	Chinese 2
Year and Period	Period 3-4
Teacher(s)	Part-time Untenured Teacher, Matina Ma
CEF Level	A2
Aims	The course is meant for those who want to achieve HSK level 2 and want to equip with Chinese language ability for the future career in Chinese-European company or in East Asia, included Hong Kong, Taiwan, Macao, Singapore and China. Through knowing an East Asian culture and language, students will be able to ponder how their future expertise can be useful to the society in a globalised economy.
Content	Students will learn Chinese typing and the most frequently used vocabularies. Students will be introduced Chinese culture included custom, history and economy. The topics are including 1. Chinese typing 2. Cover letter & curriculum vitae 3. HSK level 2's vocabularies & grammar 4. Pronunciation & intonation 5. Introduction to Chinese history and custom 6. Introduction to economy in China
Modes of Study	56 contact lessons in total. Moodle is used in this course.
Evaluation	Grade 0-5. Continuous assessment (60%) and exam (40%)
Study materials	Study materials are mainly selected from the news and the curriculum of HSK level 2.
Prerequisites	Students who have passed Chinese 1 or HSK level 1 are preferrable.

Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

FV19A3500	***BUSINESS CHINESE*** ***3 ECTS cr***
	Business Chinese
Year and Period	Period 1-2
Teacher(s)	Part-time Untenured Teacher, Matina Ma
CEF Level	B1-B2
Aims	The course is meant for those who want to learn Chinese writings on computer and work in China. At the end of the course, students should be able to make five Chinese texts ready for the purpose of employments and for the business activities between Finland and China.
Content	Students will learn Chinese phonetic system and sentence structures. Students will also read the texts and discuss the relevant topics. In the course, students should become familiar with the Chinese job application, China nowadays and commerce between Finland and China. The themes are including, 1. Chinese typing skills; 2. job application; 3. curriculum vitae; 4. overview of China; 5. introduction to Chinese companies in Finland; and 6. introduction to the commerce between Finland and China.
Modes of Study	56 contact lessons in total. Moodle is used in this course.
Evaluation	Writing assignments or exam. Grade 0-5.
Study materials	Study materials are selected from current announcements provided by the Ministry of Foreign Affairs of the People's Republic of China and the Ministry of Foreign Affairs of Finland.
Prerequisites	The course is meant for the students who have studied Chinese language before.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

FV19A5100	***INDUSTRIAL ECONOMY IN CHINA*** ***3 ECTS cr***
	Industrial economy in China **This course is not available in 2015 – 2016**
Year and Period	Period 3-4
Teacher(s)	Part-time Untenured Teacher, Matina Ma
CEF Level	B1
Aims	The course is meant for those who want to learn the trend of needs in China's market. In addition to those who want to work in Chinese-European company or in East Asia, included Hong Kong, Taiwan, Macao, Singapore and China in their future career. This course is also welcome for those who have ideas of establishing a business in China or who want to invent a product for China's market.
Content	Students will learn the components of the Chinese characters and the most frequently used terminologies. Students will also read the texts and discuss the relevant topics. In the course, students should become familiar with the Chinese culture and the recent development of industrial economy in China. The topics are including 1. solar energy; 2. wind power; 3. Mobile-Commerce; 4. 200 million electronic bicycles in China; 5. 35,000 robots are needed in China;
Modes of Study	56 contact lessons in total.

	Moodle is used in this course.
Evaluation	Grade 0-5. Continuous assessment (60%) and exam (40%).
Study materials	Study materials are selected from current announcements provided by the Ministry of Commerce of the People’s Republic of China.
Prerequisites	Students who have passed Chinese 2 or HSK level 2 or has studied in China are preferrable.
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

9. THE INTERNATIONAL BUSINESS AND TECHNOLOGY MANAGEMENT PROGRAMME IBTM

IBTM is a non-degree study programme where all the courses are taught in English and offered on several aspects of international business, finance, technology and innovation management as well emerging economies. Students can select the most desirable courses from a total selection of approximately 30 different courses per semester. About 30 ECTS credits represent the workload of a semester. The curriculum is managed by the School of Business, the Department of Industrial Engineering and Management and the International Services.

More information on the programme can be found at the following website:
www.lut.fi/exchange > Study possibilities

Inquiries should be addressed to the following E-mail address: incomingexchange@lut.fi

Autumn Semester 2015

Course number, Course		*ECTS cr*
A350A1000	Transformation of A Modern Industrial Society: The Finnish Model	2
A365A0250	Organizational Learning in Knowledge Management	6
A370A0401	Case-course of Business	6
A370A6000	Organizational Culture and Gender Aspects in Management	5
A380A6050	Introduction to International Business and Planning	3
CS10A7000	The Economies of the Baltic States	3
CS30A7200	Global Innovation Networks	3
CS30A7220	Managing in the Global Environment	3
Course descriptions available in the "Course Descriptions in Business Administration"		
A210A0050	Comparative International Accounting: Theory and Practice	6
A210A0601	Information Systems in Corporate Management and Decision-making	6
A220A0000	Financial Econometrics	6
A220A0101	Derivatives and Financial Risk Management	6
A220A0200	International Financial Management	6
A220A0550	Advanced Decision-making	6
A310A0101	Strategic Supply Management	6
A310A0201	External Resource Management	6
A310A0750	Logistics Outsourcing and Innovation	3
A330A0100	International Business Strategies	6
A330A0151	International Entrepreneurship Challenge	6
A330A0200	International Marketing of High Technology Products and Innovations	6
A330A0250	Internationalization of the Firm and Global Marketing	6
A330A0300	Strategic Global Marketing Management	6
A350A0050	Business Research Methods	6
A350A0200	Introduction to Economics	6
A350A0300	Technology and Innovation Management	6
A350A0500	Sustainable Strategy and Business Ethics	3
A365A0100	Organization Theory	6
A365A0300	Knowledge-based Networks	6
Course descriptions available in the "Course Descriptions in Industrial Engineering and Management"		
CS10A0260	Managing International Business	5
CS10A0270	Economic Challenges in Russia	3
CS10A0431	Industrial Project and Solution Marketing	5
CS30A1371	Creative Design and Problem Solving	5
CS30A1375	Product Development	5
CS30A1551	System Dynamics and Industrial Management	5

CS30A1601	Case Course in Strategy Consulting	3
CS30A7401	Software and Application Innovation	5
CS31A0603	Life-Cycle Costing of Investment Projects	5
CS34A0301	Theory of the Entrepreneurship	5
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	5

A350A1000	*TRANSFORMATION OF A MODERN INDUSTRIAL SOCIETY: THE FINNISH MODEL* 2 ECTS cr
	Transformation of A Modern Industrial Society: The Finnish Model
Year and Period	Period 1/3
Teacher(s)	Professor, Ph.D. Karl-Erik Michelsen
Aims	1. When students have completed the course, they are able to understand and analyze social change and the factors which affect social change. 2. They are familiar with theoretical frameworks which are used to study social change. 3. They understand the relationship between economy, technology, politics and culture. 4. They are able to write and present critical arguments and complete independent research assignments. 5. They are able to compare different social systems and understand why societies evolve differently.
Content	1. Core content: Transformation from industrial into post- or information society. How various factors shape the social change? 2. Additional content: The dynamics of the change: What are the factors and how the transformation takes place in a society? What are the consequences of change? 3. Special content: How the Finnish society has evolved from agricultural into industrial and now into postindustrial society?
Modes of Study	22 hours lectures in English. 20 hours preparation for lectures, 60 hours preparations for written assignments. Total 80 hrs. Moodle is used in this course.
Evaluation	Final grades 0-5: Lecture activity 20%, 80% written assignments (two blogs, one 5-10 page paper)
Study materials	Pekka Himanen – Manuel Castells; The Information Society and the Welfare State. The Finnish Model; Oxford University Press 2002.
Prerequisites	This course is open to all students.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

A365A0250	*ORGANIZATIONAL LEARNING IN KNOWLEDGE MANAGEMENT* 6 ECTS cr
	Organizational Learning in Knowledge Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1
Teacher(s)	Post doctoral researcher, D.Sc. (Econ. & Bus. Adm.) Anna-Maija Nisula
Aims	By the end of the course, students will be able to: - familiarize themselves with the state of the art literature on the studied subject; - identify basic concepts, functioning principles and enabling tools for organizational learning in knowledge management; - apply organizational learning literature and methods to future work and learning situations.
Content	The course consists of three parts of virtual participation and interaction: 1) active participation in individual literature study (e.g. intensive reading of the course materials presented on the web and required journal articles and book

	chapters), 2) a case analysis and written report in a group, and 3) case presentation and discussion in a course virtual discussion forum. The course is related to sustainability.
Modes of Study	Intensive lecture and study discussion (9 hours), Reading assigned articles and writing summaries (42 hours), Commenting on others work (6 hours), Group case analysis (72 hours), Discussion and contribution through Moodle (31 hours), Total workload for student 160 hours. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, individual literature study 30%, group work on the case analysis 70%
Study materials	1. Course materials presented on Moodle. 2. Assigned reading to be announced on the course web page.

A370A0401	***CASE-COURSE OF BUSINESS*** ***6 ECTS cr***
	Case-course of Business
Year and Period	B.Sc. (Econ. & Bus. Adm.) 3 Period 1-2/3-4
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Noora Rantanen Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Noora Rantanen
Aims	After completing the course, the student is familiar with basics of case-writing. S/he is able to describe business practices and explain their development using the frameworks s/he has previously learned. The student is able to construct a well-written description of a case-company and its development as well as development targets using different empirical materials.
Content	Strategy analysis. Case study methodology. Case-writing.
Modes of Study	Lectures 3 h, selection of case-company and collection of data 40 h, reading of the literature needed in the description 40 h, case-writing in English (international groups) or Finnish 77 h. Total workload for student 160 h.
Evaluation	Grade 0-5, evaluation 0–100 p. Literary group assignment 100%.
Study materials	Lecture slides.
Prerequisites	B. Sc. (Econ. & Bus. Adm.) 2 studies

A370A6000	***ORGANIZATIONAL CULTURE AND GENDER ASPECTS IN MANAGEMENT*** ***5 ECTS cr***
	Organizational Culture and Gender Aspects in Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 2 int.
Teacher(s)	Professor, Ph.D. Albert J. Mills, Saint Mary's University, Halifax Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Pia Heilmann
Aims	By the end of the course students will have 1. a working knowledge of the concept of organizational culture and its implications for workplace equity; 2. an in-depth understanding of gender and its influence on behaviour at work; 3. a working knowledge of the role of management in the shaping of organizational culture and its relationship to organizational culture; 4. an understanding of selected methods for understanding gender and organizational culture, and 5. the ability to apply understandings for organizational culture and gender to selected case studies.
Content	Managers and other experts working in organizations need appropriate skills to work with the multiple questions related to gender equality. The course will provide students with an understanding of the interrelationships between organizational culture, management, and gendered practices at the workplace. The course focus is on how managers can identify, assess and address the organizational processes that lead to discriminatory outcomes for women and men at work. The course stresses that the cultures of organizations should be

	constructed to accommodate the needs of all members of the organization regardless of sex. To that end we will cover the following content: 1. Understanding organizational culture. Its definition, discussion and methods of analysis. 2. Gender and organizational culture. An overview of an organizational culture approach to understanding the development of discriminatory practices of men and women in the corporation. 3. Examination of selected issues to be drawn from corporate image-making, communication, structure, organizational rules, discourse analysis, group dynamics and interpersonal relations, studied in relation to the questions about gendered practices in the organization. 4. Equality practices in selected case studies. 5. Managing gender at work - issues and debates.
Modes of Study	Intensive course during 2. period. 24 hours of lectures, case exercises and group work, with a total workload of 130 hours (including the class time of 24 hours). Moodle is used in this course.
Evaluation	Graded 0-5; The final grade will consist of continuous assessment (60%) and a final case study/presentation (40%). Evaluation 0 – 100 points.
Study materials	Articles, book chapters and cases to be specified by the lecturers and read before the course.
Prerequisites	Basic courses in Human Resource Management advisable.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

A380A6050	***INTRODUCTION TO INTERNATIONAL BUSINESS AND PLANNING***	***3 ECTS cr***
	Introduction to International Business and Planning	
Year and Period	B.Sc. (Econ. & Bus. Adm.) 3 Period 1 int.	
Teacher(s)	D.Sc. (Econ.) Toivo S. Äijö, Top Trainers Group Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio	
Aims	To familiarize the students with the fundamentals of international business in general and strategic planning for international business in particular. To provide the students with the analytical skills required for critical evaluation of actual international business strategies.	
Content	- The changes in the international Business environment and their effect of strategic planning. - Theories of international trade and business. - The institutions of international trade and business. - The essence of competitive strategy. - Levels of strategic planning. - International expansion strategy. - Supporting research. - International marketing strategy: entry modes, targeting, product, service, pricing, promotion, sales and CRM. - International functional strategies. - Case studies.	
Modes of Study	Intensive course during 1. period. 25 hours of lectures, interactive analyses, case exercises and assignments, carried out by the student, 55 hours, total course 80 h. Written examination.	
Evaluation	Graded 0-5 on the basis of case studies 20 % and written examination 80 %, evaluation 0 – 100 points. 50 % class attendance and participation required.	
Study materials	The study material will be distributed at the beginning of the lectures.	
Prerequisites	Basic course in marketing	
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.	

CS10A7000	***THE ECONOMIES OF THE BALTIC STATES 3 ECTS cr***
	The Economies of the Baltic States
Year and Period	M.Sc. (Tech.) 1 Period 2 int.
Teacher(s)	Professor, D.Sc. (Econ.) Alari Purju Tallinn University of Technology and Estonian Business School
Aims	The students taking this course must know basic information about the development pattern of the Baltic States. They have to be ready to interpret the macroeconomic data on the Baltic States (economic growth, inflation, employment, interest rate, dynamics of wages and productivity) in the context of macroeconomic theory. They must have the basic knowledge on foreign trade and foreign investments in the region and must be prepared to analyse respective trends in the framework of international business and international economics theories. Also they must be prepared to analyse adjustment of the listed on stock exchange companies with the changes in the macroeconomic framework. They must be familiar with the case study method.
Content	- Economic development and structural changes in Estonia, Latvia and Lithuania. - Transition to market economy. - Comparison of developments with other East European countries. - Business framework (tax system, labour market regulations). - International indicators to characterize competitiveness of business environment (The World bank´s “How to do business in 2011”) - Structure of foreign trade and factors which determine it (concept of absolute and comparative advantage, intra-industry trade, value chain and localization theories, clusters). - Trade with the EU and the CIS. Export impediments of enterprises. - Introduction to economic problems of enterprises. Case studies. - Role of foreign direct investments (FDI). The cycle theory of FDI. The Dunning´s eclectic theory of FDI. - Real and monetary integration with the EU. - Theories of economic convergence. - What are the main factors determining future development of the Baltic states?
Modes of Study	Intensive course during 2. period. The study course contains 16 hours of lectures and 4 hours of seminars. Students have to work independently to prepare for classes and exam during the week of intensive studies with working load of additional 20 hours. They have to prepare a case study and present this after two weeks of end of lecturing period which needs additionally 28 hours of independent work per student. The case study is a group work. The total working load of the course is 78 hours.
Evaluation	Graded 0-5 on the basis of active class participation and a case study (60 % of grade) and a written exam (40 %).
Study materials	1. Åslund, Anders and Valdis Dombrovskis, 2011, How Latvia Came through the Financial Crises. Peterson Institute for International Economics, Washongton, DC. 2. Erixon, Fredrik, 2010, “Baltic Economic Reforms: A Crises Review of Baltic Economic Policy”, ECIPE Working Papers, No.04, 60 p. 3. Lumiste, Rünno, Robert Pefferly and Alari Purju, 2008, “Estonia’s Economic Development: Trends, Practices, and Sources”; The Commission on Growth and Development, The World Bank, Working Paper No.25, 46 p. 4. Purju, Alari, 2004,"The institutional framework and trade pattern of the Baltic states after EU membership in trade with the CIS ", Turku School of Economics and Business Administration, Series C Discussion, ISSN 1456-4793, 20 p. 5. How to do Business in 2012, 2011, The World Bank, Washington. 6. Case studies of enterprises, material http://www.hex.com/tallinn/riga/vilnius
Prerequisites	Basic courses in international economics and marketing
Further Information	This course has 1-15 places for open university students. More information on the web site for open university instruction.

CS30A7200	*GLOBAL INNOVATION NETWORKS 3 ECTS cr*
	Global Innovation Networks
Year and Period	B.Sc. (Tech.) 3 Period 1 int.
Teacher(s)	Karol Pelc, Ph.D., Professor Michigan Technological University
Aims	At the end of the course a student is expected to know: 1. How to define innovation and distinguish it from invention or discovery, and how to classify innovations 2. How to explain the open innovation approach to collaborative product development 3. How to distinguish major types of global innovation networks 4. How to calculate the transnationality index for a company 5. How to define the modules of a global project management system 6. How to evaluate an international high-tech project network organization 7. How to analyze the scope and contents of a non-disclosure agreement between partners in an innovation project 8. How to distinguish the options for intellectual property allocation in a collaborative R&D agreement
Content	The course provides practical knowledge of innovation networking. It is based on international experience of the instructor combining engineering and managerial expertise in products/systems development and in execution of collaborative innovation projects. Conceptual models and empirical data on innovation networks in the context of global scale projects and organizations are presented. Students have opportunity to interact, discuss, explore future opportunities and analyze collaborative innovation projects. The course includes the following topics: 1. Schumpeterian perspective on innovation networks and basic concepts related to technological innovation 2. Global networks for knowledge generation, and collaborative practices in global product development, production, marketing and distribution 3. Open innovation systems and networks 4. Introduction to Big Data problems and prospects 5. Strategic roadmapping and knowledge management in a global organization 6. Issues of intellectual property in the global networking environment. Discussion will include issues related to impact of global economic down- and up-turns on innovation strategies.
Modes of Study	Intensive course during 1. period. 20 hours of lectures and class discussions and case study workshop, 8 hours assigned written report preparation 50 hours independent out-of class work Moodle is used in this course.
Evaluation	Graded 0-5 on the basis of case study assignment, active participation, and a written examination. 50 % class attendance and participation required. The grade will be based on the following components: - Case study review 10% - Class discussion 10% - Final exam 80%
Study materials	The students will have access to lecture materials prior to each class and will receive case descriptions for study. LITERATURE: 1. Boutellier, R., Gassman, O., Von Zedtwitz, M., Managing Global Innovation, Third Edition, Springer, Berlin and Heidelberg 2008. 2. Chesbrough, H., Vanhaverbeke, W., West, J. (eds.), Open Innovation: Researching New Paradigm, Oxford University Press, Oxford and New York 2008 (paperback edition).

	3. Nambisan, S., Sawhney, M., The Global Brain: Your Roadmap for Innovating Faster and Smarter in a Networked World, Wharton School Publishing, Upper Saddle River, New Jersey, 2008.
Prerequisites	Basic knowledge of management and economics.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CS30A7220	***MANAGING IN THE GLOBAL ENVIRONMENT 3 ECTS cr***
	Managing in the Global Environment
Year and Period	B.Sc. (Tech.) 3 Period 1 int.
Teacher(s)	Karol Pelc, Ph.D., Professor Michigan Technological University
Aims	At the end of the course a student is expected to know: 1. How to identify opportunities and conditions for globalization of business. 2. How to assess different entry mode alternatives to the internationalization/globalization process. 3. How to distinguish conceptual perspectives on multinational, international, global and transnational organization. 4. How to measure the extent of transnationality in a global transnational organization. 5. How to define relations between a global business organization and host governments. 6. How to analyze organizational structure and strategic capabilities of a global transnational organization. 7. How to develop capabilities and define the role and responsibilities of a manager in global business. 8. How to create and design a joint venture at a global scale. 9. How to formulate functional requirements for management information system in a global project. 10. How to formulate basic agreements for intellectual property sharing in collaborative projects. 11. How to analyze intellectual capital and knowledge diffusion processes in a global transnational organization.
Content	The course is focused on practical problems in global management. It provides insights and recommendations based on the instructor's unique working experience in industries, consulting services and academic institutions of several countries of Asia, Europe and the United States. Emphasis is placed on interactive learning, exploring future opportunities, and discussion of illustrative situations related to potential tensions or conflicts emerging in transnational and cross-cultural environments. The context of the evolution of globalization process, conceptual models and empirical materials on global transnational organizations are also presented. The following topics are included: 1. Impact of international economic, social, technological and cultural forces on process of business globalization 2. Conditions and incentives (or barriers) for global business expansion and collaborative arrangements 3. Issues of cross-cultural management in a global transnational organization 4. Social media and networks for global business 5. International joint ventures, strategic alliances and collaborative innovation projects 6. Selected issues of intellectual capital and knowledge management in global transnational organizations Discussions will include issues related to the current international market and financial system fluctuations and their impact on global transnational organizations.
Modes of Study	Intensive course during 1. period. 20 hours of lectures and class discussions and case study workshop, 8 hours assigned written report preparation

	50 hours independent out-of class work Moodle is used in this course.
Evaluation	Graded 0-5 on the basis of case study assignment, active participation, and a written examination. 50 % class attendance and participation required. The grade will be based on the following components: Case study review 10%, Class discussion 10%, Final exam 80%.
Study materials	The students will have access to lecture materials prior to each class and will receive case study descriptions for study. LITERATURE: 1. Bartlett, C. A., Beamish, P. W. Transnational Management: Text, Cases, and Readings in Cross-Border Management, 6th Edition, McGraw-Hill Irwin, New York 2011, ISBN 978-0-07-813711-2. 2. Cleland, D. I., Gareis, R. (eds), Global Project Management Handbook, McGraw-Hill, New York 2006. 3. Conklin, D. W., The Global Environment of Business: New Paradigms for International Management, Sage Publ., Thousand Oakes 2011. 4. Tapscott, D., Williams, A. D., Wikinomics: Rebooting Business and the World, Penguin Group, London, New York 2010.
Prerequisites	Basic knowledge of management and economics
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

Spring Semester 2016

		ECTS cr
A330A6010	Buyer-Seller Relationship Management	4
A370A0401	Case-course of Business	6
A380A0000	Cross-Cultural Issues in International Business	6
A380A0200	Promotion and Sales Management	6
A380A6000	Cross-Cultural Encounters	3
A380A6010	Entering Emerging Markets	3
CS30A7210	Innovation Management and New Product Development	3
Course descriptions available in the "Course Descriptions in Business Administration"		
A210A0200	Empirical Strategy Research	6
A210A0350	Real Options and Managerial Decision-making	6
A220A0052	Investment and Business Analysis with Excel	3
A220A0400	Empirical Research in Finance	6
A220A0500	Contemporary Issues in Strategic Finance	3
A220A0600	Banking and Insurance Finance	6
A220A0650	Financial Theory and Valuation	6
A310A0301	Supply Chain Improvement	6
A310A0401	Public Procurement	6
A310A0500	Global Sourcing and Sub-Contracting	6
A310A0601	Reading Course of Supplier Relationship Management	3
A310A0650	Cost and Risk Management in Supply Chain	6
A330A0010	Contemporary Issues in International Marketing	3
A330A0400	International Marketing Research	6
A330A0500	Brand Management	3
A350A0050	Business Research Methods	6
A350A0200	Introduction to Economics	6
A350A0250	Multivariate and Econometric Analysis Methods	6
A350A0601	Contemporary Issues in Strategic Management and Innovation	6
Course descriptions available in the "Course Descriptions in Industrial Engineering and Management"		
CS10A0351	Qualitative Research in Industrial Management	5
CS10A0551	International Business Methods	6
CS10A0651	Management of Innovations in Russia	5
CS10A0760	Business in Russia	6
CS30A1390	Systems Engineering	5
CS30A1640	Inventive Product Design and Advanced TRIZ	5
CS30A1661	Open Innovation	6
CS30A1682	Advanced Course in Strategic Management	5
CS30A1690	Social Sustainability	5

A330A6010	BUYER-SELLER RELATIONSHIP MANAGEMENT 4 ECTS cr
	Buyer-Seller Relationship Management **Only LSB exchange students are accepted to this course.**
Year and Period	B.Sc. (Econ. & Bus. Adm.) 2 Period 4
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi
Aims	The aim of the course is to familiarize the students with the theory of relationship marketing, customer relationship management, related concepts and models. After completing the course the students: - are able to define the main concepts and know the principles of relationship marketing theory - are able to define and explain the building blocks of long-term customer relationships - are familiar with customer relationship management as an organization-wide strategic approach to managing customer relationships both in B2C and B2B markets - are able to describe different options to attract and retain customers both in B2B and B2C environments - know how to evaluate the performance of customer relationships, are able to analyze the customer base, and recognize various strategies for managing customer relationships
Content	Core content: Relationship marketing as a novel marketing paradigm, the development and categorization of customer relationships, specific features and building blocks of long-term customer relationships, customer value creation and measurement of customer life-time value, the strategic framework for customer relationship management. Additional content: The characteristics of a customer-relationship oriented firm, specific features of large customer management, challenges of CRM system implementation Special content: Technical characteristics of front- and back-office CRM applications, call-centre management, loyalty schemes
Modes of Study	18 hours of lectures, 4th period. Preparation for lectures 12 h, 4th period. Term paper preparation 20 h, 4th period. Written exam and preparation for exam 58 h. Total workload for student 108 h.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 70 %, term paper 30 %, all assignments must be passed to obtain final grade.
Study materials	1. Payne, Adrian (2006): Handbook of CRM: Achieving Excellence through Customer Management, Butterworth-Heinemann 2. Godson, Mark (2009), Relationship Marketing, Oxford University Press 3. Assigned readings 4. Lecture slides
Prerequisites	Basic course in the field of marketing or international marketing.

A370A0401	CASE-COURSE OF BUSINESS 6 ECTS cr
	Case-course of Business
Year and Period	B.Sc. (Econ. & Bus. Adm.) 3 Period 1-2/3-4
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Noora Rantanen Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Noora Rantanen
Aims	After completing the course, the student is familiar with basics of case-writing. S/he is able to describe business practices and explain their development us-

	ing the frameworks s/he has previously learned. The student is able to construct a well-written description of a case-company and its development as well as development targets using different empirical materials.
Content	Strategy analysis. Case study methodology. Case-writing.
Modes of Study	Lectures 3 h, selection of case-company and collection of data 40 h, reading of the literature needed in the description 40 h, case-writing in English (international groups) or Finnish 77 h. Total workload for student 160 h.
Evaluation	Grade 0-5, evaluation 0–100 p. Literary group assignment 100%.
Study materials	Lecture slides.
Prerequisites	B. Sc. (Econ. & Bus. Adm.) 2 studies

A380A0000	***CROSS-CULTURAL ISSUES IN INTERNATIONAL BUSINESS 6 ECTS cr***
	Cross-Cultural Issues in International Business
Year and Period	B.Sc. (Econ. & Bus. Adm.) 2 per 3-INT 9
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi
Aims	The goal of the course is to give an understanding of how the cultural environment affects management in international business, and advance students' global mindset by giving conceptual tools to increase their intercultural competence. After completing the course the students can: - define and categorize culture - explain the concept of time orientation - explain the concept of value orientations - remember Hofstede's and GLOBE cultural dimensions - evaluate the effects of the cultural environment on international marketing strategies - analyze the sources of cultural conflicts in international organizations - identify the barriers in intercultural communication - understand the role of cultural factors in managing and leading international teams General aim of the course is to improve following personal skills of the students: - managerial communication skills - multi-cultural communication skills - group work skills
Content	Definitions of culture, the Hofstede and GLOBE cultural dimensions, the effect of culture on leadership and management in international business The limits of globalization from the cultural perspective, cross-cultural issues in virtual teams, standardization and adaptation in international marketing Country cases of cultural differences (term paper reports)
Modes of Study	14 hours of lectures, case study workshop (2 hours) and term paper presentation seminar (4 hours). Preparation for lectures 12 h, 3rd period. Writing of term paper, preparation for case study and term paper presentations, 63 h, 3rd period. Written exam and preparation for exam 65 h, 3rd period. Total workload for student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 60 %, term paper 30 %, case assignment 10 %, all assignments must be passed to obtain final grade.
Study materials	1. Broweys & Price: Understanding Cross-Cultural Management, Prentice Hall 2008. 2. Assigned readings 3. Lecture slides 4. Additional material distributed in class

Prerequisites	Basic course in management or marketing
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

A380A0200	***PROMOTION AND SALES MANAGEMENT 6 ECTS cr***
	Promotion and Sales Management
Year and Period	B.Sc. (Econ. & Bus. Adm.) 3 Period 4
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Anssi Tarkiainen, Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Tommi Rissanen Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Anssi Tarkiainen, Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Tommi Rissanen
Aims	After completing the course the student will understand how marketing communication (MC) and sales management (SM) are planned and implemented in an organization. This course will pay special emphasis on understanding the linkages between marketing communication and sales, and the challenges in their integrated management. The learning outcomes of the course are the following: - to understand the role of MC and SM in marketing strategy - to assess the usability of different forms of communication with regard to buyer behavior - to be able to design, implement and manage marketing communication as part of the marketing process - to be able to design, implement and manage sales as part of the marketing process - to assess the challenges of integrating MC and sales management strategies - to evaluate the effectiveness of MC and sales - to recognize the ethical issues of promotion and sales management
Content	The role of marketing communication (MC) and sales management in marketing strategy. The role of buyer behavior and its effects on the nature of communication (mass vs interactive/personal). MC strategy process, message and media strategy. Media planning and characteristics of different media. Sales process and selling typologies. Responsibilities and tasks of sales management. Online marketing and selling. Strategic planning process of MC and sales; challenges of integrating MC and sales management strategies. Evaluation and ethics of promotion and sales management. The advertiser-agency relationship. The services in marketing communications campaign planning.
Modes of Study	Lectures 21 h 4. period. Exercises 15 h 4. period. Preparation for exercises 58 h (including written work) and preparation for the exam 66 h. Written exam. Total workload for student 160 h.
Evaluation	Final grade 0-5, evaluation 0-100 points. Exercises 40 points, written exam 60 points.
Study materials	Johnston, Mark W. and Greg Marshall, 2006. Churchill/Ford/Walker's Sales Force Management. McGraw-Hill/Irwin, New York. Percy, Larry (2008). Strategic Integrated Marketing Communications. Butterworth-Heinemann. (also available as eBook) Selected articles.
Prerequisites	A130A0250 Kansainvälisen markkinoinnin perusteet
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

A380A6000	CROSS-CULTURAL ENCOUNTERS 3 ECTS cr
	Cross-Cultural Encounters
Year and Period	B.Sc. (Econ. & Bus. Adm.) 2 Period 3
Teacher(s)	M.A. Tanja Karppinen, Coordinator; M.A. Aino Harinen, Planning Officer (and visiting lecturer) Person in Charge: M.A. Tanja Karppinen, Coordinator
Aims	By the end of the course, students will know why it is important to understand and appreciate cultural differences both in business and private life. Students will be able to explain the basic concepts of intercultural communication by the main course themes: cultures and communication, verbal and nonverbal communication, national stereotypes, intercultural sensitivity, cross-cultural interaction, culture shock, adaptation, expatriate assignments. Students will be able to describe themselves as an intercultural communicator, recognize symptoms of culture shock in their own life and know how to make intercultural adaptation process easier.
Content	The purpose of the course is to develop students' abilities to understand and appreciate cultural differences both in business and private life. - cultures and communication - verbal and nonverbal communication - national stereotypes - intercultural sensitivity - cross-cultural interaction - culture shock - adaptation - intercultural effectiveness - expatriate assignments
Modes of Study	24 hours of lectures and case exercises in English and 56 hours of out-class work. Total course 80 h. Moodle is used in this course.
Evaluation	Graded 0-5 on the basis of activity, assignments given during the lectures and a portfolio composed of them. Case exercises 80 %, active participation and attendance 20 %. Evaluation 0 – 100 points.
Study materials	Reading material for the course provided by the lecturer.
Prerequisites	Active participation and 80 % attendance.
Further Information	This course has 1-10 places for open university students. More information on the web site for open university instruction.

A380A6010	ENTERING EMERGING MARKETS 3 ECTS cr
	Entering Emerging Markets **Number of students is limited (max 80). Priority is given to the IBTM exchange students.**
Year and Period	B.Sc. (Econ. & Bus. Adm.) 2-3 Period 3 int.
Teacher(s)	Associate Professor, Ph.D. Francisco José Molina Castillo, University of Murcia Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Olli Kuivalainen
Aims	In particular, the aims of the course unit are: 1. To encourage students to develop strategic thinking in international market entry and marketing, especially in the context of emerging markets. 2. To examine multidimensional tasks of managerial decision-making within a multitude of different environments. 3. To develop skills of successfully assessing international market opportunities and formulating an international marketing mix. 4. To enable students to understand and critically analyse the international marketing strategies of multinational companies.

	On successful completion of the course unit, students are expected to be able to: 1. Use their insight into the complex, dynamic and increasingly global nature of the marketing environment for international marketing research and management assignments. 2. Contribute to the debate relating to marketing strategy, standardisation and adaptation, country entry decisions in global markets, especially within an emerging markets setting. 3. Demonstrate a set of analytical skills, computer skills and presentation skills for debating central issues in global marketing. 4. Empower themselves and others to work constructively in a group context.
Content	The course unit focuses on strategic aspects of global marketing issues, most importantly entry into emerging markets. Extending beyond issues of domestic activities, it aims to develop strategic thinking in an international marketing context. Managerial issues will be explored using an interactive computer simulation and tools and key methods will be discussed for solving international marketing problems. The scenario for this course is structured around the market entry theme, building on a computer simulation called “Country Manager”. The course is organised such that lecture topics provide the prelude to the practical computer simulation, as well as giving students an appreciation of the broader context of international marketing. In the simulation, the scenario for the students is based on the following: Faced with a mature domestic market, your (consumer healthcare) home office has decided to expand abroad and enter the regional market in Latin America. You are tasked with preparing the regional expansion, select lucrative markets and deploy the product launch in the respective country markets in Latin America.
Modes of Study	22 hours of lectures and in-class assignments (4 hours per day over 5 days, plus a 2-hour online introduction to prepare for computer simulation practice). 58 hours of preparation for lectures and group assignments. Total course 80 h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points: - Group country attractiveness assessment exercise (Country Manager), 10%, - Group forecasting exercise (Country Manager), 10% - Group presentation (Country Manager), 30% - Group final report (Country Manager), 30%, - Individual reflective report, 20% All assignments must be passed to acquire the final grade.
Study materials	Required: Feick, Lawrence, Martin Roth, Michael Deighan, and Stuart James (2003) Country Manager: The International Marketing Simulation. Charlottesville, Virginia: Interpretive Software Inc. (ISBN: 1885837283). http://www.interpretive.com/ Optional supplementary reading: - The following textbook is suggested as supplementary international marketing reference-book: Ghauri, Pervez N. and Philip R. Cateora (2014), International Marketing (4th ed.). London: McGraw-Hill Publishing Company (ISBN: 9780077148157). - However, any other international marketing book may be used as reference book, e.g. Mühlbacher, Leihs and Dahringer (2006), or Doole and Lowe (2008) Further supplementary reading, especially journal articles will be informed later.
Prerequisites	Previous studies in business studies, especially basic course in marketing is recommended.

CS30A7210	INNOVATION MANAGEMENT AND NEW PRODUCT DEVELOPMENT 3 ECTS cr
	Innovaatiojohtaminen ja uusien tuotteiden kehittäminen
Year and Period	B.Sc. (Tech.) 3 Period 3
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Tuomo Kässi
Aims	The student 1. recognizes the most important terms and concepts in innovation management 2. recognizes the most important terms and concepts in managing technology and knowledge 3. recognizes the most important terms and concepts in new product development. In section 1 the student learns to know, what does managing innovative firm and innovative operations mean. In section 2 concepts networks, alliances and management of R&D project and R&D unit are introduced to the student. In section 3 examples and cases in practical new product development are discussed. After having passed the course the student can identify the main concepts and definitions of innovation and technology management; explain the different viewpoints of enterprise operations through the frameworks of new product/service development as well as explain the phases. He/she can identify the significance of networks in innovation and technology management, and apply the principles of innovation and technology management on selected problem area. He/she can understand a build-up of company networks and develop solutions for the issues relating to them.
Content	The content of the course is close to the course Innovation and Technology Management: a Basic Course CS30A0951. The course has different scope and credit valuation and they do not replace each other. The course reviews basic ideas and concepts of strategic and operational innovation technology management including: 1. Management of innovation 2. Managing technology and knowledge 3. New product development
Modes of Study	21 hours of lectures in English in 3. period. Lectures 21 hours, preparation for the exam 57 hours, altogether 78 hours. Written exam to pass the course. Moodle is used in this course.
Evaluation	Graded 0-5 on the basis of a written examination 100 %.
Study materials	1. Paul Trott: Innovation and new product development. Prentice Hall, England, 2008 4th edition or newer edition. 2. Other materials assigned or given at lectures.
Prerequisites	Basic knowledge of industrial and business management.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

10. LUT SUMMER SCHOOL AND LUT WINTER SCHOOL

LUT Summer School is a short-term academic event offering intensive Master's-level courses for final-year Bachelor's and Master's students. LUT students and international students from all around the world can attend the programme. Lecturers of the LUT Summer School include academic staff from LUT and international guest lecturers from US, Russia and Europe. More information about the LUT Summer School http://www.lut.fi/summerschool.

LUT Winter School is an academic programme offering both period-long and intensive courses. It offers courses at Bachelor's and Master's level. LUT students and international students from all around the world are welcome to attend the programme. More information about the LUT Winter School http://www.lut.fi/winterschool.

11. DOCTORAL EDUCATION AT LUT

LUT offers excellent opportunities to complete scientific doctoral studies in technology or business. The postgraduate degrees include Licentiate of Science (Technology), Doctor of Science (Technology), Licentiate of Science (Economics and Business Administration), Doctor of Science (Economics and Business Administration) and Doctor of Philosophy.

The doctoral degree is equivalent of four academic years of full-time studies, and the licentiate degree corresponds to two academic years of full-time studies. The studies are planned and organised depending on the research field. The workload of the studies is 40 ECTS credits. In addition, the student must prepare a licentiate thesis or a doctoral dissertation depending on the degree.

All doctoral students of the university belong to LUT Doctoral School (LUT DS), which covers all the disciplines of the university. LUT also has double doctoral degree agreements with some partner universities abroad.

The aim of the university is to admit skilled, motivated students who have the aptitude for a career in research and other demanding expert tasks, who are committed to their doctoral studies and research and who have sufficient skills in research.

Doctoral education is offered in the following fields:

- Electrical Engineering, Energy Technology, Environmental Technology, Mechanical Engineering (LUT School of Energy Systems)
- Chemical Engineering, Mathematics, Physics (LUT School of Engineering Science)
- Business Administration, Software Engineering, Industrial Engineering and Management (LUT School of Business and Management)

Applicants planning doctoral studies should first contact the professor of the intended research field (major subject), i.e. the possible supervisor of the studies, and discuss the practical matters related to the studies (e.g. supervision, major subject, financing). An application for doctoral studies is prepared on the basis of the discussion between the applicant and professor, and submitted to LUT Doctoral School.

Further information on the application procedure and studies is available in the student portal Uni.