LUT
Lappeenranta
University of Technology

STUDY GUIDE 2014-2015

STUDY PROGRAMMES AND COURSES IN ENGLISH

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WE SOLVE GLOBAL CHALLENGES TOGETHER

Green energy. The international financial crisis. The availability of clean water. Climate change. Sustainable competitiveness.

These are all global challenges. Solving them requires expertise in technology and business. With scientific research and academic education, we at Lappeenranta University of Technology (LUT) provide solutions and experts for these issues. You are one of the experts who will address future challenges.

LUT's strategic focus areas are green energy and technology, sustainable value creation and our role as an international hub of Russian relations. These areas of strength ensure that the Master's level graduates and doctors in these fields have a wide range of tools to solve important future challenges in the society.

LUT's strengths are its strategic agility and cooperation. The LUT School of Technology, the LUT School of Industrial Management and the LUT School of Business combine expertise in technology and business in their education and research. Seize this opportunity for cross-disciplinary cooperation.

Our scientific community consists of 6500 students and experts representing nearly 70 nationalities. They all share a solution-oriented outlook and open-minded approach to crossing boundaries. We are proud to work together with you, as well.

THE UNIVERSITY'S ACADEMIC YEAR

1 August 2014 – 31 July 2015

AUTUMN SEMESTER 2014

Orientation days for new students / Exam retake week	1. – 5.9.2014
1st teaching period, weeks 37 – 42	8.9. – 17.10.2014
Intensive and exam week, week 43	20.10. – 24.10.2014
2nd teaching period, weeks 44 – 49	27.10. – 5.12.2014
Intensive and exam week, weeks 50 ja 51	8.12. – 19.12.2014
No instruction or examinations, weeks 52 and 1	22.12.2014 – 2.1.2015

SPRING SEMESTER 2015

Intensive week, week 2, only intensive instruction	5.1. – 9.1.2015
3rd teaching period, weeks 3 - 8	12.1. – 20.2.2015
Exam week, week 9	23.2. – 27.2.2015
Intensive week, week 10, also exam retakes in the evening	2.3. – 6.3.2015
4th teaching period, weeks 11 - 16	9.3. – 17.4.2015
Intensive week, week 17, only intensive instruction	20.4. – 24.4.2015
No instruction or examinations, week 18	27.4. – 1.5.2015
Exam week, weeks 19 – 21	4.5. – 22.5.2015
Intensive week, week 22, also exam retakes In the morning and evening	25.5. – 29.5.2015

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, five-hour exams from 15:15 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, five-hour exams 15:15-20:15)

Examinations may be arranged on the **Saturdays** 15 November 2014 and 14 March 2015. The decision will be made later in the Degree Programmes.

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 faculties' own 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 Noppa or Moodle.

The Studies and Services page in the Uni portal includes all of the information needed in studies. Information and instructions specific to each degree programme can be found under the degree programme links, and general information related to studies, such as examinations, course schedules, student services and graduation, is available in the Student Services at LUT links. 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 2014-2015 starts 1 June 2014 and ends 1 September 2014. 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 Student Affairs Office.

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 Student Affairs Office, opinto(at)lut.fi, by the registration deadline. If necessary, you may also telephone or visit the Student Affairs Office 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 Student Affairs Office.

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 2014 starts on 1 August 2014, and for courses in the spring semester 2015 on 1 December 2014. Enrolment for each period ends as follows:

Registration for courses in Period 1 ends	Sat, 6 Sep 2014 at 20:00
Registration for courses in Period 2 ends	Mon, 20 Oct. 2014 at 23:59
Registration for courses in Period 3 ends	Mon, 5 Jan. 2015 at 23:59
Registration for courses in Period 4 ends	Mon, 2 Mar. 2015 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 8 September 2014, and in the spring semester on Monday 12 January 2015.

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 twice. If a student does not pass the examination after taking it twice, 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 Student Affairs Office 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 Student Affairs Office at least a week before the exam date and fulfil the special requirements. Further information is available in the Uni portal.

Noppa and Moodle

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

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.

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.

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 STUDY GUIDANCE AND STUDENT SUPPORT SERVICES

Study Affairs at Faculties

Study Affairs Services at the School of Technology

The Study Affairs Services team of the School of Technology helps in all of the faculty's study affairs matters, and provides study guidance for degree students.

Contact information: https://uni.lut.fi/en/web/lut.fi-eng/study-affairs-services

Study Affairs Services at the LUT School of Industrial Engineering and Management

The study affairs services' staff of the LUT School if Industrial Engineering and Management serves degree students, and LUT staff members in all of the faculty's study affairs matters. Study guidance for degree students is provided by the study coordinator and for postgraduate students by the head of study affairs. Also the student affaris secretaries and student advisers are available.

Study guidance for international degree students:

Ms. Suvi Tiainen, Student Affairs Secretary
Phone + 358 40 502 2196, suvi.tiainen(at)lut.fi

More detailed information on study affairs services and study guidance is available in Uni portal learning support pages.

Study Affairs at the School of Business

The study affairs' services team of the School of Business assists degree students, and LUT staff members in all study affairs matters. Study guidance for degree students is provided by study coordinators and study secretaries and for postgraduate students by the head of study affairs. The study affairs offices of the School of Business are located in the university's 7th building on the 3rd floor.

Contact information:

Ms Essi Reponen
Coordinator, International Affairs
Phone +358 400 380 265
E-mail essi.reponen(at)lut.fi

Ms Minna Ranta
Head of Study Affairs
Phone +358 40 510 0597
E-mail minna.u.ranta(at)lut.fi

More detailed information on study affairs services and study guidance is available in Uni portal.

Study Affairs at the Language Centre

The study affairs services of the Language Centre help students with matters related to language studies related (e.g. enrollment for language courses, registration for language course exams). Study guidance is provided by the student adviser, study secretary, teacher adviser and director of language centre.

Contact information: https://uni.lut.fi/en/web/lut.fi-eng/lang

LUT Student Affairs Office

The student service of the Student Affairs Office helps students with registration-related matters (e.g. enrolment for the academic year, registration for courses and exams), and provides students with e.g. certificates of attendance, certificates entitling students to travel discounts, and official transcripts of records. You should contact the Student Affairs Office whenever you have questions regarding e.g. your right to study or the entry of grades into the student register.

Student services:
phone +358 294 463 040 and +358 294 463 041
e-mail: opinto(at)lut.fi.

More detailed information on student affairs office's services is available in Uni portal.

The Student Affairs Office is located on the 3rd floor of the university's 2nd building, room 2313.

LUT International Services

The International Services of Lappeenranta University of Technology provide services supporting student and staff mobility.

International Services provide guidance and counselling in practical matters to all international students studying at LUT. International services are in charge of the university's international student exchange – both students going abroad to study and those coming to Lappeenranta. Thanks to an extensive cooperation network, LUT students have the opportunity to take part in exchange programmes around the world and LUT welcomes international exchange students from over 140 partner universities.

International Services coordinate the International Business and Technology Management programme. Both international exchange students and LUT degree students may take courses in the programme.

International Services offer the students guidance and councelling in all international traineeships, while also coordinating Erasmus and IAESTE traineeship programs at LUT.

LUT's International Services are located in the university's main building, the 3rd floor of the main building. The office is open from Monday to Thursday 9.30-15.00 and on Friday 9.30-14.00

Contact information of International Services:

Incoming Exchange Students
Ms Virpi Maunuksela, International Coordinator
Phone: +358 40 738 1315
E-mail: virpi.maunuksela(at)lut.fi

Support Services for Incoming Master's Degree Students and Incoming Exchange Students
Ms Pauliina Talka, International Study Secretary
Phone: +358 40 738 1303
E-mail: pauliina.talka(at)lut.fi

Outgoing Exchange Students
Ms Kaisa Nikku, International Coordinator
Phone: +358 40 576 2642
E-mail: kaisa.nikku(at)lut.fi

Outgoing & Incoming Trainees
Ms Minna Niemi, International Coordinator
Phone: +358 40 738 1312
E-mail: minna.niemi(at)lut.fi

LUT Career Services

Career Services offer all the LUT students channels and tools to create contacts with the business world. The main information channel for jobs and job hunting is the Uni-portal.

Career Services provide students with tools for looking for employment. In practice, this means facilities and tools for searching for information on jobs, employers and looking for work or international internships. Students may use the telephone, copy machine, fax and computer free of charge These facilities are located on the 3rd floor of the university's main building. Furthermore, Career Services annually organise various recruitment and corporate events where also LUT alumni participate.

Contact information of Career Services:

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

LUT Graduate School

LUT Graduate 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 (Studies and services > 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. However, there is always help and guidance available in the service point.

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.

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. The information specialist is available for personal assistance daily.

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.

The Skinnarila campus library is open during terms Mon-Thu 8.00 am – 6.00 pm, Fri 8.00 am – 3.30 pm. Changes in the opening 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. The newest books of the Library can be found in Pinterest, and Lappeenranta Academic Library has even it's own Twitter account.

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 office of the study counselling psychologist is 7642, and she 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 DEGREE 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 Degree Programme in Energy Technology
- Master's Degree Programme in Chemical and Process Engineering
- Master's Degree Programme in Mechanical Engineering
- Master's Degree Programme in Computational Sciences and Physics
- Master's Degree Programme in Computer Science
- Erasmus Mundus Master's Programme in Pervasive Computing and Communications for Sustainable Development (PERCCOM)
- Master's Degree Programme in Industrial Engineering and Management
- Master´s Degree Programme in Supply Management (MSM)
- Master's Degree Programme in Strategic Finance (MSF)
- Master's Degree Programme in International Marketing Management (MIMM)
- Master's Degree Programme in Strategy, Innovation ans Sustainability (MSIS-LUT)
- Master's Degree Programme in Strategy, Innovation ans Sustainability (MSIS) Double Degree - GSOM

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 dean of the faculty 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 at the end of this guide and in the Uni portal. Faculties may also give their own 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. SCHOOL OF TECHNOLOGY

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

Master of Science (Technology)						
Master's Programme in Energy Technology 120 ECTS cr						
Master's Thesis on major subject 30 ECTS credits						
Major Subjects (60-66 ECTS cr):						Minor Subjects (20-22 ECTS cr):
Sustainable Technology and Business	Bio-Energy Technology	Nuclear Energy Engineering	Industrial Electronics	Electricity Market and Power Systems		- Bio-Energy Technology - Sustainable Technology and Business - Industrial Émbedded Systems - Power Electronics and Electrical Drives - Modelling of Energy Systems -Sustainability - Green Chemistry
						Elective studies 18-26 ECTS cr
General studies 14 ECTS cr						

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 (13 ECTS cr)		*year*	*per.*	*ECTS cr*
FV11A6500	Presenting in English	M.Sc. (Tech.) 1-2	1, 2, 3, 4	2
FV11A8900	Academic Writing in English	M.Sc. (Tech.) 1-2	1-2, 3-4	4
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

Obligatory Studies, choose one course (1 ECTS cr)		*year*	*per.*	*ECTS cr*
BH10A1700(*	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1-2	1
BH60A4600(**	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1-2	1
BL10A8200(***	Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1-2	1

*) Obligatory to Bio-Energy Technology or Nuclear Energy Engineering major subject students
**) Obligatory to Sustainable Technology and Business major subject students
***) Obligatory to Industrial Electronics or Electricity Market and Power Systems major subject students

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
BL10A2000	Master's Thesis and Seminar	M.Sc. (Tech.) 2		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
BL10A2000	Master's Thesis and Seminar	M.Sc. (Tech.) 2		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.) 1	2-3	6

BH61A0600	Bioenergy	M.Sc. (Tech.) 1	1	3
BH10A1100	Master's Thesis and Seminar	M.Sc. (Tech.) 2		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
BH30A1402	Nuclear Engineering	M.Sc. (Tech.) 1	1-2	5
BH30A1800	Applied Reactor Physics	M.Sc. (Tech.) 2	3	3
BH30A1900	Thermal Hydraulics of Nuclear Power Plants	M.Sc. (Tech.) 2	3	3
BH30A2102	Introduction to Reactor Physics	M.Sc. (Tech.) 1	2	3
BH30A2200	Experimental Nuclear Thermal Hydraulics	M.Sc. (Tech.) 1	4, INT 17	3
BH10A1100	Master's Thesis and Seminar	M.Sc. (Tech.) 2		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
BH60A4200	Master's Thesis and Seminar	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 Energy. There is one exception: the major student in Sustainable Technology and Business may not choose the minor subject in Sustainability.

Subject combination	
Major Subject ⇒	**Minor Subject**
Industrial Electronics	Industrial Embedded Systems
Electricity Market and Power Systems	Power Electronics and Electrical Drives
Sustainable Technology and Business	Bio-Energy Technology Green Chemistry
Bio-Energy Technology	Sustainable Technology and Business

	Modelling of Energy Systems Sustainabilty
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	Johdanto sulautettuihin järjestelmiin	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	Johdanto sulautettuihin järjestelmiin	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

Elective Studies		*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 Sustainability (for students majoring in Bio-Energy Technology)

Obligatory Studies (18 ECTS cr)		*year*	*per.*	*ECTS cr*
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 1-2	2	5
BH61A0600	Bioenergy	M.Sc. (Tech.) 1-2	1	3
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1-2	3-4	5
CS30A1690	Social Sustainability	M.Sc. (Tech.) 1-2	4	5

Choose enough credits to attain 20 ECTS credits of minor subject studies.

List of selectable courses		*year*	*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1	2	6
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1	3	3
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1-2	4	4
BM20A3900	Modelling Methodology in Process Engineering	M.Sc. (Tech.) 1	1, INT 43	6
FV11A9503	Independent Study in English			1-4

8. Minor Subject in Sustainability (for students majoring in Industrial Electronics or Electricity Market and Power Systems)

Obligatory Studies (5 ECTS cr)		*year*	*per.*	*ECTS cr*
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1	3-4	5

List of selectable courses, choose enough credits to attain 20 ECTS cr		*year*	*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Tech.) 1-2	2	3
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 1-2	2	5
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1-2	1-2	6
BH50A1400	Steam Boilers	M.Sc. (Tech.) 1-2	1-2	6
BH50A1500	Bioenergy Technology Solutions	M.Sc. (Tech.) 1-2	2-3	6
BH60A1600	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1-2	2	5
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Tech.) 1-2	1-4	3
BH61A0600	Bioenergy	M.Sc. (Tech.) 1-2	1	3
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1	2	6
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1	3	3
BK30A0900	Additive Manufacturing	M.Sc. (Tech.) 1-2	3-4	5
BK50A2001	Package Performance and Sustainability	M.Sc. (Tech.) 1-2	3	5

BK50A2200	Design Methodologies and Applications of Machine Element Design	M.Sc. (Tech.) 1-2	1-2	5
BK90C1800	Green Fiber Materials	M.Sc. (Tech.) 1-2	4	5
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1-2	4	4
BM20A3900	Modelling Methodology in Process Engineering	M.Sc. (Tech.) 1-2	1, INT 43	6
CS10A0770	Cleaner Technologies and Markets	M.Sc. (Tech.) 1-2	3-4	5
CS30A1690	Social Sustainability	M.Sc. (Tech.) 1-2	4	5
CT10A7000	Green IT and Sustainable Computing	M.Sc. (Tech.) 1-2	3-4	4
FV11A9503	Independent Study in English	M.Sc. (Tech.) 1-2		1-4

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 internship improving expertise. More information: BH10A1500 Work Internship in Master's Degree, BH60A3700 Work Internship in Master's Degree and BL10A800 Work Internship in Master's Degree.

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
CT10A7000	Green IT and Sustainable Computing	3-4	4

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.

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
BL10A2000	Master's Thesis and Seminar	M.Sc. (Tech.) 1		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
BL10A2000	Master's Thesis and Seminar	M.Sc. (Tech.) 1		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.) 1	2-3	6
BH61A0600	Bioenergy	M.Sc. (Tech.) 1	1	3
BH10A1100	Master's Thesis and Seminar	M.Sc. (Tech.) 1		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
BH30A1402	Nuclear Engineering	M.Sc. (Tech.) 1	1-2	5
BH30A1800	Applied Reactor Physics	M.Sc. (Tech.) 1	3	3
BH30A1900	Thermal Hydraulics of Nuclear Power Plants	M.Sc. (Tech.) 1	3	3
BH30A2102	Introduction to Reactor Physics	M.Sc. (Tech.) 1	2	3
BH30A2200	Experimental Nuclear Thermal Hydraulics	M.Sc. (Tech.) 1	4, INT 17	3
BH10A1100	Master's Thesis and Seminar	M.Sc. (Tech.) 1		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	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 (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
BH60A4200	Master's Thesis and Seminar	M.Sc. (Tech.) 1	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

CT10A7000	Green IT and Sustainable Computing	3-4	4
FV11A8900	Academic Writing in English	1-2, 3-4	4

Course Descriptions in Energy Technology

		ECTS cr
BH10A1100	Master's Thesis and Seminar	30
BH10A1500	Work internship in Master’s degree	2 - 10
BH10A1600	Energy Technology Project Work	2 - 30
BH10A1700	Introduction to M.Sc. Studies	1
BH30A0701	Reliability Engineering	4
BH30A1402	Nuclear Engineering	5
BH30A1800	Applied Reactor Physics	3
BH30A1900	Thermal Hydraulics of Nuclear Power Plants	3
BH30A2102	Introduction to Reactor Physics	3
BH30A2200	Experimental Nuclear Thermal Hydraulics	3
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	2 - 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
BH60A3501	Sustainable Innovation and System Transition	5
BH60A3700	Work Internship in Master's Degree	2 - 10
BH60A4200	Master´s Thesis and Seminar	30
BH60A4300	Environmental Technology Project Work	2 - 30
BH60A4400	Introduction to Sustainability	3
BH60A4500	Corporate Responsibility and Management 1	3
BH60A4600	Introduction to M.Sc. Studies	1
BH60A4700	Climate Finance and Carbon Markets	3
BH61A0600	Bioenergy	3
BH70A0001	Numerical Methods in Heat Transfer	6
BH70A0101	Advanced Modeling Tools For Transport Phenomena	5
BH70A0200	Advanced Topics in Modelling of Energy Systems	6
BL10A2000	Master's Thesis and Seminar	30
BL10A8000	Work internship in Master’s degree	2 - 10
BL10A8200	Introduction to M.Sc. Studies	1
BL10A8400	Solar Economy and Smart Grids	3
BL20A0201	Power Exchange Game for Electricity Markets	3
BL20A0401	Electricity Market	5
BL20A0501	Electricity Distribution Technology	8
BL30A0400	Design of an Electrical Machine	6
BL30A0600	Power Electronics	6
BL30A1001	Electrical Drives	8
BL30A1200	Numerical Methods in Electromagnetism	4
BL40A0701	Digital Filters	5
BL40A1000	Real-time Operating Systems and Programs	5
BL40A1100	Embedded System Programming	4
BL40A1201	Digital Control Design	5
BL40A1601	Embedded System Design	6
BL40A1811	Introduction to Embedded Systems	6
BL40A2301	Energy Efficiency	6
BL40A2401	Electrical Engineering in Wind and Solar Systems	6
BL40A2700	System Engineering Project Work	6
BL40A2800	Electrical Motion Control Systems	6
BL40A3000	Wind Power and Solar Energy Technology and Business	5
BL50A0600	Electromagnetic Compatibility in Power Electronics	2
BL50A1300	Advanced Course in Electronics	6

BH10A1100	***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 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 %.	

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

BH10A1700	***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)	Postdoctoral Researcher, D.Sc. (Tech.) Aki-Pekka Grönman Person in Charge: Professor, D.Sc. (Tech.) Esa Vakkilainen	
Aims	By the end of the course, the student is expected to be able to 1. find help when needed during his/her studies, 2. describe the content and structure of the Degree Programme, interpret the study guide and describe the research areas of LUT Energy; additionally, observe the university's examination practices and degree programme practices, 3. prepare his/her individual study plan (ePSP) and follow the progress of his/her studies with the help of WebOodi's personal study plan, 4. use the services of the library, retrieve information independently and use the information sources in accordance with good practices, observing the copyrights.	
Content	Getting to know the Department of LUT Energy and Major and Minor Studies (incl. Master's Thesis). Study and exam culture in LUT. LUT library collections, databases, reference practices, and copyrights. An ePSP workshop. Research areas of LUT Energy. Two autumn lectures from Studentia Finlandia lecture series.	
Modes of Study	1st - 2nd period. Obligatory lectures 14 h (incl. participation in an ePSP	

	workshop). Obligatory library visit 0,5 h. 2nd period. Discussion with a teacher tutor 0,5 h. Individual work (total approx. 12 h): 1st period: An individual study plan (10 h). Assignments of information searching, library use, and databases on Moodle. 1 h. 2nd period: Written assignment about study and career plans. 1 h. Total workload 27 h. Moodle is used in this course.
Evaluation	Pass/fail.
Study materials	Study Guide, Moodle, LUT library collections, and databases.

BH30A0701	***RELIABILITY ENGINEERING***	***4 ECTS cr***
	Reliability Engineering **Replaces the course BH30A0700 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 2014 - 2015.**	
Year and Period	M.Sc. (Tech.) 1 Period 1-2	
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. This course is also suitable for postgraduate students.	
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 in use. 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.	

BH30A1402	***NUCLEAR ENGINEERING***	***5 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, and 3. define the elements of health effects of ionizing radiation and radiation protection.	
Content	History of nuclear energy utilisation. Light water reactor design features, main components and their design. Reactor fuel and fuel cycle. Safety and auxiliary system design. Health physics and radiation protection considerations.	
Modes of Study	1st 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. 2nd 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. Total workload 130 h. One independent assignment and a country presentation, two interim exams or one final exam. 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 in use. Lamarsh & Baratta, Introduction to Nuclear Engineering, as applicable.	

BH30A1800	***APPLIED REACTOR PHYSICS***	***3 ECTS cr***
	Applied Reactor Physics	
Year and Period	M.Sc. (Tech.) 1 Period 3	
Teacher(s)	Professor, D.Sc. (Tech.) Riitta Kyrki-Rajamäki	
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 in use. Reuss: Neutron Physics, Duderstadt & Hamilton: Nuclear Reactor Analysis, Stacey: Nuclear Reactor Physics, where applicable.	
Prerequisites	BH30A0000 Introduction to Nuclear Engineering, BH30A0200 Nuclear Engineering I and BH30A0300 Nuclear Engineering II, BH30A1700 Nuclear Reactor Physics, or BH30A1401 Nuclear Engineering and BH30A2101 Introduction to Reactor Physics.	
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	
Teacher(s)	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 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. This course is also suitable for postgraduate students.	
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 in use. Todreas, Kazimi: Nuclear Systems I & II, where applicable. Winterton: Thermal Design of Nuclear Reactors, where applicable. Wallis: One-dimensional Two-phase flow.	
Prerequisites	BH30A0000 Introduction to Nuclear Engineering, BH30A0200 Nuclear Engineering I and BH30A0300 Nuclear Engineering II.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BH30A2102	***INTRODUCTION TO REACTOR PHYSICS***	***3 ECTS cr***
	Introduction to Reactor Physics	
Year and Period	M.Sc. (Tech.) 1 Period 2	
Teacher(s)	Professor, D.Sc. (Tech.) Riitta Kyrki-Rajamäki	
Aims	Upon completion of the course the student will be able to: 1. explain the nuclear reactions, nuclear fission, and the basic principle of a nuclear core, 2. calculate simple criticality geometries, 3. explain the life cycle of neutron generations in the thermal nuclear reactor core, and 4. understand the basics of the diffusion approximation.	
Content	Neutron induced nuclear reactions, particularly fission. Basic reactor physics, simplified criticality calculations. Concept of reactivity and reactor dynamic response. Fuel conversion process.	
Modes of Study	2nd period: 24 h of lectures, 12 h of tutorials, preparation for the tutorials 10 h, preparation for the examination 29 h and written interim examinations 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 in use. Reuss: Neutron Physics, Part I, as applicable.	
Prerequisites	BH30A1401 Nuclear Engineering.	

BH30A2200	***EXPERIMENTAL NUCLEAR THERMAL HYDRAULICS*** ***3 ECTS cr***
	Experimental Nuclear Thermal Hydraulics
Year and Period	M.Sc. (Tech.) 1 Period 4, INT 17
Teacher(s)	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. design representative thermal hydraulic experiments for simple problems using analytic and system codes as design tools, and 6. describe advanced flow structure mapping techniques (e.g. wire mesh sensing, particle image velocimetry).
Content	Temperature, pressure, pressure drop and flow measurement techniques. Void fraction measurement. Similitude, scaling laws. Phenomenological models for 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. This course is also suitable for doctoral studies.
Modes of Study	Period 4, 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 in use. Ghiaasian: Two-Phase Flow, Boiling and Condensation, as applicable.
Prerequisites	BH30A0000 Introduction to Nuclear Engineering, BH30A0200 Nuclear Engineering I and BH30A0300 Nuclear Engineering II or BH30A1401 Nuclear Engineering.
Further Information	This course has 1-5 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 Postdoctoral Researcher, 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.
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.	
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.	
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.	
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.	
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	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.	
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.) 1 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 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.	
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.	
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***	***2 - 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)	Associate Professor, 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. analyse what sustainable development means for business, 3. identify corporate stakeholders and analyse their importance, 4. understand the concepts of environmental strategy and risk management, 5. use and compare the tools for measuring eco-efficiency, 6. explain the basics of life cycle thinking, management and analysis, 7. recognise basic environmental management tools and explain the reasons for their use, 8. explain the steps of planning and implementing environmental management system, and 9. understand the basics of environmental labeling, environmental marketing and sustainability reporting.
Content	Identifying the influence of sustainable development on business. Learning basic concepts related to corporate responsibility and corporate environmental management. Identifying corporate stakeholders and their importance. Recognising tools and indicators of environmental management. Understanding the concepts of environmental strategies and risk management. Knowing the basics of LCA and environmental product design. Recognising eco labels and indicators of environmental load. Knowing the basics of building and maintaining an environmental management system. Understanding the basics of environmental labeling, environmental marketing and sustainability reporting.
Modes of Study	2nd period: 22 h of lectures, including two voluntary case exercises (team 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 %. Additional 10 points maximum (1 point/lecture) can be given if students participate in the lectures and answer the “question-of-the-day” given at the end of each lecture.
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 suomi/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.
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). Written 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	Possible literature will be announced later. 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.	
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.
Modes of Study	1st period: 14 h of lectures, 12 h of exercises. 2nd period: 6 h of lectures 6 h, 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.
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, issues on energy efficiency and resource saving, air pollution, water and waste problems regarding the energy production, environmental policy and legislation, the state of water purification and waste water treatment, waste generation and organization of waste management.
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.	
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 %.

BH60A4200	***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 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)	Professor, D.Sc. (Tech.) Risto Soukka and Associate Professor, 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 mutual relationship of the 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 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. 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.	
Modes of Study	1st period: 16 h of lectures. Independent study (approx. 62 h): Project work and presentation, team work (approx. 24 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 80 %, project work 20 %.	
Study materials	Will 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.	

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.
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.
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, M.Sc. (Tech.) Henna Peltoniemi 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 LUT Energy, 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 together with LUT Energy: Getting to know the Department of LUT Energy and 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 LUT Energy. 1st - 2nd period: Two autumn lectures from Studentia Finlandia lecture series.	
Modes of Study	1st period: 15 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. 11 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)	Associate Professor, 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. explain the carbon markets mechanism, 2. describe different emission trading schemes in and outside Europe, and 3. explain the impacts of an emission trading scheme on different stakeholders.
Content	Topics include: Carbon Markets, the Kyoto protocol and Kyoto mechanisms, the EU emission trading scheme, the impact of emission trading on different industries.
Modes of Study	3rd period: 12 h of lectures 12 h. 4th period: Assignment and seminars. Examination. Independent study (approx. 66 h): assignment 22 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 70 %, assignment 30 %.
Study materials	Arnaud Brohé, Nick Eyre and Nicholas Howarth: Carbon Markets: An International Business Guide (2009).
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

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.
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.
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.
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, Lic.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.

BL10A2000	***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 1-4	
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Pertti Silventoinen	
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 %.	

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%.

BL10A8200	***INTRODUCTION TO M.SC. STUDIES***	***1 ECTS cr***
	Introduction to M.Sc. Studies **Only for the students of Master's Degree Programme in Energy Technology**	
Year and Period	M.Sc. (Tech.) 1 Period 1-2	
Teacher(s)	Postdoctoral Researcher, D.Sc. (Tech.) Katja Hynynen, Teacher Tutor, M.Sc. (Tech.) Evgeniia Vasileva	
Aims	By the end of the course, the student is expected to be able to: 1. find help when needed during his/her studies, 2. describe the content and structure of the study programme, interpret the study guide and describe the research areas of LUT Energy. In addition, to observe the university's examination practices and study programme practices. 3. prepare his/her individual study plan (ePSP) and follow the progress of his/her studies with the help of the personal study plan in WebOodi, 4. use the services of the library, retrieve information independently and use the information sources in accordance with good practices, with skills to observe the copyrights, 5. use the Moodle learning environment.	
Content	Getting to know the Department of LUT Energy and the major and minor Studies (incl. Master's Thesis). Study and examination culture at LUT. LUT library collections, databases, reference practices and copyrights. ePSP workshop. Research areas of LUT Energy. Two autumn lectures from Studentia Finlandia lecture series.	
Modes of Study	1st-2nd period. Obligatory lectures 14 h (incl. participation in an ePSP workshop). Obligatory library visit 0,5 h. Discussion with a teacher tutor 0,5 h. Individual work (total approx. 12 h): 1st period: An individual study plan (10 h). Assignments of information searching, library use and databases on Moodle 1 h. Total workload 26 h. Moodle is used in this course.	
Evaluation	Pass/fail	
Study materials	Study Guide, Moodle, LUT library collections and databases.	

BL10A8400	***SOLAR ECONOMY AND SMART GRIDS***	***3 ECTS cr***
	Solar Economy and Smart Grids **LUT Summer School -course, intensive course 4 – 8.8.2014**	
Year and Period	M.Sc. (Tech.) 1-2 Period INT.	
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.) Juha Pyrhönen, LUT Associate Professor Mats Nilsson Docent Jouni Keronen, Vice President of Fortum Corporation Person in Charge: Professor, D.Sc. (Tech.) Jarmo Partanen, LUT Docent Jouni Keronen, Vice President of Fortum Corporation	
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: Climate change Solar economy New electricity market Wind power technology Solar power technology Energy Storages Demand response Regulation of electricity distribution business 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.
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.
Evaluation	Final grade 0-5. Evaluation: project work 70 % presentation 30 %.
Study materials	Lecture notes.
Prerequisites	Previous studies either in electrical engineering, environmental engineering or energy technology are recommended.

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
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: 1. plan electricity purchase and sale in an economically viable way, 2. recognise the most common risk management instruments, 3. 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 (spot and elbas), financial products on the power exchange (forwards, futures and options), risk management.
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.	
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	
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.	
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.

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.	
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.
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.	
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.	
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)	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, application of the circuit model in calculation. This course is suitable also for doctoral studies.
Modes of Study	24 h of supervised tutorials. 3rd period. Course requirements: participation in tutorials and a satisfactorily completed assignment. Independent 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)	Post-Doctoral Researcher, 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.
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	
Teacher(s)	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.	
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.	
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.	
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.
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.
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.
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.
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.
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.

BL40A3000	***WIND POWER AND SOLAR ENERGY TECHNOLOGY AND BUSINESS 5 ECTS cr***
	Wind Power and Solar Energy Technology and Business **Self-study course. The course is meant for the students of international master's programs. The course is interchangeable with the Finnish course BL40A2600 Tuuli- ja aurinkovoimateknologia ja liiketoiminta.**

Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Olli Pyrhönen, Postdoctoral Researcher, D.Sc. (Tech.) Katja Hynynen Person in Charge: Professor, D.Sc. (Tech.) Olli Pyrhönen
Aims	Upon completion of the course the student will be able to: 1. model the process from wind energy into company turnover at the principle level, 2. model the process from solar radiation into company turnover or into electricity production in a private household, 3. identify and describe the key technologies related to wind power, the core business principles, environmental issues, energy policy and their development trends, 4. describe the mutual effects of wind power and electric power systems, 5. identify and describe the technologies related to solar power.
Content	Core content; process modelling from kinetic energy of wind into company turnover Complementary knowledge; basic components of a wind power plant (turbine, gearbox, generator, power electronics, power electronics, tower), environmental effects of wind power, wind park planning, grid effects of wind power, economic feasibility of wind power under different circumstances, wind conditions in Finland. Solar energy technologies, Operating principle of solar panels, PV solar power plant structure.
Modes of Study	Individual work. Weekly homework in Moodle consisting of various technical and economic calculation problems, 3rd and 4th period. Examination. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, examination 60%, homework 40%.
Study materials	Lecture notes available in Moodle.
Further Information	This course has 1-5 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
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. Moodle is used in this course.
Evaluation	0-5, written examination 100 %.
Study materials	Moodle.
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.	
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 1-5 places for open university students. More information on the web site for open university instruction.	

4.2 Master's Programme in Chemical and Process Engineering

4.2.1 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 or metallurgical 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.

Separation Technology (minor)

Separation Technology minor focuses extensively on separation methods used in industrial and environmental technology, such as filtering and membrane technology, precipitation, crystallization, liquid-liquid extraction, adsorption and chromatography, and ion exchange. Methods are described in theory so that the student will be able to choose the appropriate method of separation on 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 metal 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. The goal is to give the students 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 the same language

Major Subject

Obligatory studies (70 ECTS cr)		*year*	*per.*	*ECTS cr*
BJ02A2010	Modeling of Unit Operations	M.Sc. (Tech.) 1	1	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
BJ02A0020	Master's thesis and seminar	M.Sc. (Tech.) 2	3-4	30

Minor Subject

Separation Technology

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

Green Process Technology

Obligatory studies		*year*	*per.*	*ECTS cr*
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1-2	2	5
BJ02A4020	Methods in Green Chemistry	M.Sc. (Tech.) 1-2	4	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1-2	1	5
BJ02A4040	Processing of Biomaterials	M.Sc. (Tech.) 1-2	1-2, INT 43	7
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1-2	3	3

Sustainability

Obligatory studies (8 ECTS cr)		*year*	*per.*	*ECTS cr*
BH60A1600	Basic Course on Environmental	B.Sc. (Tech.) 1-2	2	5

	Management and Economics			
BH60A4400	Introduction to Sustainability	M.Sc. (Tech.) 1-2	1	3

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

Selectable courses		*vsk*	*per.*	*op*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Tech.) 1-2	2	3
BH61A0600	Bioenergy	M.Sc. (Tech.) 1-2	1	3
BJ02A1050	Biopolymeerit	M.Sc. (Tech.) 1-2	4	5
BJ02A1060	Prosessi- ja ympäristöanalytiikka	M.Sc. (Tech.) 1-2	1, INT 43	5
BJ02A1070	Bioprosessitekniikan perusteet	M.Sc. (Tech.) 1-2	4	4
BJ02A2050	Process Intensification	M.Sc. (Tech.) 1-2	4	4
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1-2	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1-2	2	6
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1-2	2	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1-2	1	5
BJ02A4040	Processing of Biomaterials	M.Sc. (Tech.) 1-2	1-2, INT 43	7
BK90C1800	Green Fiber Materials	M.Sc. (Tech.) 1-2	4	5
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1-2	3-4	5
CS10A0770	Cleaner Technologies and Markets	M.Sc. (Tech.) 1-2	3-4	5
CS30A1690	Social Sustainability	M.Sc. (Tech.) 1-2	4	5

Elective Studies

Elective studies are needed to attain the full 120 ECTS credits. 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 internship improving expertise. More information: BJ02A0030 Work Internship in Master's Degree.

4.2.2 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	2	4
BJ02A0020	Master's thesis and seminar	M.Sc. (Tech.) 1	3-4	30

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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	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

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
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 **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	
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)	Professor of the major subject.	
Aims	Upon completion of the module, the student will be able to: - define a restricted 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 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 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.	
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%.	

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 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	Pass-fail.
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)	Part-time Untenured Teacher, D.Sc. (Tech.) Yury Avramenko Person in Charge: Professor, D.Sc. (Tech.) Ilkka Turunen	
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 difficult 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)	Professor, D.Sc. (Tech.) Ilkka Turunen	
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.	
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)	Professor, D.Sc. (Tech.) Ilkka Turunen	
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)	Professor, D.Sc. (Tech.) Ilkka Turunen	
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 informatiom - 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 Post-Doctoral Researcher, Docent, 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.	
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 completing 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 and separation of metals.
Modes of Study	Lectures 20 h, 2nd period. Simulations, exercises and seminars 20 h, 2nd period. Reports, other home assignments and self-study 110 h. Total workload 150 h. Moodle is used in this course.
Evaluation	0-5, written 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 M. Sc. (Tech.) Mehdi Hasan 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 4 h, seminar 16 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%, demonstrations pass/fail.
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.) 2 Period 2	
Teacher(s)	Research Engineer, D.Sc. (Tech.) Markku Laatikainen Post-Doctoral Researcher, D.Sc. (Tech.) Sami Virolainen 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. Solution chemistry of hydrometallurgical solutions. Mining, mineral processing and leaching. Treatment of leach solutions by solvent extraction, ion exchange, adsorption and precipitation. Electrochemical methods.	
Modes of Study	Lectures and exercises 24 h, 2nd period. Home exercises 8 h, 2nd period. Laboratory work 6 h, 2nd period. Self-study 75 h. Total workload 113 h. Moodle is used in this course.	
Evaluation	0-5, written examination 100%, exercises passed, lab work pass/fail.	
Study materials	Lectures; 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
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.
Modes of Study	Lectures 24 h, exercises 16 h, 2nd period. Independent workload: literature work, altogether approx. 90 h. Total workload approx. 130 h. Moodle is used in this course.
Evaluation	0-5, literature work 50%, exam 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.

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.
Modes of Study	Lectures 4 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	This course has 1-5 places for open university students. More information on

Information	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.	
Modes of Study	Lectures 14 h, exercises 2 h, 1st period. Case studies seminars 20 h, final seminar 4 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, literature work 30%, homework 20%, case studies 50%.	
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, INT 43 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.
Modes of Study	Lectures 40 h, 1st-2nd period and intensive week 43. Self-study 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 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.
Modes of Study	Lectures 20 h, 3rd period. Project work 20 h, 3rd period. Self-study 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.

4.3 Master's Programme in Mechanical Engineering

In the Master's degree programme in Mechanical Engineering there is a possibility to select between two majors, major in Design and Manufacturing or major in Packaging Technology. The major 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 conducted in the fourth semester, after other courses have been completed. The major in "Packaging Technology" is a part-time programme leading to the degree of Master of Science in Technology. Teaching is organized 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 conducted after the other courses have been completed. Both majors in the programme leads to the degree of Master of Science in Technology.

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

Aims of the Master's Programme

The objective in both majors is to educate experts in their own areas. In the "Design and Manufacturing" major particular emphasis is placed on 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. It is aimed at students who wish to pursue a career in mechanical engineering industry using advanced engineering techniques.

In the "Packaging Technology" major the emphasis is on packaging materials, converting and packaging technologies and the skills to work throughout the whole packaging chain. This 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 the foundation for both constructive design as well as 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 the 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):
General studies are common to all the students in the programme. The studies provide a brief introduction to the field of mechanical engineering as well as language skills essential for M.Sc. studies.

Major Subject Design and Manufacturing (min 70 ECTS cr):

The person responsible for the major in Design and Manufacturing is professor, D.Sc. (Tech.) Aki Mikkola

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 optimized 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 major in Design and Manufacturing is professor Aki Mikkola (Virtual design). Other professors for major studies in the programme 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 Packaging Technology (min. 70 ECTS cr):

The person responsible for the major in Packaging Technology is professor, Ph.D Henry Lindell

In the mechanical engineering programme, students focus on machine design and manufacturing aspects. In the packaging technology the viewpoint 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 is focused 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 major in Packaging Technolgy is professor Henry Lindell (Packaging technology). Other professors for major studies in the programme are professor 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	1, 2, 3, 4	2
FV11A8900	Academic Writing in English	B.Sc. (Tech.) 3 M.Sc. (Tech.) 1-2 B.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 1-2	1-2, 3-4	4
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 specialization studies to attain 70 ECTS cr together with obligatory courses.

Specialization Studies in Design

List of selectable 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
BK70A0000	Simulation of a Mechatronic Machine	M.Sc. (Tech.) 1	1-2	6
BK70A0500	Machine Dynamics	M.Sc. (Tech.) 2	1-2	6
BK80A1200	FE-analysis Course	M.Sc. (Tech.) 1	3-4	5

Specialization Studies in Manufacturing

List of selectable courses		*year*	*per.*	*ECTS cr*
BK10A0100	Individual Project Work	M.Sc. (Tech.) 1	1-4	6
BK20A0401(*	Modern Welding Technology	M.Sc. (Tech.) 1	1-2	9
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
BK30A0900	Additive Manufacturing	M.Sc. (Tech.) 2	3-4	5
BK50A2700	Selection Criteria of Structural Materials	M.Sc. (Tech.) 1	1-2	6
BK90C1800	Green Fiber Materials	M.Sc. (Tech.) 1	4	5

*) Course can not be included in the same degree as BK20A2200 Basics of Welding Technology

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
**) The maximum amount of credits is limited to 10 ECTS

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

Elective Studies (min. 17-19 ECTS cr):
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.

Master Thesis and Seminar (30 ECTS cr):
The Master´s thesis is a research or design project, which will be written after the other courses have been completed. It is carried out in 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	1, 2, 2	
	B.Sc. (Econ. & Bus. Adm.) 2-3	3, 4	
FV11A8900 Academic Writing in English	B.Sc. (Tech.) 3	1-2, 4	
	M.Sc. (Tech.) 1-2	3-4	
	B.Sc. (Econ. & Bus. Adm.) 3		
	M.Sc. (Econ. & Bus. Adm.) 1-2		

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
BK20A0401	Modern Welding Technology	M.Sc. (Tech.) 1	1-2	9
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	1-2	6
BK70A0000	Simulation of a Mechatronic Machine	M.Sc. (Tech.) 1	1-2	6

[*] Obligatory for all

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.

Minor 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 in Manufacturing

Obligatory Studies (20 op)		*per.*	*op*
BK20A2200[*]	Basics of Welding Technology	2	3
BK30A0600	Laser Based Products and Production Technology	3-4	5
BK50A0701	Advanced Production Engineering	1-2	6
BK50A2700	Selection Criteria of Structural Materials	1-2	6

[*] Course can not be included in the same degree as BK20A0400 Modern Welding Technology

Minor 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
BK20A0401	Modern Welding Technology	9
BK20A2200	Basics of Welding Technology	3
BK30A0600	Laser Based Products and Production Technology	5
BK30A0700	Laser Materials Processing	5
BK30A0801	Laboratory Course of Laser Processing Technology	4
BK30A0900	Additive Manufacturing	5
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
BK70A0000	Simulation of a Mechatronic Machine	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 the students of Master's Degree 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 module is to prepare the student for a scientific approach in the M.Sc. thesis work. After having passed this course module the student is able to apply scientific research methods and carry out a 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.	
Modes of Study	10 h of lectures, 1st-4th period. 146 h of tutorials and independent projects, 1st-4th period. 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 Study Coordinator in Charge, M.A. Minna Loikkanen Person in Charge: Study Coordinator in Charge, M.A. Minna Loikkanen	
Aims	A) The course provides the student with basic knowledge of studying at LUT in general and particularly at his/her faculty and degree programme. The course helps the student to plan his/her studies at LUT and follow the progress of his studies with a help of WebOodi's personal study plan. B) The student learns to use the Moodle learning base which is widely used at LUT. The key topic of the web course is to learn about information searching and the information sources available at LUT. After completing the course, the student knows how to search the Library online catalog Wilma and how to find printed and electronic material from the Academic Library collections and databases.	
Content	The Orientation Days activities. Degree requirements. Planning of Master's studies. Making of the electronic personal study plan at the ePSP workshop. Use of the Moodle learning base. The Academic Library collections and databases.	
Modes of Study	Participation in the Orientation Days activities 15 h, 1st period. Library tour 1 h, 1st period. Assignments of information searching, library use and databases on Moodle. Information sources and information retrieval, lecture and exercises 2 h, 1st period. ePSP workshop 2 h, 1st period. Independent study 6 h. Total workload 26 h. Moodle is used in this course.	
Evaluation	Pass/Fail	
Study materials	The Orientation Days, Study Guide, Information Searching 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 module is selected for the major studies of packaging technology, the maximum amount of credits is limited to 10 ECTS.**	
Year and Period		
Teacher(s)	N. N. Person in Charge: Head of the Laboratory	
Aims	To give the student a deeper understanding on mechanical engineering in a specialized area.	
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.	
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 module the student is able to: - plan, lead and organize the research project according to the established scientific practices and procedures - compare, choose and utilize 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 scientific contribution. Scientific research projects in engineering science. Principles of qualitative and quantitative analysis. Viewpoints of how to illustrate the results of quantitative analysis. Different means to carry out literature reviews, interviews and surveys. Utilization of silent knowledge. Contents and structures of research plans and research structures based on IMRAD-principle. Viewpoints of writing scientific articles and conference papers. Practical advice about making a conference presentation. Guidelines of acting as an opponent in a scientific conference or seminar.	
Modes of Study	Lectures 12 h, 1st period. Exercises 24 h, 1st-2nd period. Independent study 48 h, 1st-2nd period. Seminar 20 h, 2nd period. Total workload 104 h.	
Evaluation	0-5, exercises 30%, seminar 70%.	
Study materials	Lectures.	
Further	This course has 1-5 places for open university students. More information on	

Information	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.	
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 researcher/teachers of the major subject Person in Charge: Doctoral Student, M.Sc. (Tech.) Merja Huhtala	
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. Student is able to combine theory and practice: he/she can exploit theory in solving problems in scientific research. The student is capable of independent and target-oriented working, can set goals for him/her self-concerning results and time schedules. The student manages extensive and versatile data acquisition knowhow.	
Content	The Master's thesis is a research project by nature, 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, student must show capability to work independently according to defined plans and goals. Course includes seminars.	
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. Thesis includes a seminar, where are present students who are starting to write the Master's thesis and students who are about to graduate, and their supervisors. In the final stages, each student in his/her turn represents briefly their work's goals, content and results. Student must participate other seminars (listen at least 3 seminars) before starting his/her own thesis, and also have his/her own at the end of the work. Introductory lecture 2 h, 1st and 3rd period. Seminars 2 h, 1st-4th period. Independent study 775 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%. Seminars passed; students have to attend at least 3 seminars and give their own presentation. Press release accepted/fail.
Study materials	LUT Master's thesis instructions. Seminar instructions in Moodle.

BK20A0401	***MODERN WELDING TECHNOLOGY***	***9 ECTS cr***
	Modern Welding Technology **Replaces the course BK20A0400 Modern Welding Technology. Course cannot be included in the same degree as BK20A2200 Basics of Welding Technology.**	
Year and Period	M.Sc. (Tech.) 1 Period 1-2	
Teacher(s)	University Lecturer, Lic.Sc. (Tech.) Raimo Suoranta Post-Doctoral Researcher, D.Sc. (Tech.) Paul Kah	
Aims	After having passed this course module the student is able to: - identify and define the special features welding in production and product design - select proper processes and welding procedures for different materials.	
Content	Productivity, economy and quality in welding. Welding costs. Productive and efficient new welding processes. Basics of welding metallurgy. Mechanization and robotization of welding. Basics of design of welded structures. Bevelling methods. The quality, environmental and safety in welding workshop.	
Modes of Study	Lectures 24 h, 1st-2nd period. Tutorials 14 h, seminar, 1st-2nd period. Independent study 140 h. Total workload 182 h. Moodle is used in this course.	
Evaluation	0-5, examination 80%, seminar 20%.	
Study materials	Lecture notes.	
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.	

BK20A2200	***BASICS OF WELDING TECHNOLOGY***	***3 ECTS cr***
	Basics of Welding Technology **Course cannot be included in the same degree as BK20A0401 Modern Welding Technology**	
Year and Period	M.Sc. (Tech.) 1 Period 2	
Teacher(s)	University Lecturer, Lic.Sc. (Tech.) Raimo Suoranta	
Aims	After having passed this course module the student is able to: - identify and define the special features of quality management in production	

	of welded constructions and - evaluate the influence of welding to material properties.
Content	Productivity, economy and quality in welding. Welding costs. Weldability of the most common materials. Basics of mechanization and robotization of welding. Basics of design of welded structures. Quality management.
Modes of Study	Lectures 12 h, 2nd period. Independent study 68 h. Total workload 80 h.
Evaluation	0-5, examination 100%.
Study materials	Lecture notes.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

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 module the student: - is able to compare and generalize the special features of laser processing systems in production and the impact and utilization of special features of these processes on product design - knows how to select and develop proper process and processing procedure for processing of different materials - is able to utilize means of process monitoring to practice.
Content	Knowledge on different laser equipment, resonator types, accessories and processing systems and requirements of different ways to process material with laser beam. The principles of systems used for production. Tools of beam forming, guiding and modification. Knowledge on performance of most common laser processes like laser welding, cutting, marking, micro processing, additive manufacturing and surface treatment. Optical components used with laser processing, safety and quality assurance. Practical cases. Principles of utilization of laser based processes in product design. Economical aspects of laser materials processing. Utilization of the potential of laser processing possibilities on the product design. Special features of laser processing methods for product design.
Modes of Study	Lectures 28 h, 3rd-4th period. Seminar 14 h, 3rd-4th period. Individual work 88 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, written exam 80%, seminar 20%.
Study materials	Steen W., Laser Material Processing.
Prerequisites	Obligatory BK30A0000 Sädetyöstö or BK30A0801 Laboratory Course of Laser Processing Technology accepted.
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 Docent, D.Sc. (Tech.) Veli Kujanpää Person in Charge: Professor, D.Sc. (Tech.) Antti Salminen
Aims	After having passed the course module the student: - is able to compare and select the special features of laser materials processing processes - knows how to select and optimize proper process and processing procedure for different materials - is able to develop processes for different applications.
Content	Laser beam material interaction, transmission, reflection, absorption. The features of different materials and laser beams on phenomena. Heating, melting, vaporizing, ablating material with laser beam. Behaviour of molten material, heat transfer mechanisms. Formation of keyhole and phenomena connected. Knowledge on existing ways to process material with laser beam and the effect of laser beam material interaction on that. Knowledge on most common laser processes like laser welding, cutting, marking, drilling, scribing, micro processing additive manufacturing and surface treatment. Practical cases, applications will be combined to theory.
Modes of Study	Lectures 28 h, 1st-2nd period. Seminar 14 h, 1st-2nd period. Individual work 88 h. Total workload 130 h. Moodle is used in this course.
Evaluation	0-5, written exam 80%, seminar 20%.
Study materials	Steen W., Laser Material Processing. Ion, J., Laser Processing of Engineering Materials.
Prerequisites	Obligatory BK30A0000 Sädetyöstö or BK30A0801 Laboratory Course of Laser Processing Technology accepted.
Further Information	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 **Replaces the course BK30A0800 Laboratory Course of Laser Materials Processing.**
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: Researcher, D.Sc. (Tech.) Heidi Piili
Aims	After having passed the course module the student is able to: - describe, specify and compare the special features and practical aspects of laser materials processing practices of different materials and - classify them for different processes.
Content	Basics of laser processes, systems and equipment. Processability of common engineering materials with different processes. Practical using of laser processes. Lectures for this course are similar to BK30A0000 Sädetyöstö.
Modes of Study	Lectures 10 h, 1st period. Laboratory practices 14 h, 1st-2nd period. Individual work 80 h. Total work load 104 h.
Evaluation	0-5, written exam 50%, reports of laboratory practices 50%. Both have to be passed for course completion.
Study materials	Lecture notes.

	Steen, W., Laser Material Processing.

BK30A0900	***ADDITIVE MANUFACTURING***	***5 ECTS cr***
	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 module the student: - knows the basic technologies of additive manufacturing (AM) aka 3D printing - is able to compare and select the special features of additive manufacturing processes - knows how to select proper process and equipment - knows the basics about product design for additive manufacturing (AM) aka 3D printing.	
Content	Additive manufacturing (AM) aka 3D printing processes, equipment etc. Laser beam material interaction. Principles of utilization of additive manufacturing in product design. Economic aspects of additive manufacturing. Utilization of the potential of additive manufacturing on the product design. Special features of additive manufacturing methods for product design. Practical cases and applications.	
Modes of Study	Lectures 28 h, 3rd-4th period. Tutorials 14 h, 3rd-4th period. 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.	
Prerequisites	Obligatory BK30A0000 Sädetyöstö or BK30A0801 Laboratory Course of Laser Processing Technology accepted. Preferably BK30A0600 Laser Based Products and Production Technology and BK30A0700 Laser Materials Processing accepted.	
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, D.Sc. (Tech.) Juha Varis Associate Professor, Docent, D.Sc. (Tech.) Harri Eskelinen Researcher, D.Sc. (Tech.) Mika Lohtander Doctoral Student, M.Sc. (Tech.) Ville Leminen Doctoral Student, M.Sc. (Tech.) Merja Huhtala Development Manager, M.Sc. (Tech.), M.Sc. (Econ. & Bus. Adm.) Mika Kainusalmi	
Aims	After having completed this course module 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 especially 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.
Modes of Study	Lectures 28 h, 1st-2nd period. Seminar lecture 2 h, 1st period. Seminars 18 h, 2nd period. Seminar work (pair work) and working as an opponent 65 h, 1st-2nd period. Independent study 30 h. Industry visit 12 h in 1st or 2nd period. 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. 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, Ph.D. Henry Lindell 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 module the student is able to: -choose and evaluate paper and board converting technologies -compare and analyze 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.
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, Ph.D. Henry Lindell 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, Ph.D. Henry Lindell	
Aims	After having passed this course module the student is able to: -explain and categorize 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 packageing, 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.	
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 as 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 SUSTAINABILITY***	***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 Professor, Ph.D. Henry Lindell N. N. (visiting lecturer from industry) Person in Charge: Professor, Ph.D. Henry Lindell	
Aims	After having passed this course module the student is 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 fibers -understand the interaction of package and the 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 standardization of packages in EU. Sustainability concerning packaging legislation on product safety aspects and traceability. Testing of packages. Interaction of package	

	and the content.
Modes of Study	Lectures total 24 h, 3rd-4th period. 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, Ph.D. Henry Lindell Professor, D.Sc. (Tech.) Kaj Backfolk N.N. (visiting lecturer from industry) Person in Charge: Professor, Ph.D. Henry Lindell	
Aims	After having passed this course module the student is able to: -understand and evaluate the influence of the substrate on the print quality -compare and analyze different printing methods used in packaging industry -choose proper printing methods for a certain package solution -solve printing problems and to control print quality -justify the importance of 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 packaging industry. Printing on various substrates. Composition of printing inks. Emerging printing technologies and their potential use in packaging industry. Future trends of printing technologies. Aspects of the role of package in the value chain. Demands set on the lay-out of a package. Various ways for idea generation of package lay-out.	
Modes of Study	Lectures total 26 h, 2nd-3rd period. 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 student knows:	

	- how to dimension the most essential machine elements according to the requirements of their strength, reliability, lifetime and wear - how to carry out mechanisms 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 mechanisms types, mechanisms 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.
Modes of Study	Lectures total 12 h, 1st period. Exercises total 12 h, 2nd period. Project work 86 h, 1st-2nd period. 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.
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, Ph.D. Henry Lindell Professor, D.Sc. (Tech.) Kaj Backfolk Docent, D. Sc. (Tech.) Ali Harlin Person in Charge: Professor, Ph.D. Henry Lindell	
Aims	After having passed this course module the student is 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. Foreseeable future development of each material. Material composite possibilities and their use.	
Modes of Study	Lectures total 24 h, 1st period. Seminar 8 h, 1st. 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, Ph.D. Henry Lindell Professor, D.Sc. (Tech.) Kaj Backfolk Person in Charge: Professor, Ph.D. Henry Lindell	
Aims	After having passed this course module the student is 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 main coating and laminating methods. Main properties (including printing) of the finished products. Focus i in 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.
Modes of Study	Lectures total 28 h, 2nd period. 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, Ph.D. Henry Lindell
Aims	After having passed this course module the student is able to: -explain basic general, organic and biochemical phenomena -explain and categorize basics of paper technology and products -define packaging related features of processed food.
Content	Basic phenomena of general, organic and biochemistry. 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.
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, p 1-7, 36-44, 194-324 or Smook G.A., Handbook for Pulp & Paper Technologists, 3rd edition, p 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 p 7-62, III and IV, p 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 **Replaces the course BK50A2300 Konstruktiomateriaalit ja niiden valinta and the course BK20A0101 Materials Engineering.**

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 module the student is able to: - apply and develop systematic and analytical means and tools of systematic material selection approaches into solving cross-technological material selection tasks - define and analyse the properties, the strengths, the weaknesses and the application areas of the main groups of constructional materials for different types of applications - is able to justify and build generalized models to take into a count 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 - is able to evaluate and utilize recent results and documents of material science - derive analytical models based on the principles of LCC's, LCA's 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 material science and technology will be discussed. Aspects of selecting and comparing different materials are discussed from the viewpoints of functionality, manufacturing aspects, 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 the material selection tasks will be discussed. Principles to formulate and solve the materials solution tasks based on analytical and systematic approaches and means to develop models to support the selection process staring from the product's requirement list will be discussed in details. Multi-language teaching environment will be utilized during the project work.
Modes of Study	Lectures 12 h, 1st period. Lectures 12 h, 2nd period Exercises 24 h, 1st-2nd period. Project work 88 h. Independent study 20 h. Total workload 156 h.
Evaluation	0-5, project work 70%, exercises 30%.
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. For Finnish students: Eskelinen & Karsikas, Vihreän teknologian näkökulmat konstruktiomateriaalien valinnassa, ISBN 978-952-265-457-1.
Prerequisites	Recommended BK20A1600 Metalliopin ja valmistustekniikan peruskurssi completed.
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 behavior of fluid power transmission components and system. Skills for dimensioning hydraulic components for various systems. Skills for design fluid power transmissions for industrial and mobile machines. Ability to analyze hydraulic component and systems through modeling and simulation.	

Content	Fluid power system structures, hydraulic fluids, hydraulic transmission lines, pumps, motors, cylinders, basic control valves, servo valves, accessories, hydraulic servo systems, modeling and simulation of hydraulic components and circuits.
Modes of Study	Lectures 36 h, 3rd-4th period. Tutorials 36 h, 3rd-4th period. 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 Master's Degree 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 the theoretical and practical expertise in the analysis and design of control systems as well as programming and control of robotic machines. The application of control system strategies covers a wide area and the course provides a sound base for the study of both classical and modern techniques. After having passed this course module, the student is able to: - model and simulate the control of mechatronic machines - design servo control systems for hydraulic, pneumatic and electro-machines e.g., by utilizing the frequency- and time-domain methods - programming and control 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 time- and frequency-domain. Different control strategies are introduced, mainly classical with some concepts of modern control. Design and analysis of digital control will be introduced. During this course, the design, analysis and simulation using Matlab/Simulink are conducted.
Modes of Study	Lectures 36 h, 1st-2nd period. Tutorials 36 h, 1st-2nd period. Exercises 36 h, 2nd period. 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 text books: 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 modeling, programming and simulation tools and methods are introduced for students of mechanical engineering and other departments with related background in control engineering and mechatronic. Students will learn how the related computer packages such as MATLAB, SIMULINK, C++ and LabVIEW can be used to solve and analyze Control and Mechatronic problems using Control theory. 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 control problems using their own codes, algorithms and designs. Then more complex problems will be taught to solve using SIMULINK package. After this course, they will be able to start working on various topics in mechatronic for advanced designs or analysis.
Content	Introduction to Control & Mechatronics and related problems such as: - Theoretical and practical expertise in the analysis and design of control systems - Programming and control mechatronic machines e.g., a robotic machine - The application of control system strategies in wide area of both classical and modern techniques - Model and simulation of control of mechatronic machines - Design control systems for hydraulic, pneumatic and electro-machines e.g., by utilizing the frequency- and time-domain methods - Application of computational packages (such as MATLAB, SIMULINK, LabVIEW, C++ and etc.) in solving control problems - PLC and Micro controllers 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 time- and frequency-domain. Different control strategies are introduced, mainly classical with some concepts of modern control. Design and analysis of digital control will be introduced.
Modes of Study	Lectures 36 h, 1st-2nd period. Tutorials 36 h, 1st-2nd period. Exercises 36 h, 2nd period. 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 text books: 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.

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 possesses the theories and practices of mathematical modeling and computer simulation of machine systems, which are either hydraulically or pneumatically actuated. The student is able to utilize simulations as an integrated tool of product design and he can utilize his skills to generalize the theories of engineering design to solve multidisciplinary design tasks. The student is able to compare and justify the use of different constructional solutions for linear and rotating motion mechanism based on their static, kinematic and dynamic analysis. The student is able to individual scientific work to simulate mechatronic machines.
Content	Principles of multibody dynamics, modelling of actuators, coupled simulation. The use of Lagrangian equation. Constraint equations and Lagrangian multipliers. Inertia of rigid bodies. Modeling of hydraulic components. Numerical integration of the equation of motion. Individual utilization of simulation software, which includes also the principles of how to apply previous mentioned mathematical theories into handling and solving abstract and multidisciplinary problems.
Modes of Study	Lectures 24 h, 1st-2nd period. Teamwork in multi-cultural working environment 30 h, 1st-2nd period. Supervised tutorials 24 h, 1st-2nd period. Independent study 78 h, 1st-2nd period. Total loading 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 BK80A0000 Statiikka, BK80A0100 Dynamiikka IBK80A2500 Dynamiikka II (not required from students of Master's Degree 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

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 student knows: - 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 analyze the results - 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 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, 1st-2nd period. Supervised tutorials 20 h, 1st-2nd period. Laboratory work 4 h. Independent study 76 h, 1st-2nd period. Teamwork in multi-cultural working environment 32 h, 1st-2nd period. 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 BK80A0100 Dynamiikka I, BK80A2500 Dynamiikka II (not required form students of Master's Degree Programme in Mechanical Engineering) and BK80A1100 FE-analyysin peruskurssi or BK80A1200 FE-analysis Course.
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)	Associate Professor, D.Sc. (Tech.) Pasi Tanskanen Professor, D.Sc. (Tech.) Timo Björk	
Aims	Students understand the mathematical foundations of finite element analysis and are able to use a commercial finite element program 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 the problem solving. In the tutorials the student will be acquainted with FE modelling using commercial software.	
Modes of Study	24 h of lectures, 3rd-4th period. 24 h of tutorials, 3rd-4th period. Independent study 74 h. Overall 130 h. Moodle is used in this course.	
Evaluation	0-5, examination 50%, exercises 50%.	
Study materials	The material is to be specified during lectures.	

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.
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, M.Sc. (Tech.) Marko Hyvärinen Person in Charge: Professor, D.Sc. (Tech.), D.Sc. (Agr. & For.) Timo Kärki	
Aims	After having passed this course module the student is able to: - estimate different fiber resources available - define concepts and entities related to fiber usage - conclude and ground what kind of properties fibers have in relation to growth and functions of fiber cells - compare structures and properties of fiber materials and their effects on 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. Analyzing of fibres with Franklin method. Physical and mechanical properties. Empirical methods for defining strength properties. Modeling of relations between physical/mechanical/end use properties. Introduction to fiber based composites.	
Modes of Study	Lectures 24 h, 4th period. Exercises 42 h, 4th period. 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.	

4.4 Master's Programme in Computational Science and Physics

The Master's Degree Programme in Computational Science 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 Ph.D. Matti Heiliö

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, Ph.D. Erkki Lähderanta

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.

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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.

The masters graduated from Intelligent Computing are able to apply their capabilities, scientific knowledge, and 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	2, INT 43	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
FV11A8900	Academic Writing in English	B.Sc. (Tech.) 3 M.Sc. (Tech.) 1-2 B.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 1-2	1-2, 3-4	4
FV18A9101(**	Finnish 1		1, 3	2

*) Only for students who have no Matlab programming courses in earlier studies
**) Foreign students are required to study 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 selectable 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
BM20A3900	Modelling Methodology in Process Engineering	M.Sc. (Tech.) 1	1, INT 43	6
BM20A6000	Ecomathematics	M.Sc. (Tech.) 1	3-4	5

b) Data Driven Modelling

List of selectable 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
BM20A3900	Modelling Methodology in Process Engineering	M.Sc. (Tech.) 1	1, INT 43	6

c) Numerical Methods, Optimization and Scientific Computing

List of selectable 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, INT 17	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 selectable 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 selectable 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.

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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.) 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.) 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	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.) 1	3-4	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 selectable 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, INT 17	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
BM20A3900	Modelling Methodology in Process Engineering	M.Sc. (Tech.) 1	1, INT 43	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
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
CT30A7500	Parallel Computing	M.Sc. (Tech.) 2	1-4 (book)	5

Minor Subject (a 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 student 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

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

General Studies (5 ECTS cr)

Obligatory Studies (5 ECTS cr)	*year*	*per.*	*ECTS cr*
BK10A0300 Introduction to M.Sc. Studies	M.Sc. (Tech.) 1	1	1
FV11A8900 Academic Writing in English	B.Sc. (Tech.) 3	1-2,	4
	M.Sc. (Tech.) 1-2	3-4	
	B.Sc. (Econ. & Bus. Adm.) 3		
	M.Sc. (Econ. & Bus. Adm.) 1-2		

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.) 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.) 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 degree at LUT, Computational Science 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 op)		*year*	*per.*	*ECTS cr.*
FV11A8900	Academic Writing in English	TkK 3, DI 1-2,	1-2, 3-4	4

	KTK 3, KTM 1-2

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	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.) 1	3-4	4
BM40A1200	Digital Imaging and Image Preprocessing	M.Sc. (Tech.) 1	1-2	7

1) Exchangeable

The student chooses a minimun of 6 ECTS cr to attain 66 ECTS cr of major subject studies.

List of selectable 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
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, INT 17	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
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
CT30A7500	Parallel Computing	M.Sc. (Tech.) 2	1-4 (book)	5

Minor in Technomathematics 20 ECTS cr

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, INT 17	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
BM20A3900	Modelling Methodology in Process Engineering	1, INT 43	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 in Technical Physics 20-26 ECTS cr
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
BM30A2100	Microelectronics Processing Technology	1-2	2
BM30A2200	Semiconductor and Superconductor Physics	1-2	6
BM30A2500	Nanophysics	1-2	6

Minor in Intelligent Computing 20 ECTS cr

Obligatory Studies, choose at least two courses from following courses		*year*	*per.*	*ECTS cr*
BM40A0700	Pattern Recognition	M.Sc. (Tech.) 1	1-2	7
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
BM40A1200	Digital Imaging and Image Preprocessing	M.Sc. (Tech.) 1	1-2	7

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

List of selectable courses		*year*	*per.*	*ECTS cr*
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
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
BM20A3203	Fuzzy Engineering and Decision Making	M.Sc. (Tech.) 1-2	3-4	6
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
BM40A0600	Introduction to Computer Graphics	M.Sc. (Tech.) 1-2	2	5
BM40A0700	Pattern Recognition	M.Sc. (Tech.) 1	1-2	7
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
BM40A1200	Digital Imaging and Image Preprocessing	M.Sc. (Tech.) 1	1-2	7

Course Descripions in Computational Science 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
BM20A1300	Complex Analysis	3
BM20A1901	Statistics II	4
BM20A2000	Simulation	4
BM20A2500	Linear Algebra and Normed Spaces	3
BM20A2600	Integral Transforms	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
BM20A3900	Modelling Methodology in Process Engineering	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: Associate Professor, Ph.D. Matti Heiliö
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 PhD Matti Heiliö, physics lecturer B.A. Jari Soininen, intelligent computing PhD 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. Matti Heiliö Internship coordinator in physics: Lecturer, B.A. Jari Soininen
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 technomathematics and technical physics 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 **Replaces the course CT10A9500 Research Methods.**	
Year and Period	M.Sc. (Tech.) 1 Period 2, INT 43	
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 15 h, exercises and assignments 10 h, intensive week 43. Practical assignment 30 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 **Replaces the course CT10A9601 Research Methods, Laboratory Project.**	
Year and Period	M.Sc. (Tech.) 1 Period 1-4	
Teacher(s)	Professor, Ph.D. Erkki Lähderanta Post-Doctoral Researcher, D.Sc. (Tech.) Jouni Sampo 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.

BM20A1300	***COMPLEX ANALYSIS***	***3 ECTS cr***
	Complex Analysis, Kompleksianalyysi **Lectured last time during the academic year 2014-2015.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 3	
Teacher(s)	Lecturer, Lic.Phil. Paavo Kukkurainen Person in Charge: Professor, Ph.D. Heikki Haario	
Aims	In the end of the course student is expected to be able to understand - complex numbers and functions, conformal mapping - derivative of a complex function and analytical functions - complex integration, Cauchy's theorem, complex series and Residue theorem - the necessary knowledge of complex analysis needed in technical applications.	
Content	Complex number arithmetics. Complex functions, also as mappings of complex plane. Derivative of a complex function and analytical functions. Complex integration, Cauchy's theorem and Residue theorem.	
Modes of Study	Lectures 28 h, exercises 14 h, homework 7 h, preparing to the exam and the exam 29 h, 3rd period. Overall 78 h.	
Evaluation	0-5, examination 100%.	
Study materials	Kreyszig, E.: Advanced Engineering Mathematics, 8th Ed., Part D.	
Prerequisites	Recommended Mathematics A and B.	
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	

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 Person in Charge: Professor, Ph.D. Heikki Haario
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)	Post-Doctoral Researcher, 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.

BM20A2600	*INTEGRAL TRANSFORMS* *3 ECTS cr*
	Integral Transforms, Integraalimuunnokset **Lectured last time during the academic year 2014-2015.**
Year and Period	B.Sc. (Tech.) 3 Period 4 The course is suitable also for doctoral studies.
Teacher(s)	Associate Professor, D.Sc. (Tech.) Joonas Sorvari
Aims	In the end of the course student is expected to be able to - apply Laplace transform to solve differential equations and use this knowledge to solve engineering applications - understand Fourier series and Fourier transform and apply them - understand Z-transform and apply it.
Content	Laplace transform. Inverse Transform. Linearity. Shifting. Transforms of Derivatives and Integrals. Differential equations. Unit Step Function. Second Shifting Theorem. Dirac's delta function, Differentiation and Integration of Transforms. Convolution. Integral Equations. Partial Fractions. Differential Equations. Fourier series, complex Fourier series, Fourier integrals, Fourier cosine and sine transforms, Fourier transform. Z transform, inverse Z transform, discrete-time systems and difference equations, discrete linear systems, engineering applications.
Modes of Study	Lectures 24 h, exercises 12 h, 4th period.
Evaluation	0-5, examination 100%.
Study materials	Kreyszig, E.: Advanced Engineering Mathematics, Wiley, 1999. James, G.: Advanced Modern Engineering Mathematics, Addison-Wesley, 2003.
Prerequisites	Recommended Mathematics A and B.
Further Information	This course has 1-15 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: Professor, D.Sc. (Tech.) Matti Alatalo
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. Ill-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	
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 2014 - 2015.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 4, INT 17 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 24 h, exercises 24 h, homework 54 h, 4th period. Lectures 4 h, exercises 4 h, intensive week 17. Study and exam 20 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 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)	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, Docent, 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, relations, universal approximation, fuzzy compositional calculus, aggregation operators.
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, Docent, 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)	Professor, Ph.D. Heikki Haario 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. Mixture designs. 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 2014 - 2015.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4 The course is suitable also for doctoral studies.	
Teacher(s)	Associate Professor, Docent, 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: Associate Professor, Ph.D. Matti Heiliö	
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.	

BM20A3900	***MODELLING METHODOLOGY IN PROCESS ENGINEERING***	***6 ECTS cr***
	Modelling Methodology in Process Engineering, Mallinnus prosessitekniikassa	
Year and Period	M.Sc. (Tech.) 1 Period 1, INT 43	

Teacher(s)	Associate Professor, Ph.D. Tuomo Kauranne Doctoral Student, M.Sc. (Tech.) Ville Manninen Doctoral Student, M.Sc. (Tech.) Miika Tolonen Person in Charge: Associate Professor, Ph.D. Tuomo Kauranne
Aims	The student knows the principles of regression analysis and mathematical modeling in process engineering and is able to build simple mathematical models for chemical processes using Matlab and calibrate their parameters with measurement data.
Content	Types of modelling: empirical and physicochemical models and their uses. Measurement of uncertainty in experimental data. Basic concepts of regression methods for empirical models. Building physicochemical models for engineering processes from first principles. How to employ various mathematical tools to formulate and numerically solve models. Least squares methods, curve fitting, parameter estimation and data assimilation. Examples from data analysis, process modelling, pulp and paper technology, chemical engineering, and signal processing among others. Examples and exercises with Matlab.
Modes of Study	Lectures 24 h, computer class exercises 14 h, independent study 48 h, completing a practical assignment and writing a report 70 h, 1st period and intensive week 43. Total 156 h.
Evaluation	Pass/fail.
Study materials	Giordano, Frank R. - Weir, Maurice D. - Fox, William P.: A first course in mathematical modeling, Brooks/Cole, 1997. Borrelli, R., Coleman, C.: Differential Equations: A Modeling Perspective, John Wiley & Sons, 2003. Svobodny, T.: Mathematical Modeling for Industry and Engineering, Prentice Hall, 1998.
Prerequisites	First year university calculus. Recommended BM20A1401 Tilastomatematiikka I, BM20A1501 Numeeriset menetelmät I, BM20A1601 Matriisilaskenta, BM20A2102 Differential Equations.
Further Information	This course has 1-15 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)	Professor, Ph.D. Heikki Haario 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 2014 - 2015.**	
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 2014 - 2015.**	
Year and Period	M.Sc. (Tech.) 2 Period 2 The course is suitable also for doctoral studies.	
Teacher(s)	N.N. Person in Charge: Post-Doctoral Researcher, D.Sc. (Tech.) Jouni Sampo	
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 **Replaces the course BM20A5000 Principles of Technical Computing and Scientific Publishing.**	
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, D.Sc. (Tech.) Joonas Sorvari Professor, Ph.D. Jari Hämäläinen	
Aims	The student knows basic equations of mass and heat flow, physics of electric fields, acoustics, radiation and is able of use physical principles and conservation laws to model multiphysical systems and behaviour of materials, describe boundary conditions and choose ways to describe turbulence and multiscale phenomena. 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: Associate Professor, Ph.D. Matti Heiliö Professor, Ph.D. Jari Hämäläinen	
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)	Professor, D.Sc. (Tech.) Matti Alatalo
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 **Replaces the course BM20A4201 Applied Functional Analysis.**	
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.) Jouni Sampo	
Aims	Student understand and is able to use classical methods for solving inverse problem of estimation of signal from incomplete or corrupted measurements. Student understand 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.	
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.) 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.) 2 Period 1-2 The course is suitable also for doctoral studies.	
Teacher(s)	N. N. 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 **Replaces the course CT10A9100 ECSE International Summer School in Novel Computing.**	
Year and Period	M.Sc. (Tech.) 2 Period 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 every year. Lectures will be held 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.
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 **Replaces the course CT50A5700 Introduction to Computer Graphics.**
Year and Period	M.Sc. (Tech.) 1-2 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 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. Open GL 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 **Replaces the course CT50A6000 Pattern Recognition.**
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. Reinforcement learning. Unsupervised learning.
Modes of Study	Lectures 18 h, lecture preparation 12 h, exercises 12 h, exercise preparation 24 h, 1st period. Lectures 18 h, lecture preparation 12 h, exercises 12 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	BM20A5800 Funktiot, lineaarialgebra ja vektorit, BM20A5810 Differentiaalilaskenta ja sovellukset, BM20A5820 Integraalilaskenta ja sovellukset, BM20A5830 Differentiaaliyhtälöiden peruskurssi, BM20A5840 Usean muuttujan funktiot ja sarjat, CT60A0210 Käytännön ohjelmointi, BM20A1401 Tilastomatematiikka I. Recommended 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 **Replaces the course CT50A6100 Machine Vision and Digital Image Analysis.** **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)	Professor, D.Sc. (Tech.) Heikki Kälviäinen
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.
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 **Replaces the course CT50A6201 Computer Vision.**
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.
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 **Replaces the course CT50A6501 Seminar on Intelligent Computing.**
Year and Period	M.Sc. (Tech.) 1 Period 3-4
Teacher(s)	Professor, D.Sc. (Tech.) Heikki Kälviäinen
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 3rd 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 4th period) which consists of seminar presentations given by the participating students.
Modes of Study	Seminar presentations 8 h, 3rd period. Seminar presentations 4 h, 4th 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, 3rd and 4th period. Total workload 100 h.
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	
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 practise.	
Content	Electromagentic 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, practical assignment 40 h, 2nd period. Self-study 19 h. Exam 3 h. 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.
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.

5. LUT SCHOOL OF INDUSTRIAL ENGINEERING AND MANAGEMENT

5.1 Master's Programme in Computer Science

Aims and Learning Outcomes

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 in the field of computer science. The degree programme combines up-to-date research knowledge and the fundamentals of computer science and enables learning with modern and efficient teaching methods. The degree programme has had the label "The Quality Education Unit of Lappeenranta University of Technology" since year 2007.

The degree programme in Computer Science educates Masters of Science in Technology for the needs of industry, research institutions, businesses, and public administration. The Master's Degree Programme in Computer Science is offering a major topic; "Software Engineering". Post-graduate studies are also possible in the field. The general objective of the degree programme is to train efficient teamwork-capable experts and to provide them a solid ground for the independent continuation of learning in the ever-changing field of computer science and IT industry.

The graduates from the master's degree programme in Computer Science have a solid foundation in Software Engineering and expertise in the specialities of the major. The graduates are able to work in various roles as members of a group both in domestic and international environments. The learning outcomes in the degree programme are as follows:

Master of Science (Tech.)

- is able to take advantage of the disciplines of scientific consideration and reasoning and is able to exploit scientific approaches and methods
- masters thoroughly the specialities in the selected major
- is able to act as an expert and a developer in their fields of speciality in working life
- understands the foundations of the minor subject selected
- owns good skills in communications and proficiency in a language
- owns good skills in ability as a public performer, in knowledge and capabilities in cultural and multinational aspects, team work, project work, and in leadership and management
- owns ability for doctoral studies and life-long learning in working life.

The masters graduated from the programme are able to participate in software projects in the role of an expert or as a leader and they are able to apply their knowledge and capabilities to the challenges in development projects. The graduates are able to apply scientific knowledge and methods in practice, they are able to communicate both orally and in written form (also perform in public) 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. Furthermore, each major has the following learning outcomes completing the learning outcomes listed for the full program:

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 study programme for the Master of Science (Tech.) is extended over 2 calendar years with the following schedule:

Year 1. (MSc 1): General studies, studies in the major subject, some studies in the selected minor subject, elective studies
Year 2. (MSc 2): Studies in the major subject and minor subject, elective studies

<table>
<tr><td rowspan="2">General Studies 16 ECTS cr</td><td rowspan="2">Major Subject 80 ECTS cr</td><td>Minor Subject 20 ECTS cr</td></tr>
<tr><td>Elective Studies 4 ECTS cr</td></tr>
</table>

Elective studies

Studies in other domestic and foreign universities can be accepted as part of the LUT degree based on the approval of a separate application to the Head of the Degree Programme. The students are also advised to follow the courses offered by the Open University.

Any courses offered by LUT may be included in elective studies. As a general principle the elective studies should be opted such that they support the other studies. 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.

For more information see the Study Affairs Services webpage:
https://uni.lut.fi/en/web/lut.fi-eng/studies2

Programme Specific Information

Students starting in the Master's Degree Programme are expected to have following skills
Students majoring in Software Engineering are expected to have understanding of basic engineering mathematics. The students are expected to have an understanding of 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 will make learning easier.

The student must be able to design and implement a program that uses database through a graphical user interface. The students are expected to be able to work both individually and in project groups. The students are also expected to have a good command of English language.

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: Student Affairs Secretary Suvi Tiainen, room 4430, phone +358 40 502 2196, suvi.tiainen at lut.fi.

Complementary Studies
Students with a degree from a Finnish University of Applied Sciences or Polytechnics or equivalent may have to study complementary studies (20 ECTS cr) which are not included in the Master's degree. The extent of these studies depends on the content of the previous degree. Please, see page 137. Further information: Student Affairs Secretary Suvi Tiainen.

Degree Structure

Master of Science 120 ECTS cr

	ECTS cr
General studies	16
Major subject	80
Minor subject	20
Elective studies	4
Total	*120*

General studies

Obligatory (16 ECTS cr)		*year*	*per.*	*ECTS cr*
CS10A0120	Introduction to M.Sc. Studies in Industrial Engineering and Management	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
FV11A8900	Academic Writing in English	B.Sc. (Tech.) 3 M.Sc. (Tech.) 1-2 B.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 1-2	1-2, 3-4	4
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*
CT30A8902	Service Oriented Architecture	M.Sc. (Tech.) 2	3-4	5
CT60A5100	Software Engineering Methods	M.Sc. (Tech.) 1	1-2	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
CT10A6000	Master's Thesis and Seminar	M.Sc. (Tech.) 2	1-4	30

Elective Studies (min 28 ECTS cr)		*year*	*per.*	*ECTS cr*
CT10A9520	Research Project in Software Engineering	M.Sc. (Tech.) 1	1-4	1-10
CT10A9701	Summer School on Software Engineering	M.Sc. (Tech.) 2		2
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
CS30A7400	Software and Application Innovation	M.Sc. (Tech.) 2	1-2	2
CT30A7500	Parallel Computing	M.Sc. (Tech.) 2	1-4 (book)	5
CT30A8301	Wireless Service Engineering	M.Sc. (Tech.) 1	3-4	7
CT30A9301	Code Camp on Platform Based Application Development	M.Sc. (Tech.) 1-2	1-4 int.	4
CT30A9700	Network Security	M.Sc. (Tech.) 1-2	3-4	4
CT60A5200	Software Projects and Process Improvement	M.Sc. (Tech.) 2	INT 2,10 and 17	7
CT60A7000	Critical Thinking and Argumentation in Software Engineering	M.Sc. (Tech.) 1-2	3-4	4
CT60A7302	Software Quality, Processes, and Organizations	M.Sc. (Tech.) 2	1-2	7
CT60A7400	Fundamentals of Information Systems	M.Sc. (Tech.) 1	1-2	7
CT60A8000	Game Development Project	M.Sc. (Tech.) 1-2		3-5
BM40A0000	International Summer School in Novel Computing	M.Sc. (Tech.) 2	int	1-3
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

Minor Subject, 20 ECTS credits

The minor subject can be selected freely from any LUT minor subject listed in page 292. If the student selects one of the minors from other faculties, 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. Additional information is provided by the study counselling staff of each Master's programme. Please see page 292! One of the possibilities is the following minor: Sustainability.

Minor subject: Sustainability (20 ECTS cr)

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

Elective Studies (96 ECTS cr)		*per.*	*ECTS cr*
BH60A1600	Basic Course on Environmental Management and Economics	2	5
BH60A3101	Introduction to Green Chemistry	1	4
BH60A3201	Advanced Course on Green Chemistry	2	4
BH60A3300	Methods of Green Chemistry in Environmental Technology	3-4	6
BH60A4500	Corporate Responsibility and Management 1	1-4	3
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
BH50A1600	Waste Heat Recovery Techniques	3-4	6
BH61A0600	Bioenergy	1	3
BL40A3000	Wind Power and Solar Energy Technology and Business	3-4	5
BK30A0900	Additive Manufacturing	3-4	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
CT10A7000	Green IT and Sustainable Computing	3-4	4
A350A0500	Sustainable Strategy and Business Ethics	2	3

Elective Studies

Any course given in Lappeenranta University of Technology can be included in elective studies. We recommend courses given by the department of and Finnish for Foreigners language courses.

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

Complementary Studies

Students with a Finnish degree from the University of Applied Sciences or equivalent may have to study complementary studies (20 ECTS cr) which are not included in the Master's degree.

Complementary Studies

(20 ECTS cr)		*year*	*per.*	*ECTS cr*
BM20A1401	Tilastomatematiikka I	B.Sc. (Tech.) 2-3	1-2	3
BM20A5810	Differentiaalilaskenta ja sovellukset	B.Sc. (Tech.) 1	2, INT 43 ja 50	4
BM20A5800	Funktiot, lineaarialgebra ja vektorit	B.Sc. (Tech.) 1	1	3
BM40A0300	Tietorakenteet ja algoritmit	B.Sc. (Tech.) 2	1	5
BM40A0400	Systeemiohjelmointi	B.Sc. (Tech.) 3	1-2	5

5.2 Double Degree Programme in Computer Science

Double degree programme in Computer Science is a co-operative degree programme between LUT and the partner university in Russia.The students will study one year at their home university and then come to LUT for the second year to specialize in one of the two major subjects offered. Student is expected to complete the Master's thesis according to LUT practices. Please, see page 325 for Final thesis instructions.

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

Degree structure

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 totaling to 50 ECTS credits are included as follows:
Major subject 10 ECTS cr
Minor subject 20-25 ECTS cr
Elective studies 15-20 ECTS cr

Major Subject 70 ECTS credits at LUT, Software Engineering

Obligatory Studies (70 ECTS cr)		*per.*	*ECTS cr*
CT10A9510	Research Methods in Software Engineering	1-2	5
CT30A8902	Service Oriented Architecture	3-4	5
CT60A5100	Software Engineering Methods	1-2	5
CT60A7101	Seminar on Software Engineering	3-4	4
CT60A7201	Architecture in Systems and Software Development	3-4	7
CT60A7302	Software Quality, Processes, and Organizations	1-2	7
CT60A7400	Fundamentals of Information Systems	1-2	7
CT10A6000	Master’s Thesis and Seminar	1-4	30

5.3 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

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		3	2
CT60A9000	Towards Semester 3	M.Sc. (Tech.) 1	4	1
CT60A9200	Seminar on Sustainable Software and Services 1	M.Sc. (Tech.) 1	4	3
CT60A9400	Seminar on Sustainable Software and Services 2	M.Sc. (Tech.) 1	4	3
Luleå Univ. of. Tech.	Multimedia Systems			7,5
Luleå Univ. of. Tech.	Swedish for Beginners AI:1a			1,5
Luleå Univ. of. Tech.	Seminar			3
Univ. of Lorraine	French Culture and Language			3

Major Subject, 75 ECTS credits
Software Engineering

Obligatory Studies (75 ECTS cr)		*year*	*per.*	*ECTS cr*
CT30A8902	Service Oriented Architecture	M.Sc. (Tech.) 2	3-4	5
CT30A9301	Code Camp on Platform Based Application Development	M.Sc. (Tech.) 2	3-4 int.	4
CT60A7201	Architecture in Systems and Software Development	M.Sc. (Tech.) 1	3-4	7
CT10A9520	Research Project in Software Engineering	M.Sc. (Tech.) 1-2	3-4	5
Luleå Univ. of. Tech.	Network Programming and Distributed Applications			7,5
Luleå Univ. of. Tech.	Wireless Sensor Networks/Wireless Mobile Networks			7,5
Luleå Univ. of. Tech.	Special Studies in Pervasive and Mobile Computing (Project)			3
Univ. of Lorraine	Specification Definition of Master thesis project			6
CT10A6000	Master's Thesis and Seminar	M.Sc. (Tech.) 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			3
Univ. of Lorraine	Quality of Sustainable Service			3
Univ. of Lorraine	Automatic Control for Sustainable Development			3
Univ. of Lorraine	Systems Engineering			3
Univ. of Lorraine	Sustainable Development & Circular Economy			3
Univ. of Lorraine	Seminar 1			3
Univ. of Lorraine	Seminar 2			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 required and provided by Erasmus Mundus Master's Programme in Pervasive Computing and Communications for Sustainable Development.

5.4 Course Descriptions in Computer Science

		ECTS cr
CT10A0011	Laboratory Work Course in Computer Science	10 - 30
CT10A6000	Master's Thesis and Seminar	30
CT10A7000	Green IT and Sustainable Computing	4
CT10A9510	Research Methods in Software Engineering	5
CT10A9520	Research Project in Software Engineering	1-10
CT10A9701	Summer School on Software Engineering	2
CT30A5002	Games and Networking	7
CT30A5110	Gamification - from Concepts to Implementations	3
CT30A7500	Parallel Computing	5
CT30A8301	Wireless Service Engineering	7
CT30A8902	Service Oriented Architecture	5
CT30A9301	Code Camp on Platform Based Application Development	4
CT30A9700	Network Security	4
CT60A5100	Software Engineering Methods	5
CT60A5200	Software Projects and Process Improvement	7
CT60A7000	Critical Thinking and Argumentation in Software Engineering	4
CT60A7101	Seminar on Software Engineering	4
CT60A7201	Architecture in Systems and Software Development	7
CT60A7302	Software Quality, Processes, and Organizations	7
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

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 done in one of the laboratories of the department. The project 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.	

CT10A6000	*MASTER'S THESIS AND SEMINAR*	*30 ECTS cr*
	Diplomityö ja seminaari	
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. A seminar presentation of the thesis should be given in an agreed, specific time before the assessment of the thesis.	
Modes of Study	Master's Thesis and a seminar presentation, 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.	

CT10A7000	*GREEN IT AND SUSTAINABLE COMPUTING*	*4 ECTS cr*
	Green IT and Sustainable Computing, Kestävä kehitys tietotekniikassa **Course for sustainability minor.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4	
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.	
Modes of Study	Lectures and discussions 10h, homeworks 8h, self-study 10h, 3. period OR lectures 2 h, online course 26 h.	

	Seminars and discussions 19h, homeworks 26h, self-study 31h, 4. period. Total 104h.
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 L. Webber and M. Wallace, Green Tech: How to Plan and Implement Sustainable IT Solutions, AMACOM, 2009. National Research Council, Computing Research for Sustainability, National Academies Press, 2012 R. Rattle, Computing our way to Paradise?: The role of Internet and Communication Technologies in Sustainable Consumption and Globalization, AltaMira Press, 2010.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

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.

CT10A9701	***SUMMER SCHOOL ON SOFTWARE ENGINEERING***	***2 ECTS cr***
	Ohjelmistotuotannon kesäkoulu **Intensive course in summer time.**	
Year and Period	M.Sc. (Tech.) 2 The course is suitable also for doctoral studies.	
Teacher(s)	Person in Charge: Professor, D.Sc. (Tech.) Jari Porras	
Aims	Students are expected to understand the meaning of the yearly changing topic of the summer school in the field of software engineering. Students are able to review the presentations as well as to apply the received knowledge in the implementation of their own application. Students are able to clearly present their ideas both in written and in oral form.	
Content	Content changes every year. Basics, current status and research activities of the selected field. Practical working on a code camp. Lectures will be held by visiting lecturers and researchers.	
Modes of Study	Lectures 18 h, practical assignment 22 h, written report about event 12 h. Total 52 h.	
Evaluation	Passed/failed, practical assignment and report 100%.	
Study materials	http://www.it.lut.fi/ssotc/	
Prerequisites	Basic programming skills. Recommended BM10A0500 Research Methods.	

CT30A5002	***GAMES AND NETWORKING***	***7 ECTS cr***
	Games and Networking, Pelit ja verkon vaikutus niihin **Replaces the course CT30A5001 Network Programming. Can 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, Doctoral Student, M.Sc. (Tech.) Jussi Laakkonen	
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.	

CT30A7500	PARALLEL COMPUTING	5 ECTS cr
	Parallel Computing, Rinnakkaislaskennan perusteet **Replaces the courses CT30A7001 Concurrent and Parallel Programming and CT30A7000 Parallel Computing.**	
Year and Period	M.Sc. (Tech.) 2 Period 1-4 (book) The course is suitable also for doctoral studies.	
Teacher(s)	Professor, D.Sc. (Tech.) Jari Porras	
Aims	Students are expected to understand the concept of concurrency and the meaning, concepts as well as applications of parallel and distributed computing. Students know the different parallel architectures and their usage. Students are able to apply their knowledge on various algorithms to different application problems. Students have basic knowledge on parallel programming.	
Content	Emerging need for parallel computing, parallel architectures and their classification, performance meters and scalability as well as general view of programming in parallel environment.	
Modes of Study	Book based course, Starting lectures (1st or 3rd period) 2 h, self-study 125 h. Exam 3 h. Total 130 h.	
Evaluation	0 - 5. Exam 100%.	
Study materials	Grama, A. et al.: Introduction to Parallel Computing, Addison-Wesley, 2003.	

CT30A8301	WIRELESS SERVICE ENGINEERING	7 ECTS cr
	Wireless Service Engineering, Langattomien palveluiden tekniikka	
Year and Period	M.Sc. (Tech.) 1 Period 3-4 The course is suitable also for doctoral studies.	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Pekka Jäppinen	
Aims	The student understands the challenges that wireless communication	

	technologies and mobile devices provide to service development. He/she learns methods to create and improve services for wireless environment.
Content	Wireless service types: fixed services, mobile Internet services, ad hoc services, mobile p2p, ubiquitous services, environment services. The service perspective to mobile devices and wireless network technologies. Service discovery methods. Service enhancing technologies: adaptation and personalization, context awareness, location.
Modes of Study	Lectures 28 h, exercises 14 h, practical assignment part 1 20 h, 3. period. Lectures 14 h, exercises 14 h, practical assignment part 2 30 h, 4. period. Self-study 49 h, preparation for exam 10 h and exam 3 h. Total 182 h.
Evaluation	0 - 5. Exam 50 %, practical assignments 50 %.
Study materials	Material announced in lectures.
Prerequisites	CT30A5002 Games and Networking.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

CT30A8902	***SERVICE ORIENTED ARCHITECTURE***	***5 ECTS cr***
	Service Oriented Architecture, Palvelukeskeinen arkkitehtuuri	
Year and Period	M.Sc. (Tech.) 2 Period 3-4 The course is suitable also for doctoral studies.	
Teacher(s)	Professor, D.Sc. (Tech.) Jari Porras	
Aims	Students are expected to understand the meaning of service-oriented paradigm and the aspects affecting the efficient utilization of it. Students are able to design and implement service-oriented applications.	
Content	Service and web oriented architecture terminology, technologies and infrastructures. SOA and web services fundamentals, SOA and WS-* extensions, SOA and Service-orientation, designing and building SOA.	
Modes of Study	Lectures 18 h, lecture preparation 13 h, exercises 14 h, exercise preparation 14 h, practical assignment 26 h. 3.-4. period. Self-study 32 h, exam preparation 10 h, exam 3 h. Total 130 h.	
Evaluation	0 - 5. Exam 60 %, practical assignments 40 %.	
Study materials	Erl, T. Service-Oriented Architecture: Concepts, Technology and Design, Prentice-Hall, 2005.	
Prerequisites	Recommended CT30A3201 WWW-sovellukset .	

CT30A9301	***CODE CAMP ON PLATFORM BASED APPLICATION DEVELOPMENT***	***4 ECTS cr***
	Code Camp on Platform Based Application Development, Ohjelmistotuotannon code camp **The course is arranged intensively 1-4 times/year.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 1-4 int.	
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.	
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.

CT30A9700	***NETWORK SECURITY***	***4 ECTS cr***
	Network Security, Tietoverkkojen turvallisuus	
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4	
Teacher(s)	Associate Professor, D.Sc. (Tech.) Pekka Jäppinen	
Aims	Knowledge: Understands the principles of cryptography and mathematics behind it. Skills: Student can analyse the network behavior an use tools to protect network. Can implement secure connection.	
Content	Information security goals, general terms, security policy and basics of data encrytpions and user authentication. Cryptography principles, firewalls, IDS, network analysis tools.	
Modes of Study	Lectures 14 h, exercises 14 h, 3. period. Laboratory works (3) 30 h, practical assignment 20 h, 4. period. Other load: Independent studying 26 h. Total 104 h.	
Evaluation	0 - 5. Laboratory works 50%, practical assignment 50%.	
Study materials	Pfleeger & Pfleeger: Security in Computing. Anderson: Security Engineering. Material delivered/announced during lectures.	
Prerequisites	CT30A3800 Johdatus tietoturvaan or equivalent and CT30A5002 Games and Networking.	

CT60A5100	***SOFTWARE ENGINEERING METHODS***	***5 ECTS cr***
	Software Engineering Methods, Ohjelmistotuotannon menetelmät **If all participants speak Finnish, the course will be lectured in Finnish. Replaces the course CT60A4101 Software Engineering Methods.**	
Year and Period	M.Sc. (Tech.) 1 Period 1-2	
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Jussi Kasurinen	
Aims	The student will be able to participate to the analysis and design of software and information systems. The student will understand the problems in modern system and software work and the principles in their planning, analysis, and design. The student will be able to use the UML language in analysis and design.	
Content	Features of modern software development, requirements analysis and modeling, UML use cases, class diagrams, dynamic modeling, state diagrams, architecture design, the importance of methods and processes in software and systems development.	
Modes of Study	Lectures 12 h, exercises 12 h, exercise preparation 7 h, weekly self-study 7 h, 1. period. Lectures 12 h, exercises 12 h, exercise preparation 7 h, weekly self-study 7 h, practical assignment 28 h, 2. period. Preparing for exam 15 h. Exam 3 h. Total 122 h. Moodle is used in this course.	
Evaluation	0 - 5. Exam. The course project can raise the grade as informed in the lectures.	
Study materials	Lecture slides, supplementary material, e.g. Booch, G., Rumbaugh, J., Jacobson, I.: The Unified Modeling Language User Guide, Addison-Wesley, 1999. Jacobson, I., Booch, G., Rumbaugh, J.: The Unified Software Development Process, Addison-Wesley, 1999. Fitzgerald, Russo, Stolterman: Information Systems Development - Methods in Action, McGraw-Hill, 2002. Other material announced during lectures.	
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 Period 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	CT60A5100 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.

CT60A7000	***CRITICAL THINKING AND ARGUMENTATION IN SOFTWARE ENGINEERING*** ***4 ECTS cr***
	Critical Thinking and Argumentation in Software Engineering, Kriittinen ajattelu ja argumentointi ohjelmistotuotannossa
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 and discussions 10 h, homeworks 8 h, self-study 10 h OR lectures 2h, online course 26 h, 3. period. Seminars and discussions 19 h, homeworks 26 h, self-study 31 h, 4. period. Total 104 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***
	Seminar on Software Engineering, 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.
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.

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 participants is limited to 50 students.**
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	CT60A5100 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	CT60A5100 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.

CT60A7400	***FUNDAMENTALS OF INFORMATION SYSTEMS 7 ECTS cr***
	Fundamentals of Information Systems, 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.
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***
	Object-Oriented Programming Techniques, 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, 1. period. Lectures 12 h, exercises 12 h, exercise preparation 7 h, weekly self-study 7 h, 2. 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***
	Game Development Project, 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 Technologyin 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.
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.
Modes of Study	Seminars 26h, documentation 26h, self-study and preparation 26h, 4th period. Total 78h.
Evaluation	0-5, Seminar work(s).

5.5 Master's Programme in Industrial Engineering and Management

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

Master's Degree 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 Department 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 department 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 at the department are available for supervising thesis. The topics may vary depending on the needs of the companies.

Complementary Studies
Students with a degree from a Finnish University of Applied Sciences or Polytechnics or equivalent or B.Econ.& Bus.adm. may have to study complementary studies (22 ECTS cr) which are not included in the Master's degree. The extent of these studies depends on the content of the previous degree. Further information: Student Affairs Secretary Suvi Tiainen, room 4430, phone +358 40 502 2196, suvi.tiainen at lut.fi.

Global Management of Innovation and Technology

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	2	6
FV11A8900	Academic Writing in English	B.Sc. (Tech.) 3 M.Sc. (Tech.) 1-2 B.Sc. (Econ. & Bus. Adm.) 3 M.Sc. (Econ. & Bus. Adm.) 1-2	1-2, 3-4	4

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	2-4	8
CS30A1375	Product Development	M.Sc. (Tech.) 1	1	5
CS30A1661	Open Innovation	M.Sc. (Tech.) 2	3-4	6
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	M.Sc. (Tech.) 2	1	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
CS10A0651	Management of Innovations in Russia	M.Sc. (Tech.) 1	4	5
CS30A1370	Creative Design	M.Sc. (Tech.) 1	1	5
CS30A1390	Systems Engineering	M.Sc. (Tech.) 2	3	5
CS30A1551	System Dynamics and Industrial Management	M.Sc. (Tech.) 1-2	2, INT. 43	5
CS30A1670	Service Innovation and Management	M.Sc. (Tech.) 2	3-4	5
CS30A7400	Software and Application Innovation	M.Sc. (Tech.) 2	1-2	2
A330A0200(*	International Marketing of High Technology Products and Innovations	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A0220(*	International Marketing of High Technology Products and Innovations: applications	M.Sc. (Econ. & Bus. Adm.) 2	1-2	3

*) Exchangeable

Minor Subject Business Technology 20 ECTS cr

Minor: Business Technology

Obligatory studies (10 ECTS cr)		*year*	*per.*	*ECTS cr*
CS35A0152	Product Lifecycle Management	M.Sc. (Tech.) 2	4	5
CS30A1380	Techno-Economic Systems	M.Sc. (Tech.) 2	1	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
CT60A5100	Software Engineering Methods	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
CT10A7000(*	Green IT and Sustainable Computing	M.Sc. (Tech.) 1-2	3-4	4
CT60A7000(*	Critical Thinking and Argumentation in Software Engineering	M.Sc. (Tech.) 1-2	3-4	4
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1	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.

Complementary Studies

Students with a degree from a Finnish University of Applied Sciences or Polytechnics or equivalent or B.Econ.&Bus.adm. may have to study complementary studies (22 ECTS cr) which are not included in the Master's degree. The extent of these studies depends on the content of the previous degree.

Complementary studies

Obligatory studies (17 ECTS cr)		*year*	*per.*	*ECTS cr*
CS10A0260	Managing International Business	B.Sc. (Tech.) 3	2	5
CS10A9010(*	Literature Package	M.Sc. (Tech.) 1-2	1, 2, 3, 4	5-10
BM20A5800	Funktiot, lineaarialgebra ja vektorit	B.Sc. (Tech.) 1	1	3
BM20A5810	Differentiaalilaskenta ja sovellukset	B.Sc. (Tech.) 1	2, INT 43 ja 50	4

*) The literature package will consist of books and articles which focus on industrial and technology management. The actual titles and topics of the books and articles will be decided by the person in

charge, based on the background and skills of prospective students. Contact Doctoral Student Pekka Torvinen to agree on the literature package and evaluation methods.

5.6 Master's Programme in Industrial Engineering and Management – Global Management of Innovation and Technology

Double Degree LUT – Russian home 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

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	2	6
CS30A1340	Strategic Technology and Innovation Management	M.Sc. (Tech.) 1	2-4	8
CS30A1375	Product Development	M.Sc. (Tech.) 1	1	5
CS30A1661	Open Innovation	M.Sc. (Tech.) 2	3-4	6
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	M.Sc. (Tech.) 2	1	5
CS90A0060	Master's Thesis	M.Sc. (Tech.) 2	1-4	30

Elective studies min. 3 ECTS cr		*year*	*per.*	*ECTS cr*
CS10A0151	Business Relationships and Networks	M.Sc. (Tech.) 1	3-4	5
CS10A0651	Management of Innovations in Russia	M.Sc. (Tech.) 1	4	5
CS30A1370	Creative Design	M.Sc. (Tech.) 1	1	5
CS30A1380	Techno-Economic Systems	M.Sc. (Tech.) 2	1	5
CS30A1390	Systems Engineering	M.Sc. (Tech.) 2	3	5
CS30A1551	System Dynamics and Industrial Management	M.Sc. (Tech.) 1-2	2, INT. 43	5
CS30A1670	Service Innovation and Management	M.Sc. (Tech.) 2	3-4	5

CS30A7400	Software and Application Innovation	M.Sc. (Tech.) 2	1-2	2
A330A0200[*]	International Marketing of High Technology Products and Innovations	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A0220[*]	International Marketing of High Technology Products and Innovations: applications	M.Sc. (Econ. & Bus. Adm.) 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.

5.7 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
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
CS10A9010	Literature Package	5 - 10
CS30A1340	Strategic Technology and Innovation Management	8
CS30A1362	Creativity in Innovation Processes	5
CS30A1370	Creative Design	5
CS30A1375	Product Development	5
CS30A1380	Techno-Economic Systems	5
CS30A1390	Systems Engineering	5
CS30A1500	Transportation Systems	5
CS30A1551	System Dynamics and Industrial Management	5
CS30A1601	Case Course in Strategy Consulting	3
CS30A1661	Open Innovation	6
CS30A1670	Service Innovation and Management	5
CS30A1682	Advanced Course in Strategic Management	5
CS30A1690	Social Sustainability	5
CS30A7400	Software and Application Innovation	2
CS31A0603	Life-Cycle Costing of Investment Projects	5
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	5
CS35A0152	Product Lifecycle Management	5
CS90A0060	Master's Thesis	30
CT10A7000	Green IT and Sustainable Computing	4
CT30A5110	Gamification – from Concepts to Implementations	3
CT60A5100	Software Engineering Methods	5
CT60A7000	Critical Thinking and Argumentation in Software Engineering	4
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 faculty 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. (Tech.) Risto Salminen Docent, D.Sc. (Econ. & Bus. Adm.) Henrikki Tikkanen Professor, D.Sc. (Tech.) Anne Jalkala Doctoral Student, M.Sc. (Tech.) Minna Oinonen Visiting lecturers. Person in Charge: Professor, D.Sc. (Tech.) Risto Salminen Professor, D.Sc. (Tech.) Anne Jalkala
Aims	Student 1. understands the premises of relationship and network theories in industrial marketing 2. knows the principles and key concepts of relationship marketing 3. is able to analyze different phases of a customer relationship and manage and utilize a company's customer portfolio as a strategic resource.
Content	Relationship and network theory in industrial marketing. Theoretical premises and characteristics of industrial marketing. Underlying theories and key concepts of relationship marketing. Different phases of customer relationships and customer portfolio management. Network theory and value networks. Practical illustrations related to managing business relationships.
Modes of Study	Lectures 8 h, 3rd period. Lectures 20 h, seminar 4 h, seminar work 10 h, learning diary 20 h, preparation for the exam and the exam 70 h, 4th period. Total 132 h. Moodle is used in this course.
Evaluation	0 - 5. Exam 70 %, learning diary 30 %.

Study materials	Ford, David - Berthon, Pierre et al.: The Business Marketing Course - Managing in Complex Networks. John Wiley & Sons, Ltd., IMP Group, 2002. 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 Professor, D.Sc. (Tech.) Anne Jalkala 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	
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.
Evaluation	0-5, Exam 100%
Study materials	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.

CS10A0551	***INTERNATIONAL BUSINESS METHODS 6 ECTS cr***
	International Business Methods, 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)	Lecturer, D.Sc. (Tech.) Daria Podmetina Lecturer, D.Sc. (Tech.) Irina Fiegenbaum Person in Charge: Lecturer, 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 start-ups and business incubation in Russia. Commercialization of innovations. Technology and innovation management in Russia. Case studies.
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, Enhancing Russia's competitiveness and innovative capacity, The World Bank 8. Additional material will be announced at the lectures.
Prerequisites	Sufficient prior business studies required, course is a master's level course. 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.

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 Doctoral Student, M.Sc. (Tech.) Juha Hinkkanen Person in Charge: Professor, D.Sc. (Tech.) Juha Väätänen	
Aims	Student is able to 1. explain the theory of transition from centrally planned economy (CPE) to market economy, 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	Transition of Russian society and business environment, privatization process and deregulation of the economy. Living standard analysis. Industrial sectors and foreign direct investments. Russian enterprise structures and emergence of new enterprises. Natural resources and consumer markets. Russia's competitiveness and foreign direct investment development. Role of government in Russian business life.	
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. Transition, the First Ten Years - Analysis and Lessons for Eastern Europe and the Former Soviet Union. 2002. Raj, D. and Goldberg, I. 2007. Enhancing Russia's Competitiveness and Innovative Capacity. The World Bank. Washington DC. World Economic Forum. The Global Competitiveness Report, latest available version. Geneva, Switzerland. Additional material will be announced on lectures
Prerequisites	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 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.
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 2
Teacher(s)	Lecturer, D.Sc. (Tech.) Daria Podmetina Lecturer, D.Sc. (Tech.) Irina Fiegenbaum Person in Charge: Lecturer, 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 24 h, exercises 6 h, research proposal and presentation 40 h, written assignments 33 h, course literature 30 h, self-study and exam preparation 30 h. Total 163 h. Course is using Noppa. 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.

CS10A9010	***LITERATURE PACKAGE***	***5 - 10 ECTS cr***
	Literature Package **This literature package is a part of complementary studies to obtain a Master's degree from LUT. It is required from students who do not have the necessary background information in science before starting their studies. Taking and passing the literature package can be a condition for participating in the Global Management of Innovation and Technology (GMIT) Master's Programme.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 1, 2, 3, 4	
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	The course is a complementary study package only for the students of the Global Management of Innovation and Technology (GMIT) Master's Programme. The course familiarises students with the basic literature in the field of innovation and technology management and international business.	
Content	Literature package (5-10 ECTS credits) 1.Trott, P. (2012) Innovation management and new product development 2.Chesbrough, H. (2003) Open Innovation: The New Imperative for Creating and Profiting from Technology 3.Dunning, J. H., and Lundan, S. M. (2008) Multinational enterprises and the global economy The extent of the literature package is evaluated individually based on student's previous degree before the course. (Trott, 2012; Chesbrough, 2003: 5 ECTS cr + Dunning, 2008: 5 ECTS cr)	
Modes of Study	Course requires studying the course literature and taking an exam. The exam is organised in the university exam aquarium and consists essay questions based on the course literature. The student is responsible for informing the course contact person (Doctoral Student Pekka Torvinen) before taking the	

	course. Self study (129 h-257 h) Exam (3 h)
Evaluation	0-5. Exam 100%.
Prerequisites	The course is designed for the prospective students of the Global Management of Innovation and Technology (GMIT) programme.

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 2-4 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 2nd period. Lectures and exercises 16 h in the 3rd 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.

CS30A1362	***CREATIVITY IN INNOVATION PROCESSES 5 ECTS cr***
	Luovuus innovaatioprosesseissa, Luovuus innovaatioprosesseissa **Max. 30 students admitted.**
Year and Period	M.Sc. (Tech.) 1 Period INT. 17
Teacher(s)	Professor, D.Sc. (Tech.) Vesa Harmaakorpi Guest Lecturer, D.Sc. (Econ. & Bus. Adm.) Tapani Frantsi Research Scholar, D.Sc. (Tech.) Anne Pässilä Research Scholar, D.Sc. (Tech.) Satu Parjanen
Aims	Student 1. understands creativity and its components in innovation 2.

	recognizes people as creative actors 3. is able to understand collective creativity and creativity systems 4. can combine artistic and engineer creativity 5. understands principles of multi-actor innovation and creativity processes 6. develops following skills of his/hers: creative personality, creative thinking skills and methods, creative will and motivation, as well as skills to act as innovation promotor in open innovation processes.
Content	Must know: students will be able to use practical creativity methods and methods enhancing group dynamics. Further on, they will be able to avoid association obstacles and lock-ins in creative processes. Should know: enhancing intellectual gross-fertilization in innovation sessions.
Modes of Study	Intensive course, lectures 24 h, seminar work 46 h, preparation for exam and exam 50 h. Exam. Total 120 h.
Evaluation	0 - 5. Exam 50 %, assignment 50 %.
Study materials	To be informed later.
Prerequisites	Due to the teaching methods, the amount of participants may be limited. In this case the priority would be given to the M.Sc. 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.

CS30A1370	***CREATIVE DESIGN***	***5 ECTS cr***
	Creative Design **The maximum number of students is 40. Priority is given to students for whom the course is obligatory.**	
Year and Period	M.Sc. (Tech.) 1 Period 1	
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 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 key topics 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, checklists, morphological analysis, synectics, case-based reasoning, graphical methods, evaluation of ideas.	
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 a project report. Classroom teaching and problem-solving sessions 42 hours. Project works 88 hours. Total workload 130 hours.	
Evaluation	0-5. Evaluation: solutions created in the classroom sessions 40%, project reports 30%, written exam 30%. Obligatory presence during 90% of in-class activities.	
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.	

CS30A1375	*PRODUCT DEVELOPMENT*	*5 ECTS cr*
	Product Development **The maximum number of students is 40. Priority is given to students for whom the course is obligatory.**	
Year and Period	M.Sc. (Tech.) 1 Period 1	
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	
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. 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.	

CS30A1380	*TECHNO-ECONOMIC SYSTEMS*	*5 ECTS cr*
	Techno-Economic Systems **Maximum number of students: 40.**	
Year and Period	M.Sc. (Tech.) 2 Period 1 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 concept of system architecture and basic methods of systems design and analysis 2. Distinguish the basic types of complex techno-economic systems and their characteristics 3. Work in a team during the process of complex system design.	
Content	The key topics of the course are: 1. Concept of System, 2. Principles of Life-cycle Analysis, 3. Scenario Building, 4. Systems Modelling and Simulation, 5. Complex Systems, 6. Systems Optimisation (processing and manufacturing industries, transport, energy generation, food and water supply, information generation and delivery defence), 7. Critical Infrastructure, 8. Systems Safety, 9. Evolution of Systems	

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. Total workload 130 hours.
Evaluation	0-5. Evaluation: solutions generated in classroom sessions 30%, project reports 40%, written exam 30%. 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 **The maximum number of students in the course is 40.**	
Year and Period	M.Sc. (Tech.) 2 Period 3 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.	
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. 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.	

CS30A1500	***TRANSPORTATION SYSTEMS***	***5 ECTS cr***
	Transportation Systems, Kuljetusjärjestelmät **The maximum number of students at the course is 60.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 4, INT. 17	
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Olli-Pekka Hilmola	
Aims	Student 1. understands the application of different transportation modes in transportation logistics area, particularly in Eurasia 2. knows the most suitable international routes and their performance 3. knows organizational and	

	technology development in transportation logistics, and their application and relationship on the overall performance 4. has a knowledge from environmental issues of transportation logistics - especially from the use of railways, intermodality, and containers 5. understands the environmental emissions caused by transportation systems, and the usage of dry ports for the reduction of these emissions.
Content	Among lectures, course contains case exercises (which will combine the issues of different transportation modes together), and by participating in all of these, student will have some amount of basic points for exam.
Modes of Study	Lectures 14 h, exercises 12 h; exercises conducted as a whole at the class room hours, but exam requires 104 hours from student in terms of reading course literature and getting familiar with other material. Total 130 h. Course webpage could be accessed through following link: http://kouvola.lut.fi/fi/tutkimus/innorail/transportationsystem
Evaluation	0 - 5. Examination 70 % and accepted case exercises 30 %.
Study materials	1. Roso, Violeta (2009). The Dry Port Concept. Chalmers University of Technology. Doctoral Dissertation. ISBN 978-91-7385-338-5. 2. Laisi, Milla (2013). Deregulation's Impact on the Railway Freight Transport Sector's Future in the Baltic Sea Region. Lappeenranta University of Technology, Industrial Engineering and Management, Acta Universitatis Lappeenrantaensis, No. 529. 3. Hilmola, Olli-Pekka (2012). Competing Transportation Chains in Helsinki-Tallinn Route: Multi-Dimensional Evaluation. Lappeenranta University of Technology, Department of Industrial Management. Research Report 243.
Prerequisites	Recommended to have taken some logistical courses before, e.g. from topics of supply chain management and production control.
Further Information	This course has 1-10 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 Period 2, INT. 43 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.
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. Course webpage could be accessed through

	following link: http://kouvola.lut.fi/fi/tutkimus/innorail/systemdynamics
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.

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
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 %.	

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 Research Scholar, Ph.D. Satu Pekkarinen Researcher, M.Sc. (Tech.) Suvi Konsti-Laakso Doctoral student, MBA, M.Ed. Rakhshanda Khan 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: end-user involvement, employee involvement, human impact assessment Supplementary content: practical cases, methods and Living Lab activities
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 60 %. Case exercise 40 %.
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.

CS30A7400	***SOFTWARE AND APPLICATION INNOVATION 2 ECTS cr***
	Software and Application Innovation **Suitable for the elective studies of the Communications Software and Software Engineering major students both in normal and international programs in Information Technology department. Suitable for the elective studies of students both in normal and international programs in Industrial Management department.**
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Helinä Melkas Professor, D.Sc. (Tech.) Jari Porras Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen Associate Professor, D.Sc. (Tech.) Kari Heikkinen Associate Professor, D.Sc. (Tech.) Pekka Jäppinen Person in Charge: Professor, D.Sc. (Tech.) Marko Torkkeli
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.
Modes of Study	Lectures 6 h, innovation exercises 4 h, presentation 4 h, practical work (documentation) 16 h, independent group work 22 h. Total 52 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 **English execution will be agreed separately with teachers. The execution is only for non-Finnish speaking students.**
Year and Period	M.Sc. (Tech.) 1-2 Period 1

Teacher(s)	Professor, D.Sc. (Tech.) Timo Kärri Doctoral Student, M.Sc. (Tech.) Anna-Maria Talonpoika
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, classification 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.
Modes of Study	Lectures 4 h, exercises 10 h, Excel-exercises 9 h, literature 74 h, Moodle assignments 20 h, preparation for the exam and the exam 16 h 1. period. Grand total 117 h. See Noppa for detailed information. Moodle is used in this course.
Evaluation	0 - 5. Exam, extra points from assignments.
Study materials	Lecture notes (2 copies). Mott, Graham: Investment appraisal. Pitman Publishing, 1997, (196 p.). Götze, U. et al.: Investment appraisal - Methods and models. Springer. 2008, (341 p.)
Prerequisites	CS31A0101 Kustannusjohtamisen peruskurssi or 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.

CS34A0400	***STRATEGIC ENTREPRENEURSHIP IN AGE OF UNCERTAINTY*** ***5 ECTS cr***
	Strategic Entrepreneurship in Age of Uncertainty **Maximum number of students is 50 persons.**
Year and Period	M.Sc. (Tech.) 2 Period 1
Teacher(s)	Lecturer, D.Sc. (Tech.) Irina Fiegenbaum Doctoral Student, M.Sc. (Tech.) Justyna Dabrowska Person in Charge: Lecturer, 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.
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 Doctoral Student, M.Sc. (Tech.) Kyllikki Taipale-Erävala 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. Demos of PLM systems.	
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.	
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.

CT10A7000	***GREEN IT AND SUSTAINABLE COMPUTING 4 ECTS cr***
	Green IT and Sustainable Computing, Kestävä kehitys tietotekniikassa **Course for sustainability minor.**
Year and Period	M.Sc. (Tech.) 1-2 Period 3-4
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.
Modes of Study	Lectures and discussions 10h, homeworks 8h, self-study 10h, 3. period OR lectures 2 h, online course 26 h. Seminars and discussions 19h, homeworks 26h, self-study 31h, 4. period. Total 104h.
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 L. Webber and M. Wallace, Green Tech: How to Plan and Implement Sustainable IT Solutions, AMACOM, 2009. National Research Council, Computing Research for Sustainability, National Academies Press, 2012 R. Rattle, Computing our way to Paradise?: The role of Internet and Communication Technologies in Sustainable Consumption and Globalization, AltaMira Press, 2010.
Further Information	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 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.

CT60A5100	***SOFTWARE ENGINEERING METHODS 5 ECTS cr***
	Software Engineering Methods, Ohjelmistotuotannon menetelmät **If all participants speak Finnish, the course will be lectured in Finnish. Replaces the course CT60A4101 Software Engineering Methods.**
Year and Period	M.Sc. (Tech.) 1 Period 1-2
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Jussi Kasurinen
Aims	The student will be able to participate to the analysis and design of software and information systems. The student will understand the problems in modern system and software work and the principles in their planning, analysis, and design. The student will be able to use the UML language in analysis and design.
Content	Features of modern software development, requirements analysis and modeling, UML use cases, class diagrams, dynamic modeling, state diagrams, architecture design, the importance of methods and processes in software and systems development.
Modes of Study	Lectures 12 h, exercises 12 h, exercise preparation 7 h, weekly self-study 7 h, 1. period. Lectures 12 h, exercises 12 h, exercise preparation 7 h, weekly self-study 7 h, practical assignment 28 h, 2. period. Preparing for exam 15 h. Exam 3 h. Total 122 h. Moodle is used in this course.
Evaluation	0 - 5. Exam. The course project can raise the grade as informed in the lectures.
Study materials	Lecture slides, supplementary material, e.g. Booch, G., Rumbaugh, J., Jacobson, I.: The Unified Modeling Language User Guide, Addison-Wesley, 1999. Jacobson, I., Booch, G., Rumbaugh, J.: The Unified Software Development Process, Addison-Wesley, 1999. Fitzgerald, Russo, Stolterman: Information Systems Development - Methods in Action, McGraw-Hill, 2002. Other material announced during lectures.
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.

CT60A7000	***CRITICAL THINKING AND ARGUMENTATION IN SOFTWARE ENGINEERING 4 ECTS cr***
	Critical Thinking and Argumentation in Software Engineering, Kriittinen ajattelu ja argumentointi ohjelmistotuotannossa
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 and discussions 10 h, homeworks 8 h, self-study 10 h OR lectures 2h, online course 26 h, 3. period. Seminars and discussions 19 h, homeworks 26 h, self-study 31 h, 4. period. Total 104 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 participants is limited to 50 students.**
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	CT60A5100 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***

	Fundamentals of Information Systems, 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.
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

6. SCHOOL OF BUSINESS

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
- Knowledge Management and Leadership

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 the School of Business.

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 and communication 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

The faculty may award additional language credits for student exchange or interhsips 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 major subject/specialisation/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 by the School of Business 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 the faculty. Language credits can also be granted for internships completed abroad after 1 May 2011.**

For internships abroad, the faculty awards language credits 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.

6.1. Master´s Programme in Supply Management (MSM)

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.

Recommended minor studies: Sustainability (24 ECTS cr) or Knowledge and Innovation Management (24 ECTS cr). Suomenkieliset opiskelijat voivat suorittaa myös muita, suomenkielisiä sivuopintokokonaisuuksia.

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

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Degree Structure

Core Studies	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 6 ECTS cr of the following courses:	*year*	*per.*	*ECTS cr*
A210A0200 Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	6
A365A0100 Organization Theory	M.Sc. (Econ. & Bus. Adm.) 1	1	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*
A310A0600 Reading Course of Supplier Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1	4	1
A330A0050 Customer Relationship Management	M.Sc. (Econ. & Bus. Adm.) 1	4	6
CS10A0151 Business Relationships and Networks	M.Sc. (Econ. & Bus. Adm.) 1	3-4	5

Supply Chain Management 18 ECTS cr

Obligatory	*year*	*per.*	*ECTS cr*
A310A0301 Supply Chain Improvement	M.Sc. (Econ. & Bus. Adm.) 1-2	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, intensive	6
A310A0401 Public Procurement	M.Sc. (Econ. & Bus. Adm.) 1	3, intensive	6

Academic Skills 6 ECTS cr

Obligatory	*year*	*per.*	*ECTS cr*
A365A0551 Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1	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*
A350A0102 Strategy Consulting	M.Sc. (Econ. & Bus. Adm.) 1-2	1-2/3-4	6
A310A0201 External Resource Management	M.Sc. (Econ. & Bus. Adm.) 2	2	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)

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

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Course Descriptions in Supply Management

		ECTS cr
A130A0050	Introduction to Studies of Economic Sciences for Master's Students	3
A130A0120	International Students' Peer Tutoring	3
A210A0200	Empirical Strategy Research	6
A210A0350	Real Options and Managerial Decision-making	6
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
A310A0600	Reading Course of Supplier Relationship Management	1
A310A0650	Cost and Risk Management in Supply Chain	6
A310A0700	Logistic Solutions, field trip for HSE DD	1
A310A8500	Master´s Thesis Seminar, Supply Management	3
A310A9100	Master's Thesis, Supply Management	30
A330A0050	Customer Relationship Management	6
A350A0050	Business Research Methods	6
A350A0102	Strategy Consulting	6
A365A0100	Organization Theory	6
A365A0551	Master´s Transferable Skills	3
HARE	Internship for Master´s Programmes	2 - 10

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)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, Information Specialist, M.Sc. (Tech.) Marja Talikka, N. N. Person in Charge: Post-Doctoral Researcher, 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
Evaluation	Accepted/failed
Study materials	1. Lecture slides 2. Other material informed in lectures
Further Information	This course has 1-10 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: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, M.A 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 and Effectiveness (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 10 hours, online work and self-study 12 hours, one day's lecture 4 hours in period 4. One day's lecture 2 hours in the end of August. Tutoring in groups 30 hours, online work, final raport and independent work 12 hours and 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.

A210A0200	***EMPIRICAL STRATEGY RESEARCH***	***6 ECTS cr***
	Empirical Strategy Research **The language of teaching is English.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 3-4 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 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, intensive
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
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 64 h. Written exam and preparation for the exam 75 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	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)

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 business partnerships and risks related to partnership in supply networks 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 15 h, independent reading assignments and preparation for lectures 10 h, 1st period. Tutorials 4 h, 1st period. Case assignment including written reports and class presentations. Writing of reports and preparations for presentations 20 h, 1st period. Written assignment including written essay and reading literature and articles 46 h, 1st-2nd period. Written exam and preparation for exam 65 h. Total workload for student 160 h. Moodle in use.
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. general 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)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Anni-Kaisa Kähkönen, 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.
Modes of Study	Lectures 10 h, simulation 3 h, preparation for lectures and simulation 7 h, written assignment and preparation of presentations 60 h, 2nd period. Independent reading assignments, written exam and preparation for it 80 h. Total workload for student 160 h. Moodle in use.
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

A310A0301	***SUPPLY CHAIN IMPROVEMENT***	***6 ECTS cr***
	Supply Chain Improvement **The number of participants may be limited. Students of Supply Management take precedence. Minitab software is required during the course. Replaces the course A310A0300 LEAN-lähestymistavat toimitusketjun kehittämisessä.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 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 related 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.	

A310A0401	***PUBLIC PROCUREMENT***	***6 ECTS cr***
	Public Procurement **Replaces the course A310A0400 Julkiset hankinnat.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3, intensive	
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 will understand the special features and implications of public-private cooperation. Students will be able to exploit their knowledge related to the public procurement process and plan the phases of the procurement process. They will also be familiar with the legislation related to public procurement.
Content	The public procurement and purchase process. The characteristics of public procurement and future challenges. Current topics such as the state-of-the-art of public procurement in Europe.
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. Kuusniemi-Laine, A., Takala,P., 2008. Julkiset hankinnat käsikirja, Edita Prima Oy, Helsinki 3. Other course material will be announced
Prerequisites	Bachelor's 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.
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

A310A0600	***READING COURSE OF SUPPLIER RELATIONSHIP MANAGEMENT*** ***1 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 an independent reading assignment focusing on supplier relationship management (SRM). Students can deepen their knowledge of SRM by familiarizing themselves with current academic literature in the field and further analyzing its content in a term paper. After completing the course, students will be able critically to assess and analyze literature and topics related to supplier relationship management.
Content	Current literature and topics related to supplier relationship management.
Modes of Study	Introductory lecture 2 h, independent reading assignment, term paper, 4th period. Preparing for the lectures and reading assignment and writing the term paper 25 h. Total workload 27 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, term paper 100%
Study materials	Reading assigned at 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.) Jukka Hallikas, 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 total cost thinking, and cost and risk assessment in supply chains. During the course, students apply methods and tools of cost and risk assessment in practical assignments. After completing the course, students will be able to - perform risk assessments in supply chains - evaluate the cost factors in purchasing decisions - apply tools, methods and applications in risk and cost assessment - utilize cost 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	Interactive lectures and assignments 9 h, two independent assignments, both including written reports, 4th period. Preparing for lectures 18 h, preparation of the assignment and written report 133 h. Total workload 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, two independent assignments including written reports 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 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 course includes a field trip to a logistical site or a lecture by a logistics expert. The content of this course may vary depending on the number of HSE DD students and the resources, i.e. visiting lecturers, available at the time. The course aims to familiarize students with modern logistics management, the infrastructure of distribution channels and transportation.
Content	The content of this course may vary depending on the number of HSE DD students and the resources, i.e. visiting lecturers, available at the time. Modern logistics management, infrastructure of distribution channels and transportation.
Modes of Study	Introductory lecture, site visit or visiting lecturer (logistics expert) 4 h. Essay on the topic, 4th period. Preparing for the lectures/field trip 2 h, preparing the essay 21 h. Total workload 27 h. Moodle is used in this course.
Evaluation	Pass/fail. In order to pass the course, the student is expected to participate in the field trip and/or lecture and prepare and submit the essay concerning the topic.
Study materials	Will be announced at 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 their research and in solving empirical research problems. Students will be able to justify and explain the main points of the research both orally and in writing. They will be able to assess, evaluate and analyze reports written by other students and defend their 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	Student will 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 - analyze a completed Master’s thesis (free choice)

	- prepare an analysis of their research topic - prepare and present their research plan - draw up and present a preliminary version of their thesis (70-80% completed, including introduction, literature review, research design and preliminary findings) and act as an opponent 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 an opponent for another student's thesis (6 h) - Preparing for the seminars and writing 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.
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 their research findings in writing according to scientific practices.
Content	The student applies the knowledge and skills acquired in the Master's Thesis Seminar in writing his/her 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 about it in writing (800 h). Moodle is used in this course.
Evaluation	Thesis: improbatur-laudatur
Study materials	Master's thesis instructions, lecture notes and other assigned reading during the Master's Thesis Seminar.
Prerequisites	Participation in the Master's Thesis Seminar and approximately 30 ECTS cr. Supply Management Master's studies.

A330A0050	***CUSTOMER RELATIONSHIP MANAGEMENT 6 ECTS cr***
	Customer Relationship Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Post-Doctoral Researcher, 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.

A350A0050	***BUSINESS RESEARCH METHODS***	***6 ECTS cr***
	Business Research Methods	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2/3-4	
Teacher(s)	Fall semester: Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Mika Vanhala Spring semester: Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi, 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.

A350A0102	***STRATEGY CONSULTING*** ***6 ECTS cr***
	Strategy Consulting **NOTE: Lectured twice during the academic year**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-2/3-4
Teacher(s)	Adjunct Professor, D.Sc (Econ.), Lic. Pol. Sc Timo Santalainen Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, (spring), Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli (autumn)
Aims	By the end of the course the students will 1. Master key strategic concepts, tools and frameworks for strategizing. 2. Recognize the roles, styles and practices of strategy consulting in different situations. 3. Be able to apply strategic concepts, tools and frameworks in solving the consulting case problem. 4. Be able to outline a professional written report based on the results of their analysis and contributions. 5. Be able to communicate their findings and recommendations in a convincing, professional way.
Content	The course is focused on strategy consulting with a very hands-on approach to learning: students take the role of strategy consultants to solve a case organization's concrete problem. The course and its ways of working are designed to help participants to explore strategic issues of selected companies/organizations from three perspectives: academic research and concepts (A), business practice (B), and consulting (C). Taking the role of strategy consultants participants are expected to develop value-generating ideas for their respective case organizations. The course is also aimed at the development of business "softskills" such as teamwork, leadership, project management, presentation and other

	communication skills. Core content: Evolving motivations and approaches in strategic management and thinking within the context of (hyper)competitive multinational business arenas. Conceptual tools for strategic situational analysis. The logic of developing customer-centric and resource-based strategies as well as value-capturing business models. Alternative roles, styles and practices of strategy consulting. Additional content: Alternative modes and tools of "strategizing" in case- as well as in real business situations. Information collection and problem solving skills. Effective presentation skills.
Modes of Study	Prework: Reflective essay: appr. 30 h (reading and preparation of the essay) 16 hours of lectures (Kick-off workshop, attendance compulsory) 16 hours of seminars, including final presentations of the projects to the evaluation committee Independent project work in teams: 90 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
Evaluation	Grade 0-5, evaluation 0-100 points. Max 100 points from project work. Grading of projects: 70% supervisors 30% firm representative
Study materials	Santalainen, Timo (2006) Strategic Thinking, Talentum Handout materials relating to topics of each seminar Strategy consulting tools Other material depending on the project work

A365A0100	***ORGANIZATION THEORY***	***6 ECTS cr***
	Organization Theory **Replaces course A390A0450 - 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.	
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.

A365A0551	***MASTER´S TRANSFERABLE SKILLS***	***3 ECTS cr***
	Master´s Transferable Skills	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1	
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 completion of the course, the student is able to participate in the scientific discussion relating to his/her own field of specialization. The student understands the basics of scientific writing and can present and argument his/her own work professionally. The student has sufficient abilities for team- and project work and he/she understands the significance of scheduling and distribution of liabilities and assignments.	
Content	The course covers the following themes: - Academic argumentation - Scientific writing - Basics of project work and project management - Basics of team work - Different styles of learning and time management	
Modes of Study	Compulsory lectures 8h, preparing and presenting assignments 72h. Total workload 80h. Moodle is used in this course.	
Evaluation	Final grade 0-5. Evaluated on scale 0 - 100 p. Lecture activity 20%, independent assignments 80%.	
Study materials	Selected materials, available in Noppa and Moodle.	
Prerequisites	Bachelor´s Degree	

HARE	***INTERNSHIP FOR MASTER´S PROGRAMMES***	***2 - 10 ECTS cr***
	Internship for 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.**	
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 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.
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 A220A0250 Managerial Finance A220A0300 Theory of Corporate Finance For MSM students: A310A0101 Strategic Supply Managment

6.2. 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. 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	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 ACCOUNTING 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	1-2	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 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.) 1-2	3-4, intensive	3
A220A0700 Elective Advanced Course in Strategic Finance	M.Sc. (Econ. & Bus. Adm.) 1-2	1,2,3,4	3

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
A220A0150 International Finance and Emerging Markets	M.Sc. (Econ. & Bus. Adm.) 1	2	6

Corporate Strategy

Electives	*year*	*per.*	*ECTS cr*
A210A0200 Empirical Strategy Research	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	6
A350A0500 Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
A350A0102 Strategy Consulting	M.Sc. (Econ. & Bus. Adm.) 1-2	1-2/ 3-4	6

Academic Skills

Obligatory	*year*	*per.*	*ECTS cr*
A365A0551 Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1	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, intensive	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 12 ECTS cr	*year*	*per.*	*ECTS cr*
A220A0000 Financial Econometrics	M.Sc. (Econ. & Bus. Adm.) 2	1	6
A220A0051 Investment and Business Analysis with Excel	M.Sc. (Econ. & Bus. Adm.) 1	4, intensive	6

And at least 12 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	1	6
A220A0750 Elective Special Course on Business Analytics or Decision-making	M.Sc. (Econ. & Bus. Adm.) 2	1,2,3,4	3
A350A0000 Business Process Management and Information Technologies	M.Sc. (Econ. & Bus. Adm.) 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.

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 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

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Course Descriptions in Strategic Finance and Business Analytics

		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
A220A0051	Investment and Business Analysis with Excel	6
A220A0101	Derivatives and Financial Risk Management	6
A220A0150	International Finance and Emerging Markets	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
A220A0700	Elective Advanced Course in Strategic Finance	3
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
A350A0000	Business Process Management and Information Technologies	3
A350A0050	Business Research Methods	6
A350A0102	Strategy Consulting	6
A350A0500	Sustainable Strategy and Business Ethics	3
A365A0551	Master´s Transferable Skills	3
HARE	Internship for Master´s Programmes	2 - 10

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)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, Information Specialist, M.Sc. (Tech.) Marja Talikka, N. N. Person in Charge: Post-Doctoral Researcher, 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
Evaluation	Accepted/failed
Study materials	1. Lecture slides 2. Other material informed in lectures
Further Information	This course has 1-10 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: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, M.A 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 and Effectiveness (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 10 hours, online work and self-study 12 hours, one day's lecture 4 hours in period 4. One day's lecture 2 hours in the end of August. Tutoring in groups 30 hours, online work, final raport and independent work 12 hours and 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 **The language of teaching is English.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2
Teacher(s)	Part-time Untenured Teacher, D.Sc. (Econ. & Bus. Adm.) Timo Leivo
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 Seminars: 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 **The language of teaching is English.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 3-4 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 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, intensive
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
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 64 h. Written exam and preparation for the exam 75 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	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)

A210A0601	***INFORMATION SYSTEMS IN CORPORATE MANAGEMENT AND DECISION-MAKING*** **6 ECTS cr**
	Information Systems in Corporate Management and Decision-making **Language of teaching is English. 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
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 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 **The language of teaching is English.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1	
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Kashif Saleem, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Elena Fedorova Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Kashif Saleem	
Aims	At the end of this course, students are expected to be able to conduct empirical research by using: - the classical linear regression model - univariate time series models - ARMA processes - multivariate time series models - models for simultaneous equations systems - vector autoregressive (VAR) model - GARCH-type models - Eviews - an econometric package for modeling financial data	
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's) 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.	
Modes of Study	Lectures and exercises: 24 h, Period 1 Preparation for lectures and exam: 100 h, Period 1 home assignments: 36 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 (70%) and home assignments (30%). Students are required to obtain 50 percent of the maximum points in both. Bonus points for active class participation.	
Study materials	1. Brooks, Chris: Introductory econometrics for finance. Cambridge, 2002 or newer (Text book) 2. Tsay, Ruey S.: Analysis of Financial Time Series. Wiley, 2002 or newer (additional readings) 3. Handouts in class and all additional material required by the lecturer	
Prerequisites	Compulsory Bachelor's level courses in finance and economics.	

A220A0051	***INVESTMENT AND BUSINESS ANALYSIS WITH EXCEL***	***6 ECTS cr***
	Investment and Business Analysis with Excel **The language of teaching is English. Replaces course A220A0050 - Financial Modeling Using Excel**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4, intensive	
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 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 will be able to: - plan and create simple analysis tools with spreadsheet software and perform analyses related to corporate finance - recognise and use selected built-in tools of spreadsheet software, e.g. for optimization and for statistical analysis - 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 tutorials 20 h, reading materials and preparation for the test 60 h, course work 80 h. Total workload for the student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, written exam 30%, tutorials 70%
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 1-2
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 tutorials 24 + 18 h, preparation for tutorials 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 tutorials. Evaluation 0-100 points,

Study materials	written exam 90-100% and tutorials 0-10% depending on the student's activity. 1. Hull, John C.: Options, Futures, and Other Derivatives, 2006 or newer edition. 2. Lecture handouts.

A220A0150	***INTERNATIONAL FINANCE AND EMERGING MARKETS*** ***6 ECTS cr***
	International Finance and Emerging Markets **The language of teaching is English.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 2
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Elena Fedorova Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	The aim of the course is to familiarize students with international finance in emerging economies (EEs). The course introduces various emerging markets and their special characteristics, their global financial environment, investors' opportunities for international diversification as well as the country and political risk analysis of EEs. Moreover, different episodes of financial crises, their consequences and recent empirical research on EEs are introduced in the course. Among other EEs, the course discusses Russian financial and economic development. At the end of the course, the student is expected to: - know the importance of finance in EEs; - know international financial institutions and policies in EEs; - know the specific characteristics of financial systems in different areas of EEs; - be familiar with different episodes of financial crisis in EEs and their consequences; - deepen their knowledge in recent empirical research in EEs; - be able to work in a multi-cultural environment; - be able to critically analyse newly received information and apply their own knowledge to financial evaluation; - be able to participate in discussions on topics of international finance in EEs and facilitate the dialog.
Content	Topic 1: The Importance of Finance in Emerging Market Economies: – Finance and Development – Information and Finance. Topic 2: Domestic Finance and Policies in Emerging Markets: – Institutions and Financial Systems – Fiscal Policy and Sovereign Debt – Asset Bubbles and Banking Crises. Topic 3: International Finance in Emerging Markets: – Financial Liberalization and Capital Flows – Monetary Policy and Exchange Rate Management – International Financial Crises: Currency and twin crises – Country risk analysis and FDIs. Topic 4: Describing Financial Systems in Emerging Regions of the World: – Financial systems of Emerging regions (Sub-Saharan Africa, Middle East and North Africa, Asia and Latin America) – Ten takeaways for understanding finance in emerging market economies. Topic 5: Companies' presentations by guest lecturers
Modes of Study	Book exam. Total workload: 160 h
Evaluation	Grade 0-5, on the basis of 0-100 points for the exam.
Study materials	1. Todd A. Knoop, 2013: Global Finance in Emerging Market Economies. 2. Research articles. 3. Handouts in class and all additional materials required by the lecturer.
Prerequisites	Compulsory Bachelor's level courses in finance and economics.

A220A0200	*INTERNATIONAL FINANCIAL MANAGEMENT 6 ECTS cr*
	International Financial Management **The language of teaching is English.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed
Aims	At the end of this course, students are expected to be able to: - understand the structure and functions of MNCs - analyze cross-border financing and investment decisions - evaluate the different legal environments, tax considerations and country risks involved in the financial management of MNCs - assess the impacts of exchange rates on the profitability, growth and valuation of MNCs - know the valuation and risk management strategies used by multinational corporations - measure cross-border diversification benefits in order to undertake effective risk management strategies
Content	The course is designed to give advanced-level (Master's) knowledge of multinational financial management. The course covers four different areas in international financial management: 1) currencies exchange rate risks and valuation, 2) multinational financial decision-making, 3) cross-border financing and investment diversification and 4) institutions, risk management and investors' behavior.
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 for the exam (weight 80%) and term paper (weight 20%). Students are required to obtain 50 percent of the maximum points in each task. Bonus points can be earned from active participation in in-class quizzes and case studies.
Study materials	1. Madura and Fox: International Financial Management 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 **Students who aim to prepare their Master's thesis on an empirical finance topic with econometric analysis are strongly advised to take the course.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 4
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Kashif Saleem Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed
Aims	Upon completion of this course, students will be able to: - interpret the results of recent and relevant research in finance - extend and deepen their knowledge in the areas of empirical asset pricing and corporate finance - use appropriate models and techniques to solve empirical problems in finance - prepare for conducting an empirical analysis in various areas of finance - develop a research plan on an empirical topic for their Master's thesis
Content	This advanced course provides an 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 and more recent topics in finance. The

	literature covers topics such as asset pricing, volatility dynamics, the impact of macroeconomic shocks on stock markets, corporate structure, payout policy, corporate governance, and agency theory. This approach allows students to understand more fully the implications and limitations of the theoretical models and to relate them more properly to empirical evidence.
Modes of Study	Lectures/seminar: 24 h Preparation for lectures & tutorials: 40 h Assignment # 1 & preparation for presentation: 36 h Assignment # 2 (Research proposal): 60 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	There is no textbook. Issues covered in class will be based on research papers and articles.
Prerequisites	Compulsory B.Sc. courses in Accounting or in Finance (except Bachelor's thesis). A220A0000 Financial Econometrics and/or A350A0250 Multivariate and Econometric Analysis Methods

A220A0500	***CONTEMPORARY ISSUES IN STRATEGIC FINANCE***	***3 ECTS cr***
	Contemporary Issues in Strategic Finance **This course is offered only if the lecturer is available. Intensive teaching by a team of experts from LUT 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.) 1-2 Period 3-4, intensive	
Teacher(s)	N. N. Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed	
Aims	By the end of the course, students will be able to: - assess the contemporary concepts and latest issues related to strategic finance; - synthesize and evaluate special topics (which may change on a yearly basis) of contemporary strategic finance; - expand their knowledge of an advanced topic of international corporate finance, behavioral finance, entrepreneurial finance and accounting; - demonstrate corporate learning and personal development skills in a multinational environment.	
Content	The contents of this course may change depending on the topics discussed, but the main theme remains within the broader scope of strategic finance. The selected topics may include 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 the total score 0-100. Evaluation according to the 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 **The course will take place for the first time during the academic year 2015-16**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 1
Teacher(s)	Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan
Aims	Students will learn about the principles of modern methods for multiple-criteria decision-making, decision analysis, systems for supporting decision-making, the history of decision support and operational research and the constant evolution in decision support methods. Students will be able to understand the benefits of modern decision support methods in real-world business situations.
Content	Multiple-criteria decision-making (MCDM) methods (TOPSIS, AHP), decision analysis methods (DEA), decision-making under uncertainty, the history of operational research. Fuzzy logic in decision-making, decision-support systems (DSS), expert systems, optimization. Multiple expert decision-making and reaching consensus, the Delphi method.
Modes of Study	Lectures and tutorials approximately 20 h, reading materials and preparation for the lectures and the test approximately 140 h. Possibly course work, which will then reduce the number of hours needed for lecture and test preparation. Total workload for the student 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points. The grade is determined based on the test; if there is course work, it will account for 30% of the grade.
Study materials	Lecture materials, assigned reading and course books.
Prerequisites	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)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Jyri Kinnunen
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 - securitization and the 2007 subprime crisis
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. The course includes an introduction to central banking and bank regulation as well as basic concepts of risks and insurances. The course provides an overview of selected management and monitoring tools used by banks and insurance companies.
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 **The language of teaching is English.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3	
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Kashif Saleem Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed	
Aims	At the end of this course, the student is expected to be able to: - demonstrate advanced skills in describing corporate finance theories - apply the financial theory on valuation and corporate investment decisions - understand the linkages between agency theory and corporate financing decisions - know how managerial incentives affect financial decisions - analyze the information conveyed by financial decisions, mergers and acquisitions - understand the importance of risk management in corporate financial decisions.	
Content	The course provides advanced-level (Master's) knowledge based on a theoretical understanding of the main topics of corporate finance. The course covers specific issues including valuation and capital budgeting, investment decisions, cost of capital, financing decisions and market efficiency, capital structure and dividend policy, agency theory, managerial incentives, information and corporate control in financial decisions, and risk management and corporate strategy.	
Modes of Study	Lectures: 24 h Preparation for lectures and exam: 104 h 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 for the exam (80%) and term paper (20%). Students are required to obtain 50 percent of the maximum score in each task. Bonus points for active participation in quizzes and tutorials.	
Study materials	1. Ross, S.A., Westerfield, R.W. and Jaffe, J.: Corporate Finance, 7th or later edition (selected chapters only) 2. Hiller, D., Grinblatt, M. and Titman, S.: Financial markets and corporate strategy – European edition (Chapters 18-23). 3. Handouts in class and all additional material required by the lecturer.	
Prerequisites	Compulsory Bachelor's level courses in accounting and finance.	

A220A0700	***ELECTIVE ADVANCED COURSE IN STRATEGIC FINANCE***	***3 ECTS cr***
	Elective Advanced Course in Strategic Finance	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1,2,3,4	
Teacher(s)	N. N. Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan	
Aims	The student will acquire an in-depth understanding of the focus area of the course: - to assess contemporary concepts and the latest issues related to strategic finance - to synthesize and evaluate special topics.	

Content	The content may vary depending on the topics discussed, but the main theme of the course is strategic finance.
Modes of Study	This course is for students who aim to deepen their knowledge about topics connected to the broader area of strategic finance. The course is organised as a massive open online course (MOOC), and students must contact the person in charge of the course to confirm participation. The course may be completed by participation in the Global Investment Research Challgenge competition. Total workload 80 h according to the selected content. Moodle is used in this course.
Evaluation	Grade 0–5 based on total score 0-100. Evaluation according to the course contents.
Study materials	The study material varies according to the topics. The relevant material will be provided before and during the course.

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 Period 1,2,3,4	
Teacher(s)	N. N. Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Mikael Collan	
Aims	The student will acquire an in-depth understanding of the focus area of the course: - to assess contemporary concepts and the latest issues related to business analytics (BA) or decision-making (DM) - to synthesize and evaluate special topics.	
Content	The content may vary depending on the topics dealt with, but the main themes of the course business analytics and decision-making.	
Modes of Study	Total workload 80 h, according to the selected content. This course is for students who aim to deepen their knowledge about topics connected to either business analytics or decision-making. The course is organised as a massive open online course (MOOC), and students must contact the person in charge of the course to confirm participation. The course may be completed by participation in the Global Investment Research Challgenge competition. Moodle is used in this course.	
Evaluation	Grade 0-5, depending on the contents, details to be announced later. Evaluation 0-100 points.	
Study materials	Lecture materials, assigned reading, video materials, course book	
Prerequisites	A210A0601 Information Systems in Corporate Management and Decision-making	

A220A8500	***MASTER'S THESIS SEMINAR, STRATEGIC FINANCE***	***3 ECTS cr***
	Master's Thesis Seminar, Strategic Finance	
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. (Econ. & Bus. Adm.) Kashif Saleem, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Elena Fedorova, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Jyri Kinnunen 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 their research plan and act as an opponent for another student's report - prepare and present an intermediate version of their thesis (60-70% completed, including introduction, literature review, research design and preliminary findings) - analyze a completed Master's thesis (free choice).
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). - Topic selection phase: each student goes through the topic selection with the supervisor and writes a short topic analysis in which the background, importance, and material used are described and discussed. Without an approved topic, the student cannot advance to the research plan phase. (3h) - Seminar I: Introduction to databases and statistical software (4 h) - Seminar II: presentation of the research plan (5 h). - Seminar III: presentation of the intermediate (60-70% finished) version of the thesis (5 h). - Preparing for the seminars and drawing up the first preliminary version of the manuscript (60 h). Total workload 80 h. 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.
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 discuss it with a potential instructor. Approximately 30 ECTS cr. Strategic Finance studies.

A220A9000	***MASTER'S THESIS, STRATEGIC FINANCE 30 ECTS cr***
	Master's Thesis, Strategic Finance
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. (Econ. & Bus. Adm.) Kashif Saleem, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Elena Fedorova, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Jyri Kinnunen 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 about the research in writing according to scientific practices.

Content	The student applies the knowledge and skills acquired in the Master's Thesis Seminar in writing 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 about it in writing (800 h). Moodle is used in this course.
Evaluation	Thesis: improbatur-laudatur
Study materials	Master's thesis instructions, lecture notes and other assigned reading during the Master's Thesis Seminar.
Prerequisites	Participation in the Master's Thesis Seminar and approximately 30 ECTS cr. MSF studies.

A350A0000	***BUSINESS PROCESS MANAGEMENT AND INFORMATION TECHNOLOGIES*** 3 ECTS cr
	Business Process Management and Information Technologies
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Visiting Professor Sofya Zhukova Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala
Aims	The course aim is to give students understanding how to change and improve business processes on the base of complex analysis of organization key activities in order to add value to business. Students gain knowledge to create horizontal process management structures through documenting, mapping, analyzing, simulating and validating business processes.
Content	Topic 1. System analysis and business modeling Thinking in systems. Business systems. The benefits of formalization. Models vs. systems. Models types: conceptual, physical, functional, mathematical models. Goals of using models in management. Topic 2. Formal models of business processes Abstraction concepts. Fundamental terms of control theory and business process management. Queuing theory basics. From business functions to business processes shift. Topic 3. Business process mapping and visualization Visualizing business dimensions. Types of diagram modelling: mind-maps, flowcharts, RD, CFD, AFD. Topic 4. Business process management Approaches within BPM: people, technology. Business process management life-cycle. BPM and quality management: TQM, Six Sigma, BPR. Change management techniques. Topic 5. Industry standards and notations Object-oriented approach to modeling. IDEF standards. ARIS methodology. Business modeling languages: UML, BPMN, BPEL, WS-CDL. Topic 6. Business process improvement and reengineering Business process improvement types. Creating AS-IS and TO-BE models. What-If analysis. Topic 7. Business Process Automation Automation field. Business processes and Web-technologies. Business process optimization and KPI.
Modes of Study	Lectures 20 h, 4th period. Individual class assignments 20 h, case studies 20 h, computer labs 20 h. Exam. Total workload for student 80 h.
Evaluation	Graded 0-5 on the basis of the exam (50%) and course work (50%), evaluation 0-100 points.
Study materials	Required reading 1. Sofya V. Zhukova. Guidelines for students' work on BPM: main deadlines and deliverables, 2010. 2. Pradeep Hari Pendse: Business Analysis - Visualizing Business Processes

	and Effective Software Solutions, Prentice-Hall, 2008. 3. Robert D. Austin, Richard L. Nolan, Shannon O'Donnell, Adventures of an IT Leader, Harvard Business Press, 2009 Optional reading 1. John Jeston, Johan Nelis Business Process Management: Practical Guidelines to Successful Implementations, Butterworth-Heinemann, 2006. – 464 p. 2. Adrienne Curry, Peter Flett, and Ivan Hollingsworth: Managing Information and Systems: The Business Perspective. Routledge, 2005 3. H. James Harrington, K. C. Esseling, Van Nimwegen Business Process Improvement Workbook: Documentation, Analysis, Design, and Management of Business Process Improvement, McGraw-Hill, 1997. - 314 p. 4. Michael Havey, Essential Business Process Modeling O'Reilly, 2005. - 350 p. 5. Hans-Erik Eriksson, Magnus Penker Business Modeling with UML: Business Patterns at Work, Wiley, 2000. - 480 p. 6. Stephen A. White, Business Process Modeling Notation, IBM Corporation http://bpmi.org 7. Course tutorial. IBM WebSphere Business Modeler: Process Mapping and Analysis, 2007 8. Course tutorial. IBM WebSphere Business Modeler: Process Simulation and Analysis, 2007

A350A0050	***BUSINESS RESEARCH METHODS***	***6 ECTS cr***
	Business Research Methods	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2/3-4	
Teacher(s)	Fall semester: Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Mika Vanhala Spring semester: Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi, 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.

A350A0102	***STRATEGY CONSULTING***	***6 ECTS cr***
	Strategy Consulting **NOTE: Lectured twice during the academic year**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-2/3-4	
Teacher(s)	Adjunct Professor, D.Sc (Econ.), Lic. Pol. Sc Timo Santalainen Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, (spring), Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli (autumn)	
Aims	By the end of the course the students will 1. Master key strategic concepts, tools and frameworks for strategizing. 2. Recognize the roles, styles and practices of strategy consulting in different situations. 3. Be able to apply strategic concepts, tools and frameworks in solving the consulting case problem. 4. Be able to outline a professional written report based on the results of their analysis and contributions. 5. Be able to communicate their findings and recommendations in a convincing, professional way.	
Content	The course is focused on strategy consulting with a very hands-on approach to learning: students take the role of strategy consultants to solve a case organization's concrete problem. The course and its ways of working are designed to help participants to explore strategic issues of selected companies/organizations from three perspectives: academic research and concepts (A), business practice (B), and consulting (C). Taking the role of strategy consultants participants are expected to develop value-generating ideas for their respective case organizations. The course is also aimed at the development of business "softskills" such as teamwork, leadership, project management, presentation and other communication skills. Core content: Evolving motivations and approaches in strategic management and thinking within the context of (hyper)competitive multinational business arenas. Conceptual tools for strategic situational analysis. The logic of developing customer-centric and resource-based strategies as well as value-capturing business models. Alternative roles, styles and practices of strategy consulting. Additional content: Alternative modes and tools of "strategizing" in case- as well as in real business situations. Information collection and problem solving skills. Effective presentation skills.	
Modes of Study	Prework: Reflective essay: appr. 30 h (reading and preparation of the essay) 16 hours of lectures (Kick-off workshop, attendance compulsory) 16 hours of seminars, including final presentations of the projects to the evaluation committee Independent project work in teams: 90 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	
Evaluation	Grade 0-5, evaluation 0-100 points. Max 100 points from project work. Grading of projects: 70% supervisors 30% firm representative	
Study materials	Santalainen, Timo (2006) Strategic Thinking, Talentum	

	Handout materials relating to topics of each seminar Strategy consulting tools Other material depending on the project work

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	
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); 12 hours of interactive theme sessions and seminars (weeks 4-6). Out-class hours: Preparation for the theme sessions and seminars: 16 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	Books and articles on sustainability and busines ethics. Readings list 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	
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 completion of the course, the student is able to participate in the scientific discussion relating to his/her own field of specialization. The student understands the basics of scientific writing and can present and argument his/her own work professionally. The student has sufficient abilities for team- and project work and he/she understands the significance of scheduling and	

	distribution of liabilities and assignments.
Content	The course covers the following themes: - Academic argumentation - Scientific writing - Basics of project work and project management - Basics of team work - Different styles of learning and time management
Modes of Study	Compulsory lectures 8h, preparing and presenting assignments 72h. Total workload 80h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluated on scale 0 - 100 p. Lecture activity 20%, independent assignments 80%.
Study materials	Selected materials, available in Noppa and Moodle.
Prerequisites	Bachelor´s Degree

HARE	***INTERNSHIP FOR MASTER´S PROGRAMMES 2 - 10 ECTS cr***
	Internship for 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.**
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 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.
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 A220A0250 Managerial Finance A220A0300 Theory of Corporate Finance For MSM students: A310A0101 Strategic Supply Managment

6.3. 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 2014 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.

Degree Structure

Core Studies	42	ECTS cr
Specialisation Studies	48	ECTS cr
Minor Studies	24-25	ECTS cr
Language Studies	6	ECTS cr
Credits	120 -121	ECTS cr

CORE STUDIES IN MARKETING, INTERNATIONAL BUSINESS AND TECHNOLOGY MANAGEMENT 42 ECTS cr

Students will read 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 cr*
A330A0300 Strategic Global Marketing Management	M.Sc. (Econ. & Bus. Adm.) 1	1	6

And 6 ECTS cr from the following:

Electives	*year*	*per.*	*ECTS cr*
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, intensive	3
A330A0020 Asian Management	M.Sc. (Econ. & Bus. Adm.) 1	3-4, intensive	3
A330A0400 International Marketing Research	M.Sc. (Econ. & Bus. Adm.) 1	3-4, intensive	6

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 6 ECTS cr of the following:

Electives	*year*	*per.*	*ECTS cr*
A220A0650 Financial Theory and Valuation	M.Sc. (Econ. & Bus. Adm.) 1	3	6
A350A0450 Business Models and Strategy	M.Sc. (Econ. & Bus. Adm.) 1	3-4	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

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
	OR			
A330A5000[1)]	*International Marketing of High Technology Products and Innovations (Summer School course)*	*M. Sc. (Econ.& Bus. Adm. 2*	*1*	*3*
	AND			
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

Obligatory		*year*	*per.*	*ECTS cr*
A365A0551	Master´s Transferable Skills	M.Sc. (Econ. & Bus. Adm.) 1	1	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
A350A0102	Strategy Consulting	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

RECOMMENDED MINOR STUDIES

Knowledge and Innovation Management

Obligatory courses (18 ECTS cr)		*per.*	*ECTS cr*
A365A0300	Knowledge-based Networks	2	6
A365A0250	Organizational Learning in Knowledge Management	1	6
A350A0000	Business Process Management and Information Technologies	4	3
A350A0600	Contemporary Issues in Strategic Management and Innovation	3	3

Electives, select 6 ECTS cr of the following courses:		*per.*	*ECTS cr*
CS30A1661	Open Innovation	3-4	6
CS30A1670	Service Innovation and Management	3-4	5
A350A0700	Reading Course in Innovation Management	4	1

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
BL40A3000	Wind Power and Solar Energy Technology and Business	3-4	5

BH60A1600	Basic Course on Environmental Management and Economics	2	5
FV11A9503	Independent Study in English		1-4

*) recommended, if these courses are not included in the degree somewhere else

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 INTERNATIONAL MARKETING MANAGEMENT (MIMM) AND MASTER´S DEGREE IN INTERNATIONAL MARKETING MANAGEMENT (SKEMA-DUAL DEGREE)

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

6.4. Master´s Programme in International Marketing Management (SKEMA-Dual Degree)

Programme-specific Information

The Master's Degree 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. 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 degree 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.

Degree Structure

Core Studies (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 Degree Programme in International Marketing Management (LUT DD-students)

Degree Structure

Core Studies (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 a minimum of 6 ECTS from 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	Int.	3
A330A0020	Asian Management	M.Sc. (Econ. & Bus. Adm.) 1	Int.	3
A330A0400	International Marketing Research	M.Sc. (Econ. & Bus. Adm.) 2	3-4	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 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
A350A0450	Business Models and Strategy	M.Sc. (Econ. & Bus. Adm.) 1	3-4	6

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	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
	OR			
A330A5000[1)]	*International Marketing of High Technology Products and Innovations (Summer School course)*	*M. Sc. (Econ.& Bus. Adm. 2*	*1*	*3*
	AND			
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	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*
A350A0102	Strategy Consulting*	M.Sc. (Econ. & Bus. Adm.) 1	3-4	6
A330A0151	International Entrepreneurship Challenge	M.Sc. (Econ. & Bus. Adm.) 2	1-2	6
A330A0100	International Business Strategies	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 DEGREE 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

Course Descriptions in International Marketing Management

		ECTS cr
A130A0050	Introduction to Studies of Economic Sciences for Master's Students	3
A130A0120	International Students' Peer Tutoring	3
A220A0650	Financial Theory and Valuation	6
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
A330A5000	International Marketing of High Technology Products and Innovations	3
A330A5100	Creativity, Innovation, Entrepreneurship in New Product Development	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
A350A0102	Strategy Consulting	6
A350A0300	Technology and Innovation Management	6
A350A0450	Business Models and Strategy	6
A350A0500	Sustainable Strategy and Business Ethics	3
A350A0700	Reading Course in Innovation Management	1
A365A0100	Organization Theory	6
A365A0551	Master´s Transferable Skills	3
HARE	Internship for Master´s Programmes	2 - 10

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)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, Information Specialist, M.Sc. (Tech.) Marja Talikka, N. N. Person in Charge: Post-Doctoral Researcher, 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
Evaluation	Accepted/failed
Study materials	1. Lecture slides 2. Other material informed in lectures
Further Information	This course has 1-10 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: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, M.A 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 and Effectiveness (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 10 hours, online work and self-study 12 hours, one day's lecture 4 hours in period 4. One day's lecture 2 hours in the end of August. Tutoring in groups 30 hours, online work, final raport and independent work 12 hours and 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.

A220A0650	***FINANCIAL THEORY AND VALUATION***	***6 ECTS cr***
	Financial Theory and Valuation **The language of teaching is English.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3	
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Kashif Saleem Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed	
Aims	At the end of this course, the student is expected to be able to: - demonstrate advanced skills in describing corporate finance theories - apply the financial theory on valuation and corporate investment decisions - understand the linkages between agency theory and corporate financing decisions - know how managerial incentives affect financial decisions - analyze the information conveyed by financial decisions, mergers and acquisitions - understand the importance of risk management in corporate financial decisions.	
Content	The course provides advanced-level (Master's) knowledge based on a theoretical understanding of the main topics of corporate finance. The course covers specific issues including valuation and capital budgeting, investment decisions, cost of capital, financing decisions and market efficiency, capital structure and dividend policy, agency theory, managerial incentives, information and corporate control in financial decisions, and risk management and corporate strategy.	
Modes of Study	Lectures: 24 h Preparation for lectures and exam: 104 h 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 for the exam (80%) and term paper (20%). Students are required to obtain 50 percent of the maximum score in each task. Bonus points for active participation in quizzes and tutorials.
Study materials	1. Ross, S.A., Westerfield, R.W. and Jaffe, J.: Corporate Finance, 7th or later edition (selected chapters only) 2. Hiller, D., Grinblatt, M. and Titman, S.: Financial markets and corporate strategy – European edition (Chapters 18-23). 3. Handouts in class and all additional material required by the lecturer.
Prerequisites	Compulsory Bachelor's level courses in accounting and finance.

A330A0010	***CONTEMPORARY ISSUES IN INTERNATIONAL MARKETING*** ***3 ECTS cr***
	Contemporary Issues in International Marketing **The course has intensive teaching by an international visiting professor. 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)	Professor Rudolf Sinkovics (Manchester Business School) Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli, Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo (on sabbatical)
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.
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 is lectured biennially. It is lectured as an intensive course during the academic year 2014-2015.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3-4, intensive
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)	Post-Doctoral Researcher, 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 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).
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 Preparation for lectures and exam 34 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: (2007). Global Strategic Management. Peng, M.W. (2006). Global Strategy (or a newer 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.) 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
Modes of Study	12 hours of lectures 3 hours of case narrative presentations 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.	
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: 24 hours of exam preparation 5 hours for preparing for lectures 61 hours for doing assignments 5 hours for preparing presentations 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 International Marketing of High Technology Products and Innovations, 3 ECTS, 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, Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo (on sabbatical)
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	21 hours of lectures with interactive mini-case studies, 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.
Evaluation	Final grade 0-5. Evaluation 0-100 points: written exam 70 points group assignment 30 points casework passed/failed. 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.
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.
Prerequisites	Basics in Marketing.

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 Period 3-4, intensive The course is suitable also for doctoral studies.
Teacher(s)	Honorary professor, Ph.D John W. Cadogan, Professor, D.Sc. (Tech.) Sanna-Katriina Asikainen, N. N. 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

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 21.-25.7.2014)**	
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. 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	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.	
Modes of Study	Lectures, in-class assignments, exam. 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.	

A330A5100	***CREATIVITY, INNOVATION, ENTREPRENEURSHIP IN NEW PRODUCT DEVELOPMENT*** ***3 ECTS cr***
	Creativity, Innovation, Entrepreneurship in New Product Development **LUT Summer School (intensive course 14. - 18.7.2014)**
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.
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 14. - 18.7.2014)**
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: - 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. - Understand how the companies are managing in today's volatile environments what type of analysis is needed to appreciate foreign markets and how companies can manage their foreign operations. - Appreciate issues of international trade, transformations in the world economy and in particular international issues of economic geography and global production networks. - 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	"Frontiers in IB" 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. 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 Expose students to the diversity of business systems and cultures in the international arena and the effect of this diversity on business practices.
Modes of Study	30 hours of lectures, presentations and discussion of case studies 50 hours of preparation for lectures and assignments Total workload for student 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	Required: Hill, Charles W.L. (2011), International Business - Competing in the Global Marketplace (8th ed.). Boston, Mass.: McGraw Hill. (ISBN: 0078137195). Optional supplementary reading: Other international business books may be used as reference, e.g. Peng (2010), Peng and Meyer (2011), Peng (2011), Rugman and Collinson (2006), Czinkota, Ronkainen and Moffett (2011) Further supplementary reading, especially journal articles to be announced before / in the class.

Prerequisites	Previous studies in business recommended.

A330A5300	***DOING BUSINESS IN CHINA***	***2 ECTS cr***
	Doing Business in China **LUT Summer School (intensive course, 21. - 23.7.2014)**	
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	
Modes of Study	17 hours of lectures and in-class assignments 36 hours of preparation for lectures and assignment Total workload for student 53 h. Moodle is used in this course.	
Evaluation	Final grade 0-5. Evaluation 0-100 points: Active class participation 20% Case assignment and presentation 80% 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 23. - 27.7.2014)**
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, 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 (23.-24.7.2014): - 14 hours of lectures and in-class assignments 'In class' programme in St. Petersburg (25.-27.7.2014): - 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 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): 50 % Learning diary 50 % 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, 3 ECTS cr INTERNATIONAL MARKETING MANAGEMENT***
	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.) Olli Kuivalainen (Autumn 2014)
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 2014/Spring 2015) 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.
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) Moodle is used in this course.	
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).	
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	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2/3-4	
Teacher(s)	Fall semester: Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Post-	

	Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Mika Vanhala Spring semester: Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi, 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.

A350A0102	***STRATEGY CONSULTING***	***6 ECTS cr***
	Strategy Consulting **NOTE: Lectured twice during the academic year**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-2/3-4	
Teacher(s)	Adjunct Professor, D.Sc (Econ.), Lic. Pol. Sc Timo Santalainen Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, (spring), Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli (autumn)	
Aims	By the end of the course the students will 1. Master key strategic concepts, tools and frameworks for strategizing. 2. Recognize the roles, styles and practices of strategy consulting in different situations. 3. Be able to apply strategic concepts, tools and frameworks in solving the consulting case problem. 4. Be able to outline a professional written report based on the results of their analysis and contributions. 5. Be able to communicate their findings and recommendations in a convincing, professional way.	
Content	The course is focused on strategy consulting with a very hands-on approach to learning: students take the role of strategy consultants to solve a case organization's concrete problem. The course and its ways of working are designed to help participants to explore strategic issues of selected	

	companies/organizations from three perspectives: academic research and concepts (A), business practice (B), and consulting (C). Taking the role of strategy consultants participants are expected to develop value-generating ideas for their respective case organizations. The course is also aimed at the development of business "softskills" such as teamwork, leadership, project management, presentation and other communication skills. Core content: Evolving motivations and approaches in strategic management and thinking within the context of (hyper)competitive multinational business arenas. Conceptual tools for strategic situational analysis. The logic of developing customer-centric and resource-based strategies as well as value-capturing business models. Alternative roles, styles and practices of strategy consulting. Additional content: Alternative modes and tools of "strategizing" in case- as well as in real business situations. Information collection and problem solving skills. Effective presentation skills.
Modes of Study	Prework: Reflective essay: appr. 30 h (reading and preparation of the essay) 16 hours of lectures (Kick-off workshop, attendance compulsory) 16 hours of seminars, including final presentations of the projects to the evaluation committee Independent project work in teams: 90 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
Evaluation	Grade 0-5, evaluation 0-100 points. Max 100 points from project work. Grading of projects: 70% supervisors 30% firm representative
Study materials	Santalainen, Timo (2006) Strategic Thinking, Talentum Handout materials relating to topics of each seminar Strategy consulting tools Other material depending on the project work

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, written exam 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.

A350A0450	***BUSINESS MODELS AND STRATEGY***	***6 ECTS cr***
	Business Models and Strategy	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 3-4	
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi	
Aims	Students will be able to - understand the concept of business model and its relation to strategy, technology, firm performance, and value creation and capture - analyze the business models of competitors, entrants, and incumbents - analyze business models, business model innovation and the effects of business model innovation both on firm-level and industry-level - identify and analyze the management and implementation challenges and best practices of business models and business model innovation	
Content	- Business model in relation to strategy, technology, firm performance, and value creation and capture - Business model innovation and the effects of business model innovation: firm-level and industry-level effects - Management and implementation of business models and business model innovation - Assignments on the topics covered in the course	
Modes of Study	Lectures 27 h Independent preparation for lectures 33 h Course assignments 100 h	

	Total workload for student 160 h Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, based on course assignments
Study materials	Distributed during lectures
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

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	
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); 12 hours of interactive theme sessions and seminars (weeks 4-6). Out-class hours: Preparation for the theme sessions and seminars: 16 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	Books and articles on sustainability and busines ethics. Readings list distributed during lectures.	

A350A0700	***READING COURSE IN INNOVATION MANAGEMENT***	***1 ECTS cr***
	Reading Course in Innovation Management	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4	
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi	
Aims	This course is structured as an independent reading assignment, focusing on relevant issues in innovation management. Students will familiarize themselves	

	with the recent academic literature in the field, and they will further analyze this content through discussion and presentation. The learning outcomes of the course are the following: 1. To assess contemporary topics of innovation management 2. To discuss and debate on specific topics of the course
Content	The specific content of the course is based on current topics of innovation management. The course syllabus with detailed contents will be distributed in the beginning of the course. The course will utilize independent reading assignment and oral presentation to synthesize and analyze the course content.
Modes of Study	Oral presentation of the independent reading assignment (joint seminar): 4h Independent preparation with the literature 20 h Preparation for the oral presentation 3 h. Total workload for student 27 h Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points. Grade 0-5, evaluation 0-100 points The evaluation is based on oral presentation of the independent reading assignment.
Study materials	Selected articles on innovation management, distributed during lectures.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

A365A0100	***ORGANIZATION THEORY***	***6 ECTS cr***
	Organization Theory **Replaces course A390A0450 - 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.	
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.	

A365A0551	***MASTER´S TRANSFERABLE SKILLS***	***3 ECTS cr***
	Master´s Transferable Skills	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1	
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 completion of the course, the student is able to participate in the scientific discussion relating to his/her own field of specialization. The student understands the basics of scientific writing and can present and argument his/her own work professionally. The student has sufficient abilities for team- and project work and he/she understands the significance of scheduling and distribution of liabilities and assignments.
Content	The course covers the following themes: - Academic argumentation - Scientific writing - Basics of project work and project management - Basics of team work - Different styles of learning and time management
Modes of Study	Compulsory lectures 8h, preparing and presenting assignments 72h. Total workload 80h. Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluated on scale 0 - 100 p. Lecture activity 20%, independent assignments 80%.
Study materials	Selected materials, available in Noppa and Moodle.
Prerequisites	Bachelor´s Degree

HARE	***INTERNSHIP FOR MASTER´S PROGRAMMES 2 - 10 ECTS cr***
	Internship for 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.**
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 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.
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 A220A0250 Managerial Finance A220A0300 Theory of Corporate Finance For MSM students: A310A0101 Strategic Supply Managment

6.5. 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 core 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)

Students may include 3 ECTS credits of internship into the degree. Only the internship which student does during the studies at LUT can be accepted. Two weeks of internship correspond to 1 ECTS credit

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	48	ECTS cr
Specialisation Studies	42	ECTS cr
Minor Studies	24	ECTS cr
Language	6	ECTS cr
Credits	120 (min.)	ECTS cr

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CORE STUDIES (total 48 ECTS cr, 33 ECTS cr Obligatory studies and 15 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	3-4	6
A350A0450	Business Models and Strategy	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	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
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
A350A0600	Contemporary Issues in Strategic Management and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	3	3

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	4	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	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*
A350A0102 Strategy Consulting	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	6
A365A0300 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

RECOMMENDED MINOR STUDIES (24 ECTS cr)

Sustainability
International Marketing
Business and Technology in Russia

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
BL40A3000	Wind Power and Solar Energy Technology and Business	3-4	5
BH60A1600	Basic Course on Environmental Management and Economics	2	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*
A330A0300	Strategic Global Marketing Management	1	6
A330A0250	Internationalization of the Firm and Global Marketing	2	6
A330A0050	Customer Relationship Management	4	6
A330A0010	Contemporary Issues in International Marketing	3, intensive	3
A330A0020	Asian Management	3-4, intensive	3
A330A5000	International Marketing of High Technology Products and Innovations		3
A330A0220(*	International Marketing of High Technology Products and Innovations: applications	1-2	3

*) This course can be in this minor only with the course A330A5000

Business and Technology in Russia 24 ECTS cr
Electives, choose at least 24 ECTS cr:

Elective Studies		*per.*	*ECTS cr*
A220A0150	International Finance and Emerging Markets	2	6
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.

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 INTERNATIONAL TECHNOLOGY AND INNOVATION MANAGEMENT (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

6.6. 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.

Master of Science in Economics and Business Administration

Degree Structure

Core Studies	54	*ECTS cr*
Specialisation Studies	42	*ECTS cr*
Minor Studies	24	*ECTS cr*
Credits	*120 (min.)*	*ECTS cr*

CORE STUDIES (total 54 ECTS cr, 33 ECTS Obligatory studies, and 21 ECTS 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	3-4	6
A350A0450	Business Models and Strategy	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	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
A350A0600	Contemporary Issues in Strategic Management and Innovation	M.Sc. (Econ. & Bus. Adm.) 1	3	3

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	4	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	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*
A350A0102 Strategy Consulting	M.Sc. (Econ. & Bus. Adm.) 1-2	3-4	6
A365A0300 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

Minor Studies (24 ECTS cr), Business Administration

Obligatory	*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
A350A0000 Business Process Management and Information Technologies	M.Sc. (Econ. & Bus. Adm.) 1	4	3
A365A0100 Organization Theory	M.Sc. (Econ. & Bus. Adm.) 1	1	6
HARE Internship for Master´s Programmes	M.Sc. (Econ. & Bus. Adm.) 2	1-4	3

Complemenatry 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 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

Course Descriptions in Strategy, Innovation and Sustainability

		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
A220A0650	Financial Theory and Valuation	6
A310A0500	Global Sourcing and Sub-Contracting	6
A310A0650	Cost and Risk Management in Supply Chain	6
A330A0010	Contemporary Issues in International Marketing	3
A330A0100	International Business Strategies	6
A330A0200	International Marketing of High Technology Products and Innovations	6
A350A0000	Business Process Management and Information Technologies	3
A350A0050	Business Research Methods	6
A350A0102	Strategy Consulting	6
A350A0200	Introduction to Economics	6
A350A0250	Multivariate and Econometric Analysis Methods	6
A350A0300	Technology and Innovation Management	6
A350A0450	Business Models and Strategy	6
A350A0500	Sustainable Strategy and Business Ethics	3
A350A0550	Project Course on Sustainable Business	3
A350A0600	Contemporary Issues in Strategic Management and Innovation	3
A350A0700	Reading Course in Innovation Management	1
A350A8500	Master’s Thesis Seminar, Strategy, Innovation and Sustainability	3
A350A9100	Master’s Thesis, Strategy, Innovation and Sustainability	30
A365A0100	Organization Theory	6
A365A0300	Knowledge-based Networks	6
A365A0551	Master´s Transferable Skills	3
HARE	Internship for Master´s Programmes	2 - 10

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)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, Information Specialist, M.Sc. (Tech.) Marja Talikka, N. N. Person in Charge: Post-Doctoral Researcher, 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
Evaluation	Accepted/failed
Study materials	1. Lecture slides 2. Other material informed in lectures
Further Information	This course has 1-10 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: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi, M.A 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 and Effectiveness (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 10 hours, online work and self-study 12 hours, one day's lecture 4 hours in period 4. One day's lecture 2 hours in the end of August. Tutoring in groups 30 hours, online work, final raport and independent work 12 hours and 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 **The language of teaching is English.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2
Teacher(s)	Part-time Untenured Teacher, D.Sc. (Econ. & Bus. Adm.) Timo Leivo
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 Seminars: 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 **The language of teaching is English.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 3-4 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 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	

A220A0650	***FINANCIAL THEORY AND VALUATION***	***6 ECTS cr***
	Financial Theory and Valuation **The language of teaching is English.**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 3	
Teacher(s)	Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Kashif Saleem Person in Charge: Associate Professor, D.Sc. (Econ. & Bus. Adm.) Sheraz Ahmed	
Aims	At the end of this course, the student is expected to be able to: - demonstrate advanced skills in describing corporate finance theories - apply the financial theory on valuation and corporate investment decisions - understand the linkages between agency theory and corporate financing	

	decisions - know how managerial incentives affect financial decisions - analyze the information conveyed by financial decisions, mergers and acquisitions - understand the importance of risk management in corporate financial decisions.
Content	The course provides advanced-level (Master's) knowledge based on a theoretical understanding of the main topics of corporate finance. The course covers specific issues including valuation and capital budgeting, investment decisions, cost of capital, financing decisions and market efficiency, capital structure and dividend policy, agency theory, managerial incentives, information and corporate control in financial decisions, and risk management and corporate strategy.
Modes of Study	Lectures: 24 h Preparation for lectures and exam: 104 h 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 for the exam (80%) and term paper (20%). Students are required to obtain 50 percent of the maximum score in each task. Bonus points for active participation in quizzes and tutorials.
Study materials	1. Ross, S.A., Westerfield, R.W. and Jaffe, J.: Corporate Finance, 7th or later edition (selected chapters only) 2. Hiller, D., Grinblatt, M. and Titman, S.: Financial markets and corporate strategy – European edition (Chapters 18-23). 3. Handouts in class and all additional material required by the lecturer.
Prerequisites	Compulsory Bachelor's level courses in accounting and finance.

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.
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

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.) Jukka Hallikas, 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 total cost thinking, and cost and risk assessment in supply chains. During the course, students apply methods and tools of cost and risk assessment in practical assignments. After completing the course, students will be able to - perform risk assessments in supply chains - evaluate the cost factors in purchasing decisions - apply tools, methods and applications in risk and cost assessment - utilize cost 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	Interactive lectures and assignments 9 h, two independent assignments, both including written reports, 4th period. Preparing for lectures 18 h, preparation of the assignment and written report 133 h. Total workload 160 h. Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, two independent assignments including written reports 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.

A330A0010	***CONTEMPORARY ISSUES IN INTERNATIONAL MARKETING 3 ECTS cr***
	Contemporary Issues in International Marketing **The course has intensive teaching by an international visiting professor. 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)	Professor Rudolf Sinkovics (Manchester Business School) Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli, Professor, D.Sc. (Econ. & Bus. Adm.) Sami Saarenketo (on sabbatical)
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.
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

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 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).
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 Preparation for lectures and exam 34 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: (2007). Global Strategic Management. Peng, M.W. (2006). Global Strategy (or a newer 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

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.
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: 24 hours of exam preparation 5 hours for preparing for lectures 61 hours for doing assignments 5 hours for preparing presentations 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

A350A0000	***BUSINESS PROCESS MANAGEMENT AND INFORMATION TECHNOLOGIES*** ***3 ECTS cr***
	Business Process Management and Information Technologies
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Visiting Professor Sofya Zhukova Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala
Aims	The course aim is to give students understanding how to change and improve business processes on the base of complex analysis of organization key activities in order to add value to business. Students gain knowledge to create horizontal process management structures through documenting, mapping, analyzing, simulating and validating business processes.
Content	Topic 1. System analysis and business modeling Thinking in systems. Business systems. The benefits of formalization. Models vs. systems. Models types: conceptual, physical, functional, mathematical models. Goals of using models in management.

	Topic 2. Formal models of business processes Abstraction concepts. Fundamental terms of control theory and business process management. Queuing theory basics. From business functions to business processes shift. Topic 3. Business process mapping and visualization Visualizing business dimensions. Types of diagram modelling: mind-maps, flowcharts, RD, CFD, AFD. Topic 4. Business process management Approaches within BPM: people, technology. Business process management life-cycle. BPM and quality management: TQM, Six Sigma, BPR. Change management techniques. Topic 5. Industry standards and notations Object-oriented approach to modeling. IDEF standards. ARIS methodology. Business modeling languages: UML, BPMN, BPEL, WS-CDL. Topic 6. Business process improvement and reengineering Business process improvement types. Creating AS-IS and TO-BE models. What-If analysis. Topic 7. Business Process Automation Automation field. Business processes and Web-technologies. Business process optimization and KPI.
Modes of Study	Lectures 20 h, 4th period. Individual class assignments 20 h, case studies 20 h, computer labs 20 h. Exam. Total workload for student 80 h.
Evaluation	Graded 0-5 on the basis of the exam (50%) and course work (50%), evaluation 0-100 points.
Study materials	Required reading 1. Sofya V. Zhukova. Guidelines for students' work on BPM: main deadlines and deliverables, 2010. 2. Pradeep Hari Pendse: Business Analysis - Visualizing Business Processes and Effective Software Solutions, Prentice-Hall, 2008. 3. Robert D. Austin, Richard L. Nolan, Shannon O'Donnell, Adventures of an IT Leader, Harvard Business Press, 2009 Optional reading 1. John Jeston, Johan Nelis Business Process Management: Practical Guidelines to Successful Implementations, Butterworth-Heinemann, 2006. – 464 p. 2. Adrienne Curry, Peter Flett, and Ivan Hollingsworth: Managing Information and Systems: The Business Perspective. Routledge, 2005 3. H. James Harrington, K. C. Esseling, Van Nimwegen Business Process Improvement Workbook: Documentation, Analysis, Design, and Management of Business Process Improvement, McGraw-Hill, 1997. - 314 p. 4. Michael Havey, Essential Business Process Modeling O'Reilly, 2005. - 350 p. 5. Hans-Erik Eriksson, Magnus Penker Business Modeling with UML: Business Patterns at Work, Wiley, 2000. - 480 p. 6. Stephen A. White, Business Process Modeling Notation, IBM Corporation http://bpmi.org 7. Course tutorial. IBM WebSphere Business Modeler: Process Mapping and Analysis, 2007 8. Course tutorial. IBM WebSphere Business Modeler: Process Simulation and Analysis, 2007

A350A0050	***BUSINESS RESEARCH METHODS***	***6 ECTS cr***
	Business Research Methods	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1-2/3-4	
Teacher(s)	Fall semester: Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Mika Vanhala Spring semester: Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi, 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.

A350A0102	***STRATEGY CONSULTING***	***6 ECTS cr***
	Strategy Consulting **NOTE: Lectured twice during the academic year**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-2/3-4	
Teacher(s)	Adjunct Professor, D.Sc (Econ.), Lic. Pol. Sc Timo Santalainen Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, (spring), Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Lasse Torkkeli (autumn)	
Aims	By the end of the course the students will 1. Master key strategic concepts, tools and frameworks for strategizing. 2. Recognize the roles, styles and practices of strategy consulting in different situations. 3. Be able to apply strategic concepts, tools and frameworks in solving the consulting case problem. 4. Be able to outline a professional written report based on the results of their analysis and contributions. 5. Be able to communicate their findings and recommendations in a convincing, professional way.	
Content	The course is focused on strategy consulting with a very hands-on approach to learning: students take the role of strategy consultants to solve a case organization's concrete problem. The course and its ways of working are designed to help participants to explore strategic issues of selected companies/organizations from three perspectives: academic research and concepts (A), business practice (B), and consulting (C). Taking the role of strategy consultants participants are expected to develop value-generating	

	ideas for their respective case organizations. The course is also aimed at the development of business "softskills" such as teamwork, leadership, project management, presentation and other communication skills. Core content: Evolving motivations and approaches in strategic management and thinking within the context of (hyper)competitive multinational business arenas. Conceptual tools for strategic situational analysis. The logic of developing customer-centric and resource-based strategies as well as value-capturing business models. Alternative roles, styles and practices of strategy consulting. Additional content: Alternative modes and tools of "strategizing" in case- as well as in real business situations. Information collection and problem solving skills. Effective presentation skills.
Modes of Study	Prework: Reflective essay: appr. 30 h (reading and preparation of the essay) 16 hours of lectures (Kick-off workshop, attendance compulsory) 16 hours of seminars, including final presentations of the projects to the evaluation committee Independent project work in teams: 90 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
Evaluation	Grade 0-5, evaluation 0-100 points. Max 100 points from project work. Grading of projects: 70% supervisors 30% firm representative
Study materials	Santalainen, Timo (2006) Strategic Thinking, Talentum Handout materials relating to topics of each seminar Strategy consulting tools Other material depending on the project work

A350A0200	***INTRODUCTION TO ECONOMICS***	***6 ECTS cr***
	Introduction to Economics **For MSIS and exchange students of School of Business**	
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. Moodle is used in this course.	
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, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Heli Arminen	
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, written exam 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.

A350A0450	***BUSINESS MODELS AND STRATEGY***	***6 ECTS cr***
	Business Models and Strategy	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1-2 Period 3-4	
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi	
Aims	Students will be able to - understand the concept of business model and its relation to strategy, technology, firm performance, and value creation and capture	

Content	- analyze the business models of competitors, entrants, and incumbents - analyze business models, business model innovation and the effects of business model innovation both on firm-level and industry-level - identify and analyze the management and implementation challenges and best practices of business models and business model innovation - Business model in relation to strategy, technology, firm performance, and value creation and capture - Business model innovation and the effects of business model innovation: firm-level and industry-level effects - Management and implementation of business models and business model innovation - Assignments on the topics covered in the course
Modes of Study	Lectures 27 h Independent preparation for lectures 33 h Course assignments 100 h Total workload for student 160 h Moodle is used in this course.
Evaluation	Grade 0-5, evaluation 0-100 points, based on course assignments
Study materials	Distributed during lectures
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

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
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); 12 hours of interactive theme sessions and seminars (weeks 4-6). Out-class hours: Preparation for the theme sessions and seminars: 16 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	Books and articles on sustainability and busines ethics. Readings list distributed during lectures.

A350A0550	***PROJECT COURSE ON SUSTAINABLE BUSINESS*** ***3 ECTS cr***
	Project Course on Sustainable Business **This course is available only for students of MSIS-programme in LUT School of Business.**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	N. N. 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 based on independent research project, conducted for a chosen case company. 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.
Modes of Study	Independently contacting the case company and collecting data (during period 4) 30 h Seminar work and presentations (during the intensive week after period 4) 14 h Independent project work (analyzing data, writing of the project report) 36 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.
Study materials	Assigned during the course.

A350A0600	***CONTEMPORARY ISSUES IN STRATEGIC MANAGEMENT AND INNOVATION*** ***3 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, 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 an intensive 3 week period, and is concluded with a panel discussion session.
Modes of Study	3. period, virtual course + final panel discussion 4 h (virtual part conducted online during the intensive week before the beginning of 3. period and during first two weeks of 3. period) Online work 40 h, including content production, moderation, discussion Independent familiarization with literature 36 h Panel discussion 4h Total hours: 80 h Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points. Online content creation 50% Online activity points 50% There is no written final exam.
Study materials	Independent content creation based on academic and practical sources and familiarization of other students' input.
Prerequisites	A350A0300 Technology and Innovation Management or corresponding knowledge.

A350A0700	***READING COURSE IN INNOVATION MANAGEMENT*** ***1 ECTS cr***
	Reading Course in Innovation Management
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 4
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Tech.) Kati Järvi
Aims	This course is structured as an independent reading assignment, focusing on relevant issues in innovation management. Students will familiarize themselves with the recent academic literature in the field, and they will further analyze this content through discussion and presentation. The learning outcomes of the course are the following: 1. To assess contemporary topics of innovation management 2. To discuss and debate on specific topics of the course
Content	The specific content of the course is based on current topics of innovation management. The course syllabus with detailed contents will be distributed in the beginning of the course. The course will utilize independent reading assignment and oral presentation to synthesize and analyze the course content.
Modes of Study	Oral presentation of the independent reading assignment (joint seminar): 4h Independent preparation with the literature 20 h Preparation for the oral presentation 3 h. Total workload for student 27 h Moodle is used in this course.
Evaluation	Final grade 0-5. Evaluation 0-100 points. Grade 0-5, evaluation 0-100 points The evaluation is based on oral presentation of the independent reading assignment.
Study materials	Selected articles on innovation management, distributed during lectures.
Further Information	This course has 1-5 places for open university students. More information on the web site for open university instruction.

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. (Econ. & Bus. Adm.) Paavo Ritala, 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 - prepare and present the analysis of the research topic - prepare and present the research plan and act as a discussant for another student's report - draw up and present the intermediate version of the thesis (60-70% completed, includes introduction, literature review, research design and preliminary findings) - analyze a completed Master's thesis (free choice)
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.
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. Approximately 30 ECTS cr. master's studies.

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. (Econ. & Bus. Adm.) Paavo Ritala, 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). Moodle is used in this course.
Evaluation	Thesis: improbatur – laudatur
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 **Replaces course A390A0450 - 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.	
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.** **Replaces course A340A0050 - Knowledge Management and Networks**	
Year and Period	M.Sc. (Econ. & Bus. Adm.) 2 Period 2	
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Paavo Ritala, Post-Doctoral Researcher, 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
Modes of Study	Lectures 28 h, 2. period, Independent preparation for lectures 32 h Course assignment work (group assignment) 100 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	
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 completion of the course, the student is able to participate in the scientific discussion relating to his/her own field of specialization. The student understands the basics of scientific writing and can present and argument his/her own work professionally. The student has sufficient abilities for team- and project work and he/she understands the significance of scheduling and distribution of liabilities and assignments.	
Content	The course covers the following themes: - Academic argumentation - Scientific writing - Basics of project work and project management - Basics of team work - Different styles of learning and time management	
Modes of Study	Compulsory lectures 8h, preparing and presenting assignments 72h. Total workload 80h. Moodle is used in this course.	
Evaluation	Final grade 0-5. Evaluated on scale 0 - 100 p. Lecture activity 20%, independent assignments 80%.	
Study materials	Selected materials, available in Noppa and Moodle.	
Prerequisites	Bachelor´s Degree	

HARE	***INTERNSHIP FOR MASTER´S PROGRAMMES***	***2 - 10 ECTS cr***
	Internship for 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.
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 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.
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 A220A0250 Managerial Finance A220A0300 Theory of Corporate Finance For MSM students: A310A0101 Strategic Supply Managment

6.7. Internship Instructions in Business 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

6.8. Student Assessment Policy in School of Business

Approved by the faculty council 16 March 2010

Changes approved by Head of Degree Programmes 30 April 2011. Updated 30 May 2014

General assessment principles

The key purposes of assessment

- To monitor student attainment of learning outcomes
- To provide both students and teachers with feedback on the quality of learning
- To control compliance with the developing standards of higher education
- To motivate students in their studies

Objectives of the student assessment policies

- Be equal
  - Requirements are equal across courses and programmes
  - No discrimination based on gender, sexual orientation, ethnicity, religion, belief, age, class or disability
- Be transparent
  - Students understand how they are assessed
  - Students understand how they can influence their grades
- Be coherent
  - Assessment is in line with the intended learning outcomes of the courses
  - Assessment should appropriately reflect the level of the programme
- Be educational
  - Foster student efforts towards the intended learning outcomes
  - Be an integral part of the curriculum and the learning process → support student learning

Practices to support the objectives of student assessment

An equal assessment policy

- All courses are assessed on a universal grading scale of 100 points
- The appropriateness of the assessment systems for individual courses is checked *ex ante*
- The assessment is as objective (e.g. evaluation rubric) as possible with minimal subjectivity
- The grade distributions are monitored
- The appropriateness of pass rates and progression are monitored
- School level policies regarding deadlines, retakes and resits are implemented
- The appropriateness of marking and grading standards is checked *ex post* (min. 20% of exams)*

  → The objective is to increase the *ex post* checking of marking
  → The objective is to develop practices to enable anonymous marking of exams

  * Practice will be piloted by the Master's programme of International Marketing

A transparent assessment policy

- Clear assessment criteria and weighting of components
- The use of an evaluation rubric is strongly encouraged
- Students are informed of the assessment system (and related rubric) of each course during the introductory lectures
- Material explaining the assessment policies is also available online
- Explicit school level policy with regard of deadlines, re-takes, re-sits and appeals

A coherent assessment policy

- The appropriateness of the assessment systems of individual courses is checked *ex ante*
  - Balance with theory and practice
  - Facilitates deep learning (timing and amount of assessment)

- No excessive or unnecessary assessment
- Workload in line with the course scope

An educational assessment policy

- Assessment methods are in line with the intended learning outcomes
- A varied range of assessment methods is employed on the course and programme levels to support different ways of learning
- Constructive feedback is provided in addition to the grades to support the personal development of the students (especially at the Master's level)
- Peer assessment, when appropriate, is encouraged to provide rapid feedback and promote the understanding of the assessment criteria

→ The objective is to increase the feedback on exams and other forms of student output to support personal development

Course and examination evaluation scale

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. In the five-point scale where 100 points is the maximum, grade 5 requires 90–100, grade 4 requires 80–89, grade 3 requires 70–79, grade 2 requires 60–69, grade 1 requires 50–59 and grade 0 requires 0- 49.

The possible coursework affects the final grade of the course together with the possible examination. The teacher determines how much the coursework is emphasised in the evaluation. Teachers shall forward the grades to the Student Affairs Office and make them known to the students or post them online within a month, but no later than two weeks before the following examination. If two of the exams for a course are held within a four-week period, the teacher may grade all of the exams at once. In such cases, the one-month period for grading exams starts from the latter exam.

General assessment policies

The timeliness of assessment

- All exams and other forms of student output are assessed within the period of one month

Extension of deadlines and late submission of student work

- Course deadlines will not be postponed without a clear and acceptable reason (e.g. teacher's illness)
- In the case of a clear and acceptable reason (e.g. illness, death of a close relative), students should contact the teacher responsible in advance and agree on the extension of the deadlines. In these cases, there will be no sanctions
- Student work submitted after a set deadline will not be assessed/accepted, unless agreed with the teacher responsible in advance
- Work-related reasons are not acceptable for extending the deadlines for an individual student

Retakes and resits

- Students have the possibility to retake an exam once (four exams will be organised and the student must choose which two he/she takes).
- In the case the student does not pass the exam during the two possible exams, he or she may apply for an additional retake according to LUT practise.
- It is not possible to retake an assignment that has already been accepted (except an exam)
- When the student fails to pass an obligatory assignment, he/she has the possibility to retake that assignment the following year.
- The grade of an assignment that has been assessed and accepted, will be effective max. for a period of two years. After the two year period, the student needs to resit the course.
- Only in cases where the resit would postpone the graduation of the student (an ongoing Master's thesis process), he/she will be allowed e.g. to retake a failed assignment. This needs to be agreed on with the teacher responsible. It is the student's responsibility to prove that he/she will graduate soon (max. 1 course is missing and the thesis process is advanced) by submitting a transcript and personal study plan.

Plagiarism

- Various systems to check for plagiarism are used
- When a student has been noted to have submitted a thesis including a substantial amount of plagiarism, he/she needs to write a new thesis on a new topic
- When a student has been noted to have submitted an assignment including a substantial amount of plagiarism, he/she needs to write a new assignment on a new topic
- On the basis of the nature of the assignment, the teacher responsible will determine the amount of plagiarism that requires sanctions and starting the process of disciplinary measures

Correction of the assessment of study attainments

- Students have the right to obtain information about the application of assessment criteria to their study attainments. They shall be given the opportunity to see the assessed study attainment. After the assessment, students have the right to receive a duplicate of the paper assessed
- Students dissatisfied with the assessment of a study attainment may orally or in writing request a correction within 14 days of the publication of the assessment results. The request shall be made to the instructor of the course. Students dissatisfied with the decision made regarding the correction request may request a correction from the degree board within 14 days of the date the decision was made known
- Students dissatisfied with the assessment of a final thesis may request a correction from the degree board within 14 days of days of having been informed of the assessment. The correction request shall be submitted to Records Services and as a notification to the head of study affairs of the School of Business
- The decision of the degree board is final; no appeals can be made.
- The rector nominates the members of the degree board and the Student Union nominates the student member(s)

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:

School of Technology

Energy Technology

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

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

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

Elective Studies		*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

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

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

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

Sustainability (for students majoring in Bio-Energy Technology)

Obligatory Studies (18 ECTS cr)		*year*	*per.*	*ECTS cr*
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 1-2	2	5
BH61A0600	Bioenergy	M.Sc. (Tech.) 1-2	1	3
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1-2	3-4	5
CS30A1690	Social Sustainability	M.Sc. (Tech.) 1-2	4	5

Choose enough credits to attain 20 ECTS credits of minor subject studies.

List of selectable courses		*year*	*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Econ. & Bus. Adm.) 1	2	3
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1	2	6
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1	3	3
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1-2	4	4
BM20A3900	Modelling Methodology in Process Engineering	M.Sc. (Tech.) 1	1, INT 43	6
FV11A9503	Independent Study in English			1-4

Sustainability (for students majoring in Industrial Electronics or Electricity Market and Power Systems)

Obligatory Studies (5 ECTS cr)		*year*	*per.*	*ECTS cr*
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1	3-4	5

List of selectable courses, choose enough credits to attain 20 ECTS cr		*year*	*per.*	*ECTS cr*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Tech.) 1-2	2	3
BH40A1301	Power Machines in Renewable Energy	M.Sc. (Tech.) 1-2	2	5
BH50A1200	Energy Systems Engineering	M.Sc. (Tech.) 1-2	1-2	6
BH50A1400	Steam Boilers	M.Sc. (Tech.) 1-2	1-2	6

BH50A1500	Bioenergy Technology Solutions	M.Sc. (Tech.) 1-2	2-3	6
BH60A1600	Basic Course on Environmental Management and Economics	M.Sc. (Tech.) 1-2	2	5
BH60A4500	Corporate Responsibility and Management 1	M.Sc. (Tech.) 1-2	1-4	3
BH61A0600	Bioenergy	M.Sc. (Tech.) 1-2	1	3
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1	1	5
BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1	2	6
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1	2	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1	1	5
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1	3	3
BK30A0900	Additive Manufacturing	M.Sc. (Tech.) 1-2	3-4	5
BK50A2001	Package Performance and Sustainability	M.Sc. (Tech.) 1-2	3	5
BK50A2200	Design Methodologies and Applications of Machine Element Design	M.Sc. (Tech.) 1-2	1-2	5
BK90C1800	Green Fiber Materials	M.Sc. (Tech.) 1-2	4	5
BM20A1901	Statistics II	M.Sc. (Tech.) 1-2	2	4
BM20A3401	Design of Experiments	M.Sc. (Tech.) 1-2	4	4
BM20A3900	Modelling Methodology in Process Engineering	M.Sc. (Tech.) 1-2	1, INT 43	6
CS10A0770	Cleaner Technologies and Markets	M.Sc. (Tech.) 1-2	3-4	5
CS30A1690	Social Sustainability	M.Sc. (Tech.) 1-2	4	5
CT10A7000	Green IT and Sustainable Computing	M.Sc. (Tech.) 1-2	3-4	4
FV11A9503	Independent Study in English	M.Sc. (Tech.) 1-2		1-4

Chemical Engineering

Separation Technology

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

Green Process Technology

Obligatory studies		*year*	*per.*	*ECTS cr*
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1-2	2	5
BJ02A4020	Methods in Green Chemistry	M.Sc. (Tech.) 1-2	4	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1-2	1	5
BJ02A4040	Processing of Biomaterials	M.Sc. (Tech.) 1-2	1-2, INT 43	7
BJ02A4050	Biomaterials Design and Application	M.Sc. (Tech.) 1-2	3	3

Sustainability

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

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

Selectable courses		*year*	*per.*	*ESTS cr.*
A350A0500	Sustainable Strategy and Business Ethics	M.Sc. (Tech.) 1-2	2	3
BH61A0600	Bioenergy	M.Sc. (Tech.) 1-2	1	3
BJ02A1050	Biopolymeerit	M.Sc. (Tech.) 1-2	4	5
BJ02A1060	Prosessi- ja ympäristöanalytiikka	M.Sc. (Tech.) 1-2	1, INT 43	5
BJ02A1070	Bioprosessitekniikan perusteet	M.Sc. (Tech.) 1-2	4	4
BJ02A2050	Process Intensification	M.Sc. (Tech.) 1-2	4	4
BJ02A3010	Membrane Technology	M.Sc. (Tech.) 1-2	1	5

BJ02A3020	Chemical Separation Methods	M.Sc. (Tech.) 1-2	2	6
BJ02A4010	Industrial Water Treatment	M.Sc. (Tech.) 1-2	2	5
BJ02A4030	Green Chemistry	M.Sc. (Tech.) 1-2	1	5
BJ02A4040	Processing of Biomaterials	M.Sc. (Tech.) 1-2	1-2, INT 43	7
BK90C1800	Green Fiber Materials	M.Sc. (Tech.) 1-2	4	5
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1-2	3-4	5
CS10A0770	Cleaner Technologies and Markets	M.Sc. (Tech.) 1-2	3-4	5
CS30A1690	Social Sustainability	M.Sc. (Tech.) 1-2	4	5

Mechanical Engineering

Minor 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 in Manufacturing

Obligatory Studies (20 op)		*per.*	*ECTS cr.*
BK20A2200[*]	Basics of Welding Technology	2	3
BK30A0600	Laser Based Products and Production Technology	3-4	5
BK50A0701	Advanced Production Engineering	1-2	6
BK50A2700	Selection Criteria of Structural Materials	1-2	6

*) Course can not be included in the same degree as BK20A0400 Modern Welding Technology

Minor 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

Computational Science and Physics

Minor in Technomathematics 20 ECTS cr

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 (ID 1189)		*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, INT 17	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

BM20A3900	Modelling Methodology in Process Engineering	1, INT 43	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 in Technical Physics 20-26 ECTS cr

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
BM30A2100	Microelectronics Processing Technology	1-2	2
BM30A2200	Semiconductor and Superconductor Physics	1-2	6
BM30A2500	Nanophysics	1-2	6

Minor in Intelligent Computing 20 ECTS cr

Obligatory Studies, choose a min.of two courses		*year*	*per.*	*ECTS cr*
BM40A0700	Pattern Recognition	M.Sc. (Tech.) 1	1-2	7
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
BM40A1200	Digital Imaging and Image Preprocessing	M.Sc. (Tech.) 1	1-2	7

List of selectable courses, choose enough credits to attain 20 ECTS cr.		*year*	*per.*	*ECTS cr*
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
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
BM20A3203	Fuzzy Engineering and Decision Making	M.Sc. (Tech.) 1-2	3-4	6
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
BM40A0600	Introduction to Computer Graphics	M.Sc. (Tech.) 1-2	2	5
BM40A0700	Pattern Recognition	M.Sc. (Tech.) 1	1-2	7
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
BM40A1200	Digital Imaging and Image Preprocessing	M.Sc. (Tech.) 1	1-2	7

School of Industrial Engineering and Management

Business and Technology in Russia 20/25 ECTS

Elective Studies		*per.*	*ECTS cr*
A220A0150	International Finance and Emerging Markets	2	6
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.

The minor is intended for students from all the Master Programmes in Lappeenranta University of Technology and focuses on Russian market. The minor is organized in cooperation with all the three faculties of Lappeenranta University of Technology.

Student should select courses from the list above so that the required amount of ECTS credits will be fulfilled. Only one Russian language course can be included in the minor; however language course is not obligatory.

Minor: Business Technology

Obligatory studies (10 ECTS cr)		*year*	*per.*	*ECTS cr*
CS35A0152	Product Lifecycle Management	M.Sc. (Tech.) 2	4	5
CS30A1380	Techno-Economic Systems	M.Sc. (Tech.) 2	1	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
CT60A5100	Software Engineering Methods	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
CT10A7000[(*	Green IT and Sustainable Computing	M.Sc. (Tech.) 1-2	3-4	4
CT60A7000[(*	Critical Thinking and Argumentation in Software Engineering	M.Sc. (Tech.) 1-2	3-4	4
BL40A3000	Wind Power and Solar Energy Technology and Business	M.Sc. (Tech.) 1	3-4	5

[*)] Exchangeable

School of Business

These minors are for the students who study as M. Sc. (Econ.&Bus.Adm.) at School of Business.

MIMM-programme´s Master´s students cannot study the International Marketing –minor.
MSM-programmes´s Master´s students cannot study the Supply Management –minor.

Notice also the programme-specific regulations of the minors.

Knowledge and Innovation Management

Obligatory courses (18 ECTS cr)		*per.*	*ECTS cr*
A365A0300	Knowledge-based Networks	2	6
A365A0250	Organizational Learning in Knowledge Management	1	6
A350A0000	Business Process Management and Information Technologies	4	3
A350A0600	Contemporary Issues in Strategic Management and Innovation	3	3

Electives, select 6 ECTS cr of the following courses:		*per.*	*ECTS cr*
CS30A1661	Open Innovation	3-4	6
CS30A1670	Service Innovation and Management	3-4	5
A350A0700	Reading Course in Innovation Management	4	1

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
BL40A3000	Wind Power and Solar Energy Technology and Business	3-4	5
BH60A1600	Basic Course on Environmental Management and Economics	2	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*
A330A0300	Strategic Global Marketing Management	1	6
A330A0250	Internationalization of the Firm and Global Marketing	2	6
A330A0050	Customer Relationship Management	4	6
A330A0010	Contemporary Issues in International Marketing	3, intensive	3
A330A0020	Asian Management	3-4, intensive	3
A330A5000	International Marketing of High Technology Products and Innovations		3
A330A0220(*	International Marketing of High Technology Products and Innovations: applications	1-2	3

*) This course can be in this minor only with the course A330A5000

Business Analytics

Obligatory (12 op)		*per.*	*ECTS cr.*
A220A0000	Financial Econometrics	1	6
A220A0051	Investment and Business Analysis with Excel	4, intensive	6

Electives

Choose at least 12 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	1,2,3,4	3
A350A0000	Business Process Management and Information Technologies	4	3

Supply Management

Obligatory courses: (24 ECTS cr)		*per.*	*ECTS cr*
A310A0101	Strategic Supply Management	1-2	6
A310A0301	Supply Chain Improvement	3-4	6
A310A0500	Global Sourcing and Sub-Contracting	4	6
A310A0650	Cost and Risk Management in Supply Chain	4	6

Business Administration –minor

This minor is for the students who study as M. Sc. (Tech.) at LUT. Students at School of Business cannot study this minor.

Notice! The number of students attending to the courses in the minor Business Administration can be limited. In these cases the priority is given to the students who have these courses in their compulsory studies.

Business Administration min. 20 ECTS cr

Electives, min. 20 ECTS credits should be selected		*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

8 LANGUAGE CENTRE COURSES 2014-2015

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. Students will be sent a confirmation of the course by e-mail. Please make sure that your e-mail address in WebOodi is correct.

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 I	4
FV11A4801	English Communication for Business and Management	4 - 5
FV11A6206	English for Professional Meetings and Discussions	4
FV11A6500	Presenting in English	2
FV11A8900	Academic Writing in English	4
FV11A9503	Independent Study in English	1 - 4
FV12A1210	Basic Course in German 1	2
FV12A1220	Basic Course in German 2	2
FV12A1410	Intermediate Course in German 1	2
FV12A1420	Intermediate Course in German 2	2
FV12A1611	German for Working Life	2
FV12A3300	Information on Germany	2
FV12A5202	German Independent Study	1 - 2
FV12A5600	German and Engineering	1 - 2
FV12A7113	Business German	4
FV14A1200	Russian 1	3
FV14A1201	Russian 1 for Students of Technology	4
FV14A1400	Russian 2	3
FV14A1600	Russian for Working Life	3
FV14A1801	Cases in Russian	3
FV14A4200	Russia Today	3
FV14A4501	Russian for Business People	1 - 3
FV15A1210	Basic Course in French 1	2
FV15A1220	Basic Course in French 2	2
FV15A1410	Intermediate Course in French 1	2
FV15A1420	Intermediate Course in French 2	2
FV15A5301	French for Economy and Business	3
FV15A6003	Intercultural course in French	4
FV15A9301	French Independent Study	1 - 4
FV16A1210	Basic Course in Spanish 1	2
FV16A1220	Basic Course in Spanish 2	2
FV16A1410	Intermediate Course in Spanish 1	2
FV16A1420	Intermediate Course in Spanish 2	2
FV16A1602	Spanish for Working Life	3
FV16A3201	Business Spanish	3
FV16A5202	Intercultural Spanish Course	4
FV18A9101	Finnish 1	2
FV18A9201	Finnish 2	2
FV18A9301	Finnish 3	2
FV19A1000	Chinese 1	3
FV19A2000	Chinese 2	3
FV19A3500	Business Chinese	3
FV19A5100	Industrial economy in China	3

FV11A2201	***TECHNICAL ENGLISH READING COURSE 2 ECTS cr***
	Technical English Reading Course
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, individual, pair or group work. The language of instruction is English.
Modes of Study	Period 1 and 3, Contact teaching: 24 hours of contact or online lessons, 28 hours required for homework and self-study. 50% attendance and active participation are required. Period 2 and 4, Online: 52 hours for self study and exercise completion.
Evaluation	Pass/Fail. Students are expected to attend classes regularly, take an active part in classes and complete all assignments. Marks are based on reading comprehension exam (duration 90 minutes). All assignments must be completed 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
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, individual, pair or group work. The language of instruction is English.
Modes of Study	Period 1 and 3, Contact teaching: 24 hours of contact or online lessons, 28 hours required for homework and self-study. 50 % attendance and active participation are required. Period 2 and 4, Online: 52 hours for self study and exercise completion.
Evaluation	Pass/Fail. Students are expected to take an active part in classes and complete assignmentss. Marks are based on a reading comprehension exam (duration 90 minutes). All assignments must be completed to be eligible to sit the exam.
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 I***	***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	50 contact hours (over 2 periods) + 55 hours independent study. Active communication practice in class, based on authentic written and spoken texts. Assessment: 1) reading comprehension test 2) conversation test 3) in-class continuous assessment of the oral skill 4) extra assignments. A minimum of 80 % attendance required for exemption from the conversation test and extra assignments.	
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	
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.	
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.	
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, 10 and 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	48 contact hours + 58 hours independent study. Compulsory pre-course preparation required. (Material will be sent to participants three weeks before the course begins.) Active participation in class, and self-study of language of meetings. Regular 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.	

FV11A6500	***PRESENTING IN ENGLISH***	***2 ECTS cr***
	Presenting in English	
Year and Period	B.Sc. (Tech.) 2-3, B.Sc. (Econ. & Bus. Adm.) 2-3 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	
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.	
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.	

FV11A8900	***ACADEMIC WRITING IN ENGLISH***	***4 ECTS cr***
	Academic Writing in English	
Year and Period	B.Sc. (Tech.) 3, M.Sc. (Tech.) 1-2, B.Sc. (Econ. & Bus. Adm.) 3, M.Sc. (Econ. & Bus. Adm.) 1-2 Period 1-2, 3-4	
Teacher(s)	EFL Instructor, B.A. Riitta Gröhn University Lecturer, M. A. Kristiina Karjalainen	

	University Lecturer, M.A. Tarja Kovalev
CEF Level	B2 - C1
Aims	At the end of the course, students are expected to be able to identify the characteristics of academic writing and apply them to their own writing and write an academic paper about academic conventions in their field.
Content	Students will study features of English for academic and scientific writing based on which they will participate in small group discussion and/or complete assignments online. After students have successfully completed all assignments, they will be permitted to produce and present a seminar paper to complete the course. Language of instruction: English. Students who have taken the course FV11A5200 English for Academic Seminars, FV11A9151 English for Writing Bachelor's Thesis or FV11A9000 Academic Seminar for International Programs are not eligible for this course.
Modes of Study	The course is made up of 104 hours of work and there are two ways to complete it: through investigate learning or or through individual study. Investigate learning: Contact lessons - 18-36 hrs, individual, group, online work - 68-86 hrs (the variance in the hour amounts is related to the number of study groups that will be formed at the beginning of the course). Individual study: 104 hrs of individual study, including potential tutoring meetings with the teacher.
Evaluation	Pass / Fail based on the successful completion of all assignments. PLEASE NOT 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.

FV11A9503	***INDEPENDENT STUDY IN ENGLISH***	***1 - 4 ECTS cr***
	Independent Study in English **This course is a self-study course in Moodle, with some tutoring provided by the teacher.**	
Year and Period		
Teacher(s)	University Lecturer, M. A. Kristiina Karjalainen University Lecturer, M.A. Tarja Kovalev	
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 Pronunciation 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 26-52 hours. 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.

FV12A1210	***BASIC COURSE IN GERMAN 1***	***2 ECTS cr***
	Saksan peruskurssi 1 **5 Period Intensive course**	
Year and Period	Period 1, 2, 3, (5 INT)	
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	Situations: personal data, introducing oneself, time and days of the week, food, means of transport. Structures: verbs in the present tense, negation, 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, 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.	
Evaluation	Pass/Fail.	
Study materials	Alltag, Beruf & Co. 1, chapters 1 - 5.	
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	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. 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, 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.
Evaluation	Pass/Fail.
Study materials	Alltag, Beruf & Co. 1, chapters 6 - 10.
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	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. 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, independend 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.	
Evaluation	Pass/Fail.	
Study materials	Alltag, Beruf & Co. 2, chapters 1 - 5.	
Prerequisites	FV12A1220 Basic Course in German 2, FV12A1200 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.	

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, independend 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.
Evaluation	Pass/Fail.
Study materials	Alltag, Beruf & Co. 2, chapters 6 - 10.
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	
Year and Period	Period 1, 2, 3, 4	
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, 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.	
Evaluation	Pass/Fail.	
Study materials	Alltag, Beruf & Co. 3.	
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, independent work approx. 24 hours. Pair and group assignments, role play.
Evaluation	Grade based on continuous assessment or an oral test. Continuous assessment requires 75% attendance and active participation. 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 1-2, 3	

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 2014 - 2015.**	
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 and its activity, company strategies and corporate finance.	
Content	Fields: company forms, lines of business, business organization, company strategies, 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 faculties. Language of instruction: German.	
Modes of Study	Individual, pair and group work. Contact lessons 28 of which 4 hours intensive at the end (period 3), independent work 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.	
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, 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 and plural of nouns and adjectives, possissive pronouns, verb conjugation, cases (nominative, prepositional, accusative, dative), numerals. Situations: getting to know people, family, introducing oneself, and meals. 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 two ways: 1) 50% active attendance and continuous assessment 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. 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 and plural of nouns and adjectives, possissive pronouns, verb conjugation, cases (nominative, prepositional, accusative, dative), numerals. Situations: getting to know people, family, introducing oneself, meals. Pronunciation. Learning the alphabet. Languages of instruction: Finnish and Russian.
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 two ways: 1) 50% active attendance and continuous assessment or written exam. 2) possibility for independent study: a written examination required for a passing grade. 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. Students who have passed the course FV14A1200 Russian 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	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 (genetive, 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% active attendance and continuous assessment 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. 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)	Lecturer, M.A. Pirjo Seppänen-Katajisto 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 active participation in lectures, which replaces part of the written and oral exams, 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. 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.	
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	
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. 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, 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, describing objects, expressing and understanding times and timetables, going to restaurant, talking about food, communication on the phone and by e-mail. Structures: articles, personal pronouns, verbs in the future tense, passé composé, construction and placement of adjectives, prepositions of location,	

	prepositions à and de. Languages of instruction: French, Finnish and English.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Written examination and successfully completed written assignments. Oral test or grade based on continuous evaluation. Continuous evaluation requires 75% attendance and active participation. Possibility for independent study: a written examination and an oral test required for a passing grade. 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, 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. Structures: articles, prepositions, imperfect, partitive, interrogative pronouns, demonstratives, personal pronouns. Languages of instruction: French, Finnish and English.	
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Written examination and successfully completed written assignments. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation. Students who have taken the course FV15A1400 French 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. 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, 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 day, describing production processes (in an very simple way), 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, imperative, 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: a written examination and an oral test required for a passing grade. Moodle is used in this course.
Evaluation	Pass/Fail.
Study materials	Béatrice TAUZIN, Anne-Lyse DUBOIS: Objectif Express 1, units 8 - 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.

FV15A5301	***FRENCH FOR ECONOMY AND BUSINESS 3 ECTS cr***
	Français de la vie économique et professionnelle **This course is not available in 2014 - 2015**
Year and Period	Period 3
Teacher(s)	N.N.
CEF Level	Entry level: A2.2, target level: B1.1
Aims	After completing the course the student is expected to be able to deal verbally and in writing with the technical, working life and economy-related situations addressed in class.
Content	Communication: describing tasks, processes, projects and action plans; describing organizations, products and services; explaining and clarifying; talking about past and future events; handling marketing communication; communicating by telephone and e-mail. Structures: articles, prepositions, pronouns, present, passé composé and imparfait, future tense and conditional, subjunctive, direct and reported speech, adverb clauses of cause, adverb clauses of time.
Modes of Study	Exercises that support communication skills. Contact lessons 24, independent study approx. 28 hours. Written examination and successfully completed written assignments. Oral test or grade based on continuous assessment. Continuous assessment requires 75% attendance and active participation.
Evaluation	Pass / Fail Written test and successfully completed written assignments 50%, oral test or continuous evaluation 50%.
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 2014 - 2015.**	
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, 5	
Teacher(s)	Lecturer, M.A. Vuokko Paakkonen	
CEF Level	Entry level: A2/B1	
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. This course uses 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	
Year and Period	Period 1,2, 3	
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. Students who have passed the course FV16A1200 Spanish 1 are not eligible for this course because of the similar contents of the courses. Possibility for independent study: a written examination required for a passing grade.
Evaluation	Pass/Fail.
Study materials	Mäkinen et al. ¿Qué tal?
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. Students who have passed the course FV16A1200 Spanish 1 are not eligible for this course because of the similar contents of the courses. Possibility for independent study: a written examination required for a passing grade.	
Evaluation	Pass/Fail.	
Study materials	Mäkinen et al. ¿Qué al?	
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 al?
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 al?	
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 1,3	
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	

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 28, homework approximately 24 hours. A written examination.
Evaluation	Pass/Fail.
Study materials	Course material booklet (in Noppa) 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 28, homework approximately 24 hours. A written examination.	
Evaluation	Pass/Fail.	
Study materials	Course material booklet (in Noppa) 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.
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://www.chinesetesting.cn.gosign.do. Learning Chinese info: http://finnish.chinese.cn/ and http://english.chinese.cn**	
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 Profiency Test (New HSK Level I). Students are expected to understand and use very simple Chinese phrases, meet basic needs for communication and possess the ability to further their Chinese language studies. These students should 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 also delve into Guanxi – one of the Chinese exclusive cultural phenomena. Students will work on writings and presentations on the basis of the agreed topics in the beginning of the semester. During the process of learning, students will receive audio feedback and written suggestions from the teacher. Through the corrections, students will improve their Chinese writing and speaking abilities. Language of instruction: Mandarin Chinese, Finnish and English.	
Modes of Study	56 contact lessons, intensive course 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 (40%) and continuous assessment (60%).	
Study materials	Learning materials are provided by the teacher. 1. New HSK level 1: mock paper, handbook of grammar and vocabulary 2. Course workbook 3. Essay: On the Intricacies of the Chinese Guanxi : A Process Model of Guanxi Development	
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 **More details about New HSK levels at http://www.chinesetesting.cn.gosign.do. Learning Chinese info: http://finnish.chinese.cn/ and http://english.chinese.cn**	
Year and Period	Period 3-4	
Teacher(s)	Part-time Untenured Teacher, Matina Ma	
CEF Level	A2	
Aims	By the end of the course students should be able to pass the international standardized Chinese Proficiency Test (New HSK Level 2). Students should be able to deal with the essential Chinese grammar, to understand and write passage, to read Chinese with satisfactory intonation, and be able to understand short, slowly spoken dialogues. Students should master 300 commonly used words and essential grammatical rules.	
Content	Students will develop their previous knowledge into practical use. Students will learn four essential subjects of Chinese language: accuracy in pronunciation, word, sentence and semantic meaning. Students will also delve into the Chinese cultural thinking on speech planning. The course applies student-centred approach to teaching. Finnish companies' interest in Finnish Chinese speaking employees is the main theme of the course writings & presentations. Students will work on these assignments and, during the process of learning, students will receive audio feedback and written suggestions from the teacher. Through the corrections, students will improve their Chinese writing and speaking abilities. Language of instruction: Mandarin Chinese, Finnish and English.	
Modes of Study	56 contact lessons, intensive course 80 % attendance is required. Students who do not meet the attendance requirement and course exam but have passed New HSK Level 2 may receive a grade. Moodle is used in this course.	
Evaluation	0 - 5. Exams (40%) and continuous assessment (60%).	
Study materials	Learning materials are provided by the teacher. 1. New HSK level 1: mock paper, handbook of grammar and vocabulary 2. Course workbook 3. Essay: Cultural thinking and Discourse Organizational Pattern	
Prerequisites	Successful completion of FV19A1000 Chinese 1 or equivalent skills.	
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, taxations, 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 the commerce between Finland and China
Modes of Study	56 contact lessons in total. Moodle is used in this course.
Evaluation	5 writing assignments (100%). 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	
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 to read Chinese texts and work in China. At the end of the course, students should be able to understand the terminologies and be able to read the news about Chinese industrial economy with the help of learning materials.	
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 characters and the recent development of industrial economy in China. The topics are including 1. Chinese characters; 2. Solar energy; 3. Wind power; 4. M-Commerce 5. Electronic bicycles	
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	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.	

9. FINAL THESIS INSTRUCTIONS

Approved by the vice-rector on 9 June 2010, enter into force 1 August 2010 (updated on 16 June 2014).

Introduction

These 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 faculties may give more detailed instructions on the preparation of theses.

The instructions start with a process description of the practical aspects of starting a thesis and of its assessment. Then, the contents of the thesis, conducting research and research methodologies are discussed. The final section deals with layout and gives practical examples of it.

The Master's thesis is the final project of the Master's degree studies. It demonstrates the student's knowledge of a scientifically and/or societally important topic related to his or her professional field. The thesis is a research assignment that requires approximately six months of full-time work and amounts to 30 ECTS credits in the degree. The student must demonstrate the ability to carry out the project independently and following a plan.

The Master's thesis is prepared in the second year of the Master's degree studies, and before receiving approval of their thesis topic, **students must have completed their Bachelor's degree or complementary studies**.

Final thesis process

Starting the work

Students who are starting their Master's thesis should read these instructions carefully and meet with the professor in charge of the field (usually a professor of the student's major subject). The student discusses the topic of the thesis with the professor to make sure it meets the scientific requirements for a Master's thesis.

The following points are discussed with the professor:

- the prerequisites for starting the Master's thesis (completed studies)
- the topic and objective of the thesis
- the approval of the thesis topic
- the preliminary research plan and schedule
- funding (by the student, a grant or an employer)
- the examiners of the thesis (the first examiner is the supervising professor or a docent from the student's degree programme)
- the supervisor from the commissioning organisation
- matters to be discussed with the community providing the funding and the supervisor representing it, such as the employment relationship, responsibilities, safety, insurances, invention rights, etc.
- publicity of the thesis

Receiving approval for a topic

Prerequisites for obtaining approval of the thesis topic are:

- Bachelor's degree completed (when the student has been admitted into the university for both **Bachelor's and Master's studies**)
- possible complementary studies completed (if the student has been admitted to complete only the **Master's degree**)

- possible other required studies announced by the faculty have been completed

The student applies for the approval of the topic and the appointment of the examiners from the first examiner, i.e., the professor supervising the thesis work. The application is submitted to the faculty student services via e-mail.

The student submits the thesis application only after the required studies have been completed and the thesis topic has been confirmed with the thesis supervisor and the related workplace. The title does not need to be finalised upon application; it may be modified during the course of the project.

The Master's thesis is related to the student's major subject and its topic is agreed on by the supervisor and the student together. The approval of the topic remains in force for two years from the date of approval. The first examiner must be from the student's major subject or a closely related field. The first examiner is also the supervisor of the thesis at the university. The professor supervising the work (the first examiner) also confirms the second examiner for the thesis. The second examiner must have at least a higher university degree and may be from outside of the university.

Applying for Master's thesis work at a company is the student's responsibility. If the student wishes to start preparations for the thesis before the topic is officially approved, this should be discussed with the first examiner.

The online forms to be filled in and sent via lut.fi e-mail, as well as further information on the topic application process, are available in the student portal Uni.

Assessment and publication of the Master's thesis

Students must submit their final draft of the thesis to the first examiner for reading and assessment. This is called *applying for imprimatur* (i.e. an official licence to publish). After receiving the licence, the student saves the thesis and abstract documents to the LUTPub open access database and receives a URN address related to the work.

After obtaining the URN, the student applies for faculty evaluation of the Master's thesis. This is done by submitting both the form entitled Assessment Application for Master's Thesis (1B) and the requested enclosures to the faculty student services via lut.fi e-mail.

The faculty decides the graduation schedule, and provides instructions on the evaluation.

The examiners prepare a written statement on the thesis and propose a grade. The title and grade of the thesis are shown in the degree certificate.

Students of Master's programmes in English will be provided a statement in English on their Master's thesis.

The faculties determine the assessment criteria for final theses. Frequently applied criteria include e.g.

- The problem-setting, objectives, definitions and delimitations of the thesis
- The relationship to previous research
- The research approach, methods and material used in the work
- The schedule of the research and time management
- The results and their analysis
- The organisation and coherence of the work
- The profoundness of the work
- The reliability of the work
- The language and layout of the work
- An independent approach and application

A Master's thesis in technology is assessed on a scale of 1-5, where 1 is satisfactory, 2 is very satisfactory, 3 is good, 4 is very good and 5 is excellent. A Master's thesis in business is assessed

on the scale improbatur (failed), approbatur (lowest passing grade), lubenter approbatur, non sine laude approbatur, cum laude approbatur, magna cum laude approbatur, eximia cum laude approbatur sekä laudatur (highest grade).

If the grade of the Master's thesis in technology is 5 or in business studies at least eximia cum laude approbatur, and the overall grade of the degree at least 4, the student has completed his or her degree **with distinction**.

The faculty assesses and approves the thesis only after the student has applied for the assessment, has applied for and received the imprimatur, and has submitted the thesis and abstracts to LUTPub. **The forms and further information are available in the student portal Uni.**

If a student is not satisfied with the evaluation, he or she may leave a request for correction with the degree board within 14 days of the day the grade was made known. The request for correction should be addressed to the degree board in question and submitted in writing to Records Services. 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 the grounds for giving the grade.

Publicity of the thesis

Master's theses submitted to the university for examination are normally public documents.

This must be mentioned to the commissioner when the topic of the thesis is first discussed. If the thesis includes information which the commissioner considers confidential, the university may agree to hold the thesis **confidential for a maximum of two years**. However, it is recommended that the thesis is prepared as a public-access document.

If part of the information needs to be held confidential for longer than two years, the information must be excluded from the version submitted for examination. The work will be evaluated based on the non-confidential part.

The first examiner shall see to it that the commissioner is aware of the publicity requirements from the very beginning of the discussions.

Confidentiality notification

If the thesis includes confidential information (held confidential for a maximum of two years), the commissioner of the thesis must submit a written notification of the extent of the confidential information, the reasons for confidentiality and the time the information is to be held confidential (in full years). The confidentiality period starts from the date the thesis is assessed. The student is responsible for submitting the confidentiality notification to the faculty student services no later than in connection with the assessment application. The abstract is always public.

Maturity test

Students must complete a written maturity test on the topic of their thesis. Its purpose is to verify the student's familiarity with the topic of the thesis. During the course of the studies, also the student's Finnish or Swedish skills are assessed at one point. This can be done e.g. in connection with the Bachelor's thesis. The maturity test is assessed by the first examiner of the thesis, and as needed, also a language reviser approved by the university. The maturity test is taken in the language in which the student has received his or her education in Finland. If the student has received his or her education in a language other than Finnish or Swedish, the head of the degree programme determines the language of the maturity test. In such cases, only the contents of the maturity test are evaluated, not the language.

If a student has demonstrated his or her language skills in connection with the Bachelor's degree or another previous university degree, the language of the maturity test will not be

evaluated, only the contents. In this case, the abstract of the Master's thesis serves as the maturity test.

Further instructions on taking the maturity test are available in the study guide of the LUT Language Centre. The test should be written on a computer. Further information is available in the student portal Uni.

The maturity test should be taken at least five weeks before graduation. The date and time for the test should be set together with the examiner and the person in charge of maturity tests.

The examiner gives the topic of the test. The maturity test is evaluated on a scale of pass/fail.

Content of the thesis and how to conduct research

Language of the thesis

The thesis may be prepared in Finnish, Swedish or English. Permission for using other languages is granted by the head of the degree programme. The author of the thesis is responsible for the language revision of the thesis. If the commissioner of the thesis requires the use of a language other than Finnish, the commissioner is responsible for the translation or language revision of the thesis. In degree or Master's programmes in English, the thesis is prepared in English and the author is responsible for revising the language.

Inventions related to the thesis

The research work for a Master's thesis may result in an invention that can be patented or otherwise protected by industrial law. An invention may be a new or improved technical devise or method with industrial or commercial importance.

Inventions must be discussed with all parties involved (the student, supervisors at the university and the commissioning company). If the invention made in connection with the thesis is to be patented, the patent application must be left before the work is published. Otherwise, the thesis must be written so that the invention is not revealed.

If the invention has ensued under an employment relationship, the Act on the Right in Employee Inventions (656/1967) is applied to the company. If the employment relationship is between the student and a university or higher education institution, the act on the right in employee inventions at higher education institutions (369/2006) is applied to the school.

General patenting legislation is applied to the patenting of an invention and general copyright legislation to copyright issues unless otherwise agreed by the parties involved in the work (the commissioner, university and student).

Further information is available from the university's Research and Innovation Services.

Contents of the thesis

The thesis may be composed e.g. of the following items in the following order (some apply only to the technology or the business thesis):

Title page
Abstract in Finnish
Abstract in English
Acknowledgements
Table of contents
List of symbols and abbreviations
Introduction
Discussion (theories, background and implementation of the research)
Conclusions (analysis of observations and results)

Summary (concise summary of the above)
References
Appendices

Title page

The title page includes the title of the thesis. The title must be well-defined and correspond to the content of the thesis. A keyword, which expresses something essential about the thesis and has an explicit and specific meaning, is recommended as the first word. Avoid the following: some, review, method, report, study, equipment etc.

Abstracts in Finnish and English

The abstract is a concise (one A4 sheet), objective, independent summary of the Master's thesis. It should be intelligible as such, without the original document. It explains the contents of the thesis: the objective, methodologies, results and conclusions. A good abstract is written in complete and concise sentences. The author does not express his or her opinions, but describes the thesis as would an outside reporter. No direct references are made to the original text.

The abstract is a public document, and therefore all confidential information must be excluded from it.

The abstract is prepared in Finnish and English. Both the Finnish and English abstracts are included in the thesis. The abstracts are also submitted to the faculty study affairs services as an annex to the assessment application of the thesis. Foreign nationals do not need to prepare an abstract in Finnish.

The author sends electronic copies of the abstracts or the entire thesis to the LUT library. More details are available from the library and its web site.

Acknowledgements

Acknowledgements are a brief description of what or who had an impact on the thesis. For example, the people who furthered the progress of the thesis may be thanked.

Table of contents

The table of contents lists the headings and sub-headings and their page numbers.

List of symbols and abbreviations (if needed)

Symbols, abbreviations and terms which are not common knowledge are listed in alphabetical order along with their definitions and arranged in groups: e.g. first Roman symbols, then Greek ones and finally abbreviations. The list of symbols and abbreviations is placed immediately after the table of contents.

Introduction

The actual research report is opened with an introduction. The purpose of the introduction is to introduce the topic and awaken the reader's interest. The introduction briefly describes the background, material extent and aims of the thesis. The introduction relates the thesis to other research and sources and presents the research methodology applied. It also describes the key points and organisation of the research report. It does not, however, include detailed descriptions of the theory, methods or results. A good introduction is, nevertheless, significantly longer than a couple of pages, and is organised in a logical manner.

Discussion

The discussion is divided into chapters with headings that depict the organisation of the thesis (in exactly the same form as in the table of contents). In this section, the author relates all of the material he or she wishes in reply to the research questions posed, as well as the conclusions based

on the material. Repetition should be avoided unless it is necessary. However, the discussion must be drawn up in such a way that a professional in the field can repeat the research work e.g. to check the equations, expressions, measurements, calculations or results and conclusions.

The language of the thesis must be error-free and the expression clear, accurate and concise. The topic must be presented to the reader unequivocally and intelligibly. Ideas should be developed logically and coherently. Say only what is important. Avoid wordiness and run-on sentences. Jargon and unnecessary foreign words should be eliminated.

The thesis is written in standard language and in the passive voice. Abbreviations, such as e.g. or etc. should not be used, but instead written out in their entirety.

In order for the observations to be of use to others, the stages of the research work must be presented in complete and the results of the observations in their original form in e.g. tables. Long sequences of equations and programming code are appended with headings. It is not necessary to show the derivation of the equations quoted, although the author must make sure the equations are presented correctly. However, the derivation of new expressions and equations introduced in the thesis must be shown, at least in outline. The author must also explain under which conditions the calculations, formulae and equations are applicable.

Conclusions

Depending on the nature and scope of the study, the report ends either with the chapter “Conclusions”, or two separate chapters, e.g. “Conclusions” and “Summary”. The conclusions analyse the observations and results drawn from the research. The conclusions examine and reflect on e.g. the compatibility of the theory and measurements, the reasons for possible differences, and summarise the conclusions drawn from the results. The need for further research and possible practical applications may also be argued here.

Summary

The summary is a concise description of the entire work: it presents the starting point of the research, the theoretical and empirical choices, aims, results, conclusions and possible ideas for further research. No new information is introduced in the conclusions, and no direct references are made to the discussion. The importance of the summary should not be underestimated because often the reader only reads the summary or the introduction and the summary.

Carrying out the research

The thesis is to be prepared according to good scientific practice. The research methods must be approved by the scientific community. The prevailing approaches and research methods in the field in question are to be applied. The student should learn about the research methodology and practices in his/her field sufficiently before preparing the thesis.

Plagiarism is absolutely forbidden. Citations and references must be made in accordance with good practice. If plagiarism takes place in an assignment, seminar report, Bachelor’s thesis or Master’s thesis during the supervision process, the examiner must tell the student that it is unacceptable. The thesis must be supervised so that the final version does not include references that violate good scientific practice.

If, despite the examiner’s efforts, the final version in the approval process contains plagiarised material, an assignment or report is failed, and a thesis is given a failing grade. Moreover, the matter will be brought before the provost.

Layout of the Master’s thesis

The presentation of the thesis is very important in terms of readability, intelligibility and reliability. A finished layout gives a good and reliable impression of both the work and its author.

Note: The term Master's thesis is used for both Master's thesis in technology (Diplomityö in Finnish) and Master's thesis in business (Pro gradu-tutkielma in Finnish).

Layout of a Master's thesis

On the **front cover**, the term Master's Thesis is centred and printed about 100 mm from the top margin.

The author's name and the year of publication are placed in the lower right-hand corner of the page. The recommended font style and size is Times 12 or Arial 11, and the recommended line spacing is 1.5. The left and top page margins are about 35 mm, and the right and bottom page margins are about 20 mm.

Each paragraph is aligned to the left, there are no indentations and there is an empty line between paragraphs. The paragraphs are justified.

Avoid long spaces between words: the use of the hyphenation feature of the word processing program employed is recommended.

The thesis should be approximately 80-100 pages.

Parts of the thesis

Title page

The title page is the first page of the thesis – page number 1. However, the page numbers are not shown before the first page of the table of contents. **The faculty decides on the information presented on the cover page. However, the following is always printed on it:**

- university, faculty, degree programme and/or major subject
- name of author
- title of thesis
- thesis examiners (the second examiner as well, if the student is aware of whom this is)

The points above are not to be used as headings on the title page, e.g. "University: Lappeenranta University of Technology" is incorrect, but "Lappeenranta University of Technology, Faculty of Technology" is correct. The layout of the title page should be balanced, such as in assignment reports.

Abstracts in Finnish and English

An abstract is prepared for all Master's theses. You should favour the passive voice or the 3rd person active in case the abstract is published separately. Unestablished abbreviations, symbols or technical terms should be explained. Tables, equations etc. are used only if they are necessary for the sake of clarity. No direct references are made to the original text.

The abstract is done in both Finnish and English (equivalent contents). In the Finnish abstract, the title is in Finnish and in the English one in English. Foreign students do not need to prepare an abstract in Finnish.

The complete identification information should be included in the beginning of both the Finnish and the English abstract.

Author's name
Title of thesis
Faculty
Degree programme and/or major subject
Year of completion
Master's Thesis University

Number of pages, figures, tables and appendices
Examiners (1st and 2nd)
Keywords in Finnish
Keywords in English

The keywords must be informative and describe the contents of the thesis accurately. Concrete concepts (e.g. equipment) are in plural, abstract ones (e.g. methods) in singular. A good title should include at least some of the most important keywords. The number of keywords should be three to five.

In addition to these general instructions, the faculties may give further guidelines on e.g. the layout of the abstract (e.g. students may need to fill out a form).

Acknowledgements

The acknowledgements recognise the help, guidance, advice etc. provided by others and give thanks to them. Also the commissioner of the thesis is mentioned. The acknowledgements are concluded with the author's name and the date after which no more modifications have been made to the work.

Table of contents

The table of contents must show the page numbering starting from the first text page. **Please note that the first page (number 1) of the thesis is the title page.** Thus the table of contents may be e.g. on page 5. A separate list of figures and tables can be included at the end of the table of contents.

Decimals and indentations are used in the table of contents – as well as in the headings in the text – according to the following example (note the use of upper and lower case lettering and the indentation of sub-headings). **Please note that no more than three levels of headings are allowed.** If there is need for more detailed sub-headings, they should not be numbered. If variables need to be used in the first-level headings, they are to be written out as they are in equations. In such cases, the author and the supervising professor may decide on the most appropriate way to present the headings in order to obtain a neat and legible layout. The page numbers are aligned to the right.

TABLE OF CONTENTS

Discussion

Each citation in the discussion should be clearly referenced so that the reader may refer to the original source.

The nature of the work determines the formulation of the discussion. The discussion may often be divided into a theoretical part, empirical part and results:

- the theoretical background, including the literature and previous research and concepts on which the thesis is based
- observations and collection of basic material etc. In order for the observations to be scientifically valid, the research process should be described in as much detail as possible.
- the discussion on observations and presentation of the results are often closely connected. All calculations need not be shown, as long as the author explicitly explains how they are done.

Figures, tables, equations etc. make the discussion more concrete and enhance readability. They are captioned and numbered, each as their own group.

Equations must be written clearly, each on their own line so that they are separated from the text. They may, for instance, be indented. Equations are numbered either consecutively or by chapter. The number is written in parentheses on the right-hand side of the column. References to an equation can be made only after it has been presented, with certain exceptions. Figures and tables are captioned and numbered similarly to equations. Figures and tables have to be referred to in the text, preferably before they are introduced. **The captions of tables are placed above the table and those of figures below the figure.** The variables in the figures are presented in the same way as in the text and equations.

In mathematical presentation, the author must use standard symbols if such exist and if not, other established symbols. In the absence of established symbols, the author may create new ones.

The name of a unit symbol, e.g. the electric charge Q, must be mentioned when it is first introduced in the text and repeated when needed. Standard conventions must be followed when marking variables. For instance, variables in equations, charts and figures are *written in italics*, ***vectors in bold italics*** (or in italics and topped with an arrow, $\vec{E}$). Subscripts and superscripts or numbers are not italicised unless they refer to a variable. For example: There is a relationship between the electric field strength $\boldsymbol{E_1}$ and the electric flux density $\boldsymbol{D_1}$, which depends on permittivity ε

$$\boldsymbol{D_1 = \varepsilon E_1.} \quad (4)$$

As in Equation (4) above, equations may be treated as elements of a sentence, which means punctuation, such as commas and periods, may also be used in connection with them.

Mathematical functions and operators are written in normal text type (sin, log, lim, etc.).

Matrices may be treated as ordinary variables, in which case their symbols may be bolded, e.g. tension matrix **U**. Equations may be used as parts of sentences with normal punctuation. Punctuation marks are placed immediately after the equation, not its number.

Standardised graphic symbols are used in drawings and graphs. Their figures and variables are expressed in the same way as in equations.

References

Listing references and the related ISO 690.2 and SFS 5342/1987 standards are presented in detail by Mälkiä (1994). In the commonly used name-and-year system (the Harvard system), the reference list is alphabetised according to the first author of the source. If several sources by the same author or group of authors are referenced, they are listed in order of publication starting from the oldest one. When referencing several sources published by an author within the same year, they are distinguished from each other with a lower case letter after the publication year (1999a, 1999b etc.). If the author is unknown, the abbreviation Anon. may be used instead of the author's name. Alternatively, the name of the publication may be used as the reference.

References to oral communication (e.g. from a lecture or seminar) or unpublished sources are also listed. The sources must be critically evaluated. The reference list must also indicate where rare and less known sources are available.

The references may not include sources that are not cited. The sources should be described in detail and in the same way.

Sources are usually referenced as follows:

books author(s), editor(s)
publication year
title
edition (if more than one)
place of publication
publisher (NB: not printing press! Excluding company form abbreviations)

Example of source with one author: Patton, M. Q. 1990. Qualitative evaluation and research methods. London: Sage.
Esimerkki, kun kirjoittajia on kaksi: Johnson, G. & Scholes, K. 1999. Exploring corporate strategy. 5th ed. Harlow: Prentice Hall

Sources with many volumes are presented in the same way, and the volume in question is also mentioned.

journal papers author(s)
publication year
title of paper
title of journal
volume (annual set)
issue
pages

Example of a source with more than one author: Santamaría, L., Neito, M.J. & Barge-Gil, A. 2009. Beyond Formal R&D: Taking Advantage of Other Sources of Innovation in Low- and Medium-Technology Industries. *Research Policy*, vol. 38, pp. 507-517.

publication series author(s)
publication year
title of publication
body in charge
place of publication
publisher
title and number of series

E.g.: Laiho, L. (ed.) 1984. Arctic technology research projects in Finland. Espoo: Valtion teknillinen tutkimuskeskus (VTT). Tiedotteita 331.

final theses	author year title type of thesis (doctoral dissertation, Master's Thesis etc.) institution and department

If you reference a compilation, introduce the parent publication with the word "In:" or type it in capital letters.

For example: Rajala. T. 2000. Henkilöstö kunnan voimavarana. Rajala. T. 2000. Henkilöstö kunnan voimavarana. In: Hoikka, P. (ed.) Kunnat 2000-luvun kynnyksellä. 2nd revised ed. Tampere: Tampereen yliopisto.

conference papers	author publication year title of paper name, place and date of conference place of publication publisher or conference organiser pages

For example: Sandström, J. 2001. How to reduce the complexity when formulating cost information for design engineers? 16th International Conference on Production Research (ICPR), July 23 - August 3, Prague, Czech Republic.

Electronic Publications

Electronic sources are referred to according to the SFS 5831 standard. Further information: the library web site www.lut.fi/fi/kirjasto, the library's SFS standard collection and the library administrators. Electronic documents should be referenced only if no other original source exists.

Example of e-mail source:

- Bergman, S. 1996. The Iceland Teacher Training School in the field of biology, science education and development work in environmental education. [e-mail]. stefanb@khi.is 28 June 1996.

Example of Internet source:

- Denning, P. 1996. Business Designs of the New University [online document]. [Accessed 5 June 2007]. Available at http://ene.grnu.edu/pjd/education.html

Referencing (citations in the text)

Citations from books, journals, publication series and theses follow the same guidelines as the list of references. Citations include the following: **author(s), year, page(s)**. Thus referencing can be done as follows: "Williamsson (1995, 23-25) states" or (Teece et al. 1986). Mälkiä also discusses citations.

If there is more than one author, the first author's name is followed only by "et al." This is also how you should cite electronic sources, for instance (Denning 1996). Do not include the web site address – it should be indicated in the list of references. If several sources are referenced at once (e.g. two different authors cited in one paragraph), they should be separated with a semicolon and in parenthesis (;).

You should pay attention to where you place the reference. If you want the reference to include the entire preceding paragraph, place it in parenthesis after the final period. If you only want it to include the preceding sentence, place the period after the second bracket. This should also be done within a paragraph. Direct quotations should be in quotes. If you cite the same source twice in a row, the latter may simply be marked: Ibid.

The instructions above are merely guidelines, they are not binding. Referencing may be done in another commonly approved way or following the examiners' instructions. The key to referencing is consistency.
Faculties may issue their own instructions for authors to follow. Authors must also take into account the requirements set by the language of the thesis.

Footnotes

Footnotes are only used for explanations and additional comments on the text and are numbered separately for each page. Footnotes are placed at the bottom of the page and separated from the actual text with a line approximately 5 cm long. There should be an empty row above and below the line.

1.1.
1.2.

Appendices

Appendices may include equations, diagrams, drawings, forms, etc. that do not need to be included in the actual text but to which a reference is made. Extensive additional reports, large tables and e.g. tables that are referred to often should be appended. However, figures, equations, tables, etc., which are a key part of the text and are also interpreted, are placed in the text. The appendices should not, however, contain anything irrelevant to the thesis.

The heading of an appendix is written at the top of the page. Appendices are numbered. Appendix pages are not numbered; only the final numbered pages of the thesis are part of the table of contents. Appendices and their headings may be listed at the end of the table of contents. If the appendix consists of several pages, the pages are marked as follows:

For example: 1 Appendix I, 1
Appendix I, 2 etc.

For example: 2 Appendix 1. Heading

- (continued on page x) is written at the bottom of the page
- (Appendix 1 continued) is written in the upper right-hand corner of the following page.

REFERENCES

ISO 690-2:1997 Information and documentation—Bibliographic references—Part 2: Electronic documents or parts thereof

Mälkiä, M. 1994. Teksti ja kirjallisuusviitteiden laatiminen. 2nd unrevised ed. Tampere: University of Tampere. Hallintotiede B 6.

SFS 5342 Bibliographic references. 2nd ed. Helsinki: Finnish Standards Association. 1992.

SFS 5831 Bibliographic references. Electronic documents or parts there of. Helsinki: Finnish Standards Association. 1998.

Hannu Rantanen
Vice-rector

10 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 2014

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
Course descriptions available in the Master's Degree programmes of School of Business (name of the programme in the brackets):		
A210A0050	Comparative International Accounting: Theory and Practice (Strategic Finance, MSF)	6
A210A0601	Information Systems in Corporate Management and Decision-Making (MSF)	6
A220A0000	Financial Econometrics (MSF)	6
A220A0101	Derivatives and Financial Risk Management (MSF)	6
A220A0150	International Finance and Emerging Markets (MSF)	6
A220A0200	International Financial Management (MSF)	6
A220A0700	Elective Advanced Course in Strategic Finance (MSF)	3
A220A0750	Elective Special Course on Business Analytics or Decision-Making (MSF)	3
A310A0301	Supply Chain Improvement (Supply Management, MSM)	6
A310A0101	Strategic Supply Management (Supply Management, MSM)	6
A310A0201	External Resource Management (MSM)	6
A330A0100	International Business Strategies (International Marketing Management, MIMM)	6
A330A0151	International Entrepreneurship Challenge (MIMM)	6
A330A0200	International Marketing of High Technology Products and Innovations (MIMM)	6
A330A0250	Internationalization of the Firm and Global Marketing (MIMM)	6
A330A0300	Strategic Global Marketing Management (MIMM)	6
A350A0050	Business Research Methods (MSIS)	6
A350A0200	Introduction to Economics (MSIS)	6
A350A0300	Technology and Innovation Management (MSIS)	6
A350A0500	Sustainable Strategy and Business Ethics (MSIS)	3
A365A0100	Organization Theory (MIMM)	6
CS10A0260	Managing International Business	5
CS10A0270	Economic Challenges in Russia	3
CS10A7000	The Economies of the Baltic States	3
CS30A1370	Creative Design	5
CS30A1375	Product Development	5
CS30A1380	Techno-Economic Systems	5
CS30A1551	System Dynamics and Industrial Management	5
CS30A1601	Case Course in Strategy Consulting	3

CS30A7200	Global Innovation Networks	3
CS30A7220	Managing in the Global Environment	3
CS30A7400	Software and Application Innovation	2
CS34A0400	Strategic Entrepreneurship in Age of Uncertainty	5

Subject to alterations

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 **Language of teaching is English. Replaces course A340A0100 - Organizational Learning in Knowledge Management**
Year and Period	M.Sc. (Econ. & Bus. Adm.) 1 Period 1
Teacher(s)	Docent, D.Sc. (Econ. & Bus. Adm.) Jianzhong Janne Hong
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 the problem-based method to

	future work and learning situations and related problem-solving.
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), able to apply theories learnt in case analysis, 2) a case analysis and written report by group, and 3) case presentation and discussion in a virtual discussion forum. The case analysis is conducted based on the problem-based learning (PBL) method.
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 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.) Terhi Tuominen, Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Noora Rantanen Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Terhi Tuominen	
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	Core content: Strategy analysis. Additional content: Case study methodology. Special content: 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	25 hours of lectures; 55 hours of interactive analyses, case exercises and assignments carried out by the student. 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.

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 Professor, D.Sc. (Tech.) Anne Jalkala 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	
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.	
Evaluation	0-5, Exam 100%	
Study materials	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.

CS10A7000	***THE ECONOMIES OF THE BALTIC STATES 3 ECTS cr***
	The Economies of the Baltic States
Year and Period	M.Sc. (Tech.) 1 Period 1 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	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 workload 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.

CS30A1370	***CREATIVE DESIGN***	***5 ECTS cr***
	Creative Design **The maximum number of students is 40. Priority is given to students for whom the course is obligatory.**	
Year and Period	M.Sc. (Tech.) 1 Period 1	
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 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 key topics 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, checklists, morphological analysis, synectics, case-based reasoning, graphical methods, evaluation of ideas.	
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 a project report. Classroom teaching and problem-solving sessions 42 hours. Project works 88 hours. Total workload 130 hours.	
Evaluation	0-5. Evaluation: solutions created in the classroom sessions 40%, project reports 30%, written exam 30%. Obligatory presence during 90% of in-class activities.	
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.	

CS30A1375	***PRODUCT DEVELOPMENT***	***5 ECTS cr***
	Product Development **The maximum number of students is 40. Priority is given to students for whom the course is obligatory.**	
Year and Period	M.Sc. (Tech.) 1 Period 1	
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
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. 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.

CS30A1380	***TECHNO-ECONOMIC SYSTEMS***	***5 ECTS cr***
	Techno-Economic Systems **Maximum number of students: 40.**	
Year and Period	M.Sc. (Tech.) 2 Period 1 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 concept of system architecture and basic methods of systems design and analysis 2. Distinguish the basic types of complex techno-economic systems and their characteristics 3. Work in a team during the process of complex system design.	
Content	The key topics of the course are: 1. Concept of System, 2. Principles of Life-cycle Analysis, 3. Scenario Building, 4. Systems Modelling and Simulation, 5. Complex Systems, 6. Systems Optimisation (processing and manufacturing industries, transport, energy generation, food and water supply, information generation and delivery defence), 7. Critical Infrastructure, 8. Systems Safety, 9. Evolution of Systems	
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. Total workload 130 hours.	
Evaluation	0-5. Evaluation: solutions generated in classroom sessions 30%, project reports 40%, written exam 30%. 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.	

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 Period 2, INT. 43 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.
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. Course webpage could be accessed through following link: http://kouvola.lut.fi/fi/tutkimus/innorail/systemdynamics
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.

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	20 hours of lectures and class discussions and case study workshop, 8 hours assigned written report preparation and 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	20 hours of lectures and class discussions and case study workshop, 8 hours assigned written report preparation and 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.

CS30A7400	***SOFTWARE AND APPLICATION INNOVATION 2 ECTS cr***
	Software and Application Innovation **Suitable for the elective studies of the Communications Software and Software Engineering major students both in normal and international programs in Information Technology department. Suitable for the elective studies of students both in normal and international programs in Industrial Management department.**
Year and Period	M.Sc. (Tech.) 2 Period 1-2
Teacher(s)	Professor, D.Sc. (Tech.) Helinä Melkas Professor, D.Sc. (Tech.) Jari Porras Adjunct Professor, D.Sc. (Tech.) Jouni Ikonen Associate Professor, D.Sc. (Tech.) Kari Heikkinen Associate Professor, D.Sc. (Tech.) Pekka Jäppinen Person in Charge: Professor, D.Sc. (Tech.) Marko Torkkeli
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.
Modes of Study	Lectures 6 h, innovation exercises 4 h, presentation 4 h, practical work (documentation) 16 h, independent group work 22 h. Total 52 h.
Evaluation	0 - 5. Practical work 100 %.
Study materials	To be announced later.

CS34A0400	***STRATEGIC ENTREPRENEURSHIP IN AGE OF UNCERTAINTY*** ***5 ECTS cr***
	Strategic Entrepreneurship in Age of Uncertainty **Maximum number of students is 50 persons.**
Year and Period	M.Sc. (Tech.) 2 Period 1
Teacher(s)	Lecturer, D.Sc. (Tech.) Irina Fiegenbaum Doctoral Student, M.Sc. (Tech.) Justyna Dabrowska Person in Charge: Lecturer, 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.
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.

Spring Semester 2015

Course, Course number		*ECTS cr*
A330A6010	Buyer-Seller Relationship Management	4
A350A1000	Transformation of A Modern Industrial Society: The Finnish Model	2
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
Course descriptions available in the Master's Degree programmes of School of Business (name of the programme in the brackets):		
A210A0350	Real Options and Managerial Decision-Making (Strategic Finance, MSF)	6
A220A0051	Investment and Business Analysis with Excel (MSF)	6
A220A0400	Empirical Research in Finance (MSF)	6
A220A0500	Contemporary Issues in Strategic Finance (MSF)	3
A220A0600	Banking and Insurance Finance (MSF)	6
A220A0650	Financial Theory and Valuation	6
A220A0700	Elective Advanced Course in Strategic Finance (MSF)	3
A220A0750	Elective Special Course on Business Analytics or Decision-Making (MSF)	3
A310A0401	Public Procurement (Supply Management, MSM)	6
A310A0500	Global Sourcing and Sub-Contracting (MSM)	6
A310A0650	Cost and Risk Management in Supply Chain (MSM)	6
A310A0600	Reading Course of Supplier Relationship Management (MSM)	1
A330A0020	Asian Management (International Marketing Management, MIMM)	3
A330A0400	International Marketing Research (MIMM)	6
A350A0700	Reading Course in Innovation Management (Strategy, Innovation and Sustainability, MSIS)	1
A350A0000	Business Process Management and Information Technologies (MSIS)	3
A350A0050	Business Research Methods (MSIS)	6
A350A0200	Introduction to Economics (MSIS)	6
A350A0450	Business Models and Strategy (MSIS)	6
CS10A0551	International Business Methods	6
CS10A0651	Management of Innovations in Russia	5
CS10A0760	Business in Russia	6
CS30A1390	Systems Engineering	5
CS30A1500	Transportation Systems	5
CS30A1661	Open Innovation	6
CS30A1682	Advanced Course in Strategic Management	5
CS30A1690	Social Sustainability	5
CS30A7210	Innovation Management and New Product Development	3

Subject to alterations

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)	Post-Doctoral Researcher, 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 5. Additional material distributed in class
Prerequisites	Basic course in the field of marketing or international marketing.

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.

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.) Terhi Tuominen, Doctoral Student, M.Sc. (Econ. & Bus. Adm.) Noora Rantanen Person in Charge: Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Terhi Tuominen	
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	Core content: Strategy analysis. Additional content: Case study methodology. Special content: 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 **The number of attending students may have to be limited. If necessary, priority is given to students and exchange students of the LUT School of Business.**	
Year and Period	B.Sc. (Econ. & Bus. Adm.) 2 Period 3	
Teacher(s)	Post-Doctoral Researcher, D.Sc. (Econ. & Bus. Adm.) Hanna Salojärvi Person in Charge: Post-Doctoral Researcher, 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	18 hours of lectures with integrated exercises including case assignment and term paper assignment. 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 67 h, 3rd period. Total workload for student 160 h.
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)	Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Anssi Tarkiainen Person in Charge: Professor, D.Sc. (Econ. & Bus. Adm.) Liisa-Maija Sainio, Associate Professor, D.Sc. (Econ. & Bus. Adm.) Anssi Tarkiainen
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 (2010), International Marketing (3rd ed.). London: McGraw-Hill Publishing Company (ISBN: 9780077122850); 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.

CS10A0551	***INTERNATIONAL BUSINESS METHODS 6 ECTS cr***
	International Business Methods, 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)	Lecturer, D.Sc. (Tech.) Daria Podmetina Lecturer, D.Sc. (Tech.) Irina Fiegenbaum Person in Charge: Lecturer, 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 start-ups and business incubation in Russia. Commercialization of innovations. Technology and innovation management in Russia. Case studies.
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, Enhancing Russia's competitiveness and innovative capacity, The World Bank 8. Additional material will be announced at the lectures.
Prerequisites	Sufficient prior business studies required, course is a master's level course. 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.

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 Doctoral Student, M.Sc. (Tech.) Juha Hinkkanen Person in Charge: Professor, D.Sc. (Tech.) Juha Väätänen	
Aims	Student is able to 1. explain the theory of transition from centrally planned economy (CPE) to market economy, 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	Transition of Russian society and business environment, privatization process and deregulation of the economy. Living standard analysis. Industrial sectors and foreign direct investments. Russian enterprise structures and emergence of new enterprises. Natural resources and consumer markets. Russia's competitiveness and foreign direct investment development. Role of	

	government in Russian business life.
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. Transition, the First Ten Years - Analysis and Lessons for Eastern Europe and the Former Soviet Union. 2002. Raj, D. and Goldberg, I. 2007. Enhancing Russia's Competitiveness and Innovative Capacity. The World Bank. Washington DC. World Economic Forum. The Global Competitiveness Report, latest available version. Geneva, Switzerland. Additional material will be announced on lectures
Prerequisites	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 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.

CS30A1390	***SYSTEMS ENGINEERING***	***5 ECTS cr***
	Systems Engineering **The maximum number of students in the course is 40.**	
Year and Period	M.Sc. (Tech.) 2 Period 3 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.	
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. 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.	

CS30A1500	***TRANSPORTATION SYSTEMS***	***5 ECTS cr***
	Transportation Systems, Kuljetusjärjestelmät **The maximum number of students at the course is 60.**	
Year and Period	M.Sc. (Tech.) 1-2 Period 4, INT. 17	
Teacher(s)	Professor, D.Sc. (Econ. & Bus. Adm.) Olli-Pekka Hilmola	
Aims	Student 1. understands the application of different transportation modes in	

	transportation logistics area, particularly in Eurasia 2. knows the most suitable international routes and their performance 3. knows organizational and technology development in transportation logistics, and their application and relationship on the overall performance 4. has a knowledge from environmental issues of transportation logistics - especially from the use of railways, intermodality, and containers 5. understands the environmental emissions caused by transportation systems, and the usage of dry ports for the reduction of these emissions.
Content	Among lectures, course contains case exercises (which will combine the issues of different transportation modes together), and by participating in all of these, student will have some amount of basic points for exam.
Modes of Study	Lectures 14 h, exercises 12 h; exercises conducted as a whole at the class room hours, but exam requires 104 hours from student in terms of reading course literature and getting familiar with other material. Total 130 h. Course webpage could be accessed through following link: http://kouvola.lut.fi/fi/tutkimus/innorail/transportationsystem
Evaluation	0 - 5. Examination 70 % and accepted case exercises 30 %.
Study materials	1. Roso, Violeta (2009). The Dry Port Concept. Chalmers University of Technology. Doctoral Dissertation. ISBN 978-91-7385-338-5. 2. Laisi, Milla (2013). Deregulation's Impact on the Railway Freight Transport Sector's Future in the Baltic Sea Region. Lappeenranta University of Technology, Industrial Engineering and Management, Acta Universitatis Lappeenrantaensis, No. 529. 3. Hilmola, Olli-Pekka (2012). Competing Transportation Chains in Helsinki-Tallinn Route: Multi-Dimensional Evaluation. Lappeenranta University of Technology, Department of Industrial Management. Research Report 243.
Prerequisites	Recommended to have taken some logistical courses before, e.g. from topics of supply chain management and production control.
Further Information	This course has 1-10 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	
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.

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 %.

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 Research Scholar, Ph.D. Satu Pekkarinen Researcher, M.Sc. (Tech.) Suvi Konsti-Laakso Doctoral student, MBA, M.Ed. Rakhshanda Khan 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: end-user involvement, employee involvement, human impact assessment Supplementary content: practical cases, methods and Living Lab activities	
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 60 %. Case exercise 40 %.	
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.	

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.

11. LUT SUMMER SCHOOL

The LUT Summer School is a short academic event organised in summer. The LUT Summer School offers Master's level courses for LUT students and international students from around the world.

The curriculum is designed by the School of Business, the School of Industrial Engineering and Management, the School of Technology, and LUT International Services. More information on the programme at www.lut.fi/summerschool.

Inquiries to summerschool(at)lut.fi.

12. 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 Graduate School (LUT GS), which covers all the disciplines of the university. LUT also has double doctoral degree agreements with some partner universities abroad.

Doctoral education at LUT is the first stage of the four-stage tenure track for researchers. The aim 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 studies can be completed in the following fields:

- Chemical Engineering, Electrical Engineering, Energy Technology, Environmental Technology, Mathematics, Mechanical Engineering and Physics (LUT School of Technology)
- Industrial Engineering and Management and Information Technology (LUT School of Industrial Engineering and Management)
- Business Administration (LUT School of Business).

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 Graduate School.

Further information on the application procedure and studies is available in the student portal Uni.