TÆKNI- OG VERKFRÆÐIDEILD
SCHOOL OF SCIENCE AND ENGINEERING

Master of Science Programmes in Engineering

MSc in Biomedical Engineering
MSc in Civil Engineering
MSc in Electrical Engineering
MSc in Engineering Managment
MSc in Financial Engineering
MSc in Mechanical Engineering
MSc in Sustainable Energy Engineering

Course Catalogue 2014-2016

Revised June 30th 2014

REYKJAVIK UNIVERSITY
School of Science and Engineering www.ru.is

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Courses taught in Spring Semester

Master of Science Programmes in Engineering

The School of Science and Engineering offers the following MSc programmes in engineering, with an emphasis is on research and innovation.

MSc in Biomedical Engineering
MSc in Civil Engineering
MSc in Electrical Engineering
MSc in Engineering Managment
MSc in Financial Engineering
MSc in Mechanical Engineering
MSc in Sustainable Energy Engineering (within the Iceland School of Energy)

As a member of the CDIO network Reykjavik University emphasizes curriculum being taught in the context of professional engineering. The teaching approach balances academic rigour with a practical understanding of work in a fast-changing industry and world. During the course otheir studies graduates will have become accustomed to the process of design, implementation and operation which they will face in their future careers.

This course catalogue contains descriptions of graduate level courses offered within the School of Science and Engineering, fall semester 2014 to spring semester 2016. Additionally, students have the option of choosing elective courses from Reykjavik University´s School of Computer Science, School of Business and School of Law, see http://en.ru.is/ Course descriptions may be subject to change without notice.

Degree seeking students should generally apply for enrolment starting in the fall semester (August). Exchange students can be admitted in the spring semester (January) or fall semester (August). For information on admission and support for foreign students, as well as the research focus and structure of each MSc programme see http://en.ru.is/sse/ and http://en.ru.is/ise

For further information on Master of Science programmes in engineering contact:

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Course Descriptions for MSc Programmes in Engineering

Courses taught in Fall Semester

T-411-MECH MECHATRONICS I 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites:
Practical Computer Science AT FOR 1003; Mathematics III T-301-MATH; Electronics T-509-RAFT; Programming in C++ (can be taken at the same time); Basic electronics (resistors, inductors, capacitors, current, voltage); Physics I (mechanics).
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Joseph Timothy Foley.

Learning outcome: On completion of the course students should:
• Be able to design, build, and test advanced circuits with active elements
• Fix and improve simple broken mechatronic devices
• Build motor and heater control systems with feedback
• Program a microcontroller using an appropriate language to read sensors and control actuators. For example: An Arduino with C++ or a Raspberry Pi with python
• Understand digital and analog communication interfaces such as wireless networks
• Create schematics, layout PCB boards, and solder components to build working devices
• Be able to understand actuator and electronics specification sheets
• Use a research notebook properly for international-quality research
• Write lab reports for experiments performed
• See opportunities, not obstacles, when problems arise.
Content: This is an introduction to Mechatronics, the technique of interfacing software, electronics, and mechanical components. This time we will be focusing on the low-cost Arduino microcontroller platform as our method for sensing and control. Students will have pay a small deposit for their personal lab kit that can be returned at the end of the semester if the student does not wish to keep it. We will begin with an introduction to microcontroller programming and software engineering. This includes C++ and Subversion (for collaboration). We will then shift to electronics design, implementation, and testing. We will cover both analog and digital electronics with a focus on interfacing to sensors, DC motors, and stepper motors. Students will be designing and building PCB boards using EAGLE to connect to sensors and interface with the motors using H-bridges. We will complete the academic side of the course with closed loop control of these actuators. Students will choose a final mechatronics group project to be presented at the end of the semester. This project should involve manufacturing mechanical elements and interfacing them with the microcontrollers to demonstrate their mastery of the subject. Students will be spending a good deal of time in the Electronics Lab and Machine Shop building projects. This means that each student will be going through safety training in the labs as part of the course.

Reading material: *Introduction to Mechatronic Design*, J. Edward Carryer, R. Matthew Ohline, and Thomas W. Kenny, International, First Ed., Pearson UK, 2011. *FUNdaMENTALS of Design*, Alexander Slocum, 2nd, MIT (Private).
Teaching and learning activities: A combination of lectures and practical sessions. Communication and rigor are critical to proper mechatronic design. Students will be shown how to use a research notebook and expected to keep it up to date as part of their grade. Peer-review of designs will be required. Proper citation of included internet and written material must be performed. Each subject will consist of lectures

and related labs or projects. Student participation and interaction in lecture discussions is mandatory. Some assignments will be individual, some as groupwork. Collaboration on individual assignments is expected, but each student must do their own writeup (no copying). There will be a mid-term examination and final project. The final project may be sponsored by an outside company or internal research. At the end of each project, students will be presenting their design and results along with a short written report. Lab assignments only require a report based upon a standard template. Students are expected to make use of the Machine shop and Electronics lab, taking appropriate International safety precautions where applicable. The instructor will give guidelines on these procedures and assist in execution.
Assessment methods: No final exam, instead a final project presentation and report. There will be a written midterm exam. Students must be able to effectively communicate their ideas through written and oral methods. Students will each have a research notebook which must be used on a regular basis on topics relating to the class and will be checked periodically for grading purposes. In-class participation is part of the student´s grade. Each assignment will be evaluated considering these three aspects:
• process
• documentation quality/rigor
• product/result
Proper citation is a requirement in this class, without exemptions. All material from an outside source (ideas, text, pictures) must include a proper citation. IEEE bibtex is the preferred format. Failure to include citations will result in a 0 for the assignment and considered plagarism. You are explicitly given permission to use the RU logo on your reports and presentations without citation because you are enrolled at our university. Late work will be penalized according to the degree of lateness: You lose 1 point per day that work is late to a maximum of 5 points (for 5+ days late). Lateness begins at 00:00, regardless of the time specified in MySchool. Assigments may only be submitted up to two weeks late. Software with code that was checked in to SVN or MySchool at the due date/time can be checked off at the next lecture at full credit. If any changes are made after that time, the late work penalty kicks in. For LaTeX documents, the SVN/MySchool submission time of the source .tex files will be used to assess lateness. Unless specified, assignments should be submitted to MySchool. Notebooks will be graded with a grading sheet that will be provided. Reports may be resubmitted up to a week after they are returned for regrading. These grades will be averaged for the new grade. The previous report and grading sheet must be returned with a copy of the edited report. Breakdown of assessment: 5% class participation (in zulip, class, etc); 15% problem sets; 20% labs, reports, and small projects; 20% notebook evaluations; 10% written midterm; 5% final project milestone presentation; 10% final project presentation; 15% final report.
Language of instruction: English.

T-561-LIFF BIOMECHANICS 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: Physics I T-102-EDL1; Statics and Mechanics of Materials T-106-BURD.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Magnús Kjartan Gíslason.

Learning outcome: N/A
Content: The foundation of biomechanics will be introduced and how movement and muscle forces will affect internal joint forces and stress distribution in various joints within the body. Equilibrium calculations on internal joint moments and joint reaction forces will be introduced as well as muscle fores in statically determinite and indeterminate systems. Motion analysis and how it can be used to capture movement in 3D space. Gait analysis will be discussed and a lab be carried out. Material properties of bone, cartilage, ligaments and tendons will be introduced and stuctural mechanics used to calculate stress in various joints of the body for a given load case. Biomechanical analysis if various joints of the body, such as knee, hip, back, shoulder and wrist will be discussed. Finally, pathomechanics will be introduced and how diseases such as osteoporosis, arthritis and other degenerative diseased will affect the biomechanics and how

mechanical stability can be achieved using total joint arthroplasty or other surgical procedures. After the course, the student will have an understanding on how forces are transmitted and distributed within the body during various motions and how different materials of the human body (bones, tendons, muscles and cartilage) behaves under loading.

Reading material: N/A
Teaching and learning activities: Lectures, problem sessions and laboratory sessions.
Assessment methods: Coursework will account for 30% of the final grade and the final exam will account for 70%.
Language of instruction: English.

T-603-AKVA DECISION ANALYSIS FOR MANAGEMENT 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: T-302-TOLF Statistics I.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Þórður Víkingur Friðgeirsson.

Learning outcome: This course is structured around methods and disciplines used by professionals to make decisions where there are uncertainties regarding the outcome. Uncertainties are dealt with by statistical methods and awareness of cognitive biases related to how the mind processes information. The objective is to train future managers in applying disciplines of Decision and Risk Management in their work.
· Knowledge: After the course the student should be able to apply the basic tools of analytical decision processing i.e. influence diagrams, decision trees, Monte Carlo simulation, pay off tables/matrices, weighted methods, Delphi, group techniques, etc.
· Skills: After the course the student should be able to apply the knowledge on to build a decision models/structure to solve decision where multiple objectives are at stake and more than one option to consider for the best possible outcome. · Interpersonal skills: After the course the student should be able to master group work were group techniques are applied to gain consensus and unbiased view on the decision problem.
· Competence: After the course the student to think critically about the decision problem and to be able to design a management process to ensure that the optimal solution based on prevailing information, risk attitude and uncertainty.
Content: When you think of it, decision making is what managers are really paid for. Decision making is a critical part of every manager’s work. The fate of success and failure is primarily related to the quality of our decisions. Sometimes we get lucky and stumble on the optimal decision accidentally. Sometimes the decision is obvious as no other alternative is apparent. However, big decisions are not straight forward. No professional manager is willing to rely purely on luck or intuition. To solve a problem the decision maker must analyze the context of the problem, segment it into manageable parts, consider a number of possible options and choose the most optimal one in the light of the prevailing information. In the evaluation process a risk is embedded as the optimal problem solution is uncertain at the point of decision. Decisions are therefore attached to uncertainty and risk which must be measured, quantified and mitigated. Decisions are a fascinating subject. Most decisions cost next to nothing. It is the consequences that cost or create value! I can promise the motivated and interested student a real “eye-opening” course in one of the most exiting fields of today´s management science. The general learning outcome is to be able to use structured methods to increase the quality, risk awareness and professionalism in decision making when uncertainty is attached to the outcome and best option. This will be aquired by the following : 1. The use of applied statistics in decision analysis. 2. The major methods and procedures of decision analysis ea SMART, decision trees, Bayes rule, Monte Carlo simulation, value of information, utility theory, forecasting, NPV etc. 3. A study on decision fallacies and cognitive biases. 4. A study of basic decision models. 5. The methods of group work and negation skills.

Reading Material: *Decision Analysis for Management Judgement* 4th ed, Goodwin & Wright, Wiley.
Teaching and learning activities: The course is structured in lectures and exercise classes intended for pure academic exercises, teamwork and status exams. Exercise classes are either: 1.Selected exercises from the textbook and/or from the teacher. 2.Teamwork assignments on specific course related topics. Among the planned team assignments are (not necessarily in this order): a.Brain storming sessions to achieve consensus on goals and objectives b.Scenario planning c.Decision modelling d.Risk study´s e.Case study´s 3.Status exams I value a lot a dialog with my students and please observe that the class participation is a part of the final course evaluation. Also observe that the registration list will be removed after the first lecture.
Assessment methods: Individual final exam 65%. Assignments/Status exams (3 * 10%). Class participation 5%.
Language of instruction: English.

T-621-CLIN CLINICAL ENGINEERING 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Core in MSc Biomedical Engineering, elective in other programmes.
Prerequisites: Physics I T-102-EDL1; Electric Circuit Analysis T-104-RAFF; Calculus II T-102-STA2; Physics II T-202-EDL2; Physiology I T-206-LIFE; Mathematics III T-301-MATH; Physiology II T-306-LIFE; Physics III T-307-HEIL.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Paolo Gargiulo.

Learning outcome: Clinical engineering is the field of engineering responsible for applying technology for the improvement and delivery of health services with special emphasis on equipment management, maintenance, and patient care setting. The CE course will provide both general and specific knowledge of clinical engineering practice. The main learning outcome which the course aim to achieve are:
- demonstrate an understanding of the range of engineering disciplines and apply them to the clinical field;.
- apply solutions to problems using engineering analysis and techniques.
- understanding the use of different methods applied to solve particular problems in clinical engineering.
- understand the multidisciplinary nature of medical engineering and the need for integration of knowledge from a range of engineering disc.

Content: In this course, participation in class is necessary since most of the work will performed in class during the lectures time. Briefly the course content is the follow: Part-I, CE General
•Basic of biomedical engineering science and CE discipline.
•Health technology evaluation, design and control in the hospital, acquisition, maintenance and repair of medical devices.
•Patient safety issue, risk management and electromagnetic interference in the hospital.
•Medical device regulatory, health care quality, ISO standards.
•Information system management, telemedicine, communication system (PACS).
•Clinical engineering practise at Landspitali: medical device park, acquisition and maintenance Part-II, CE Electronic.
•Electrical safety in clinical enviroments.
•Leakage currents.
• Fault conditions.
• Medical devices utilization and service: intensive care, operating room, anaesthesiology.
•Engineering the clinical environment: Physical plant, heating, air conditioning, operation room, electrical power.
•The future of clinical engineering.
•Pratical Mesurments of leakage current.

Reading material: N/A
Teaching and learning activities: Lectures, projects, visits and exercises.
Assessment methods: Projects, lectures and in-class examinations.
Language of instruction: English.

T-800-MATH DIFFERENTIAL EQUATIONS AND NUMERICAL ANALYSIS 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: Mathematics I AT STÆ 1003; Mathematics II AT STÆ 2003; Mathematics III AT STÆ 3003.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Hlynur Arnórsson.

Learning outcome: On completion of the course the student should:
• be confident in applying his knowledge in mathematics to realistic problems in engineering
• have aquired good skills in constructing mathematical models in engineering and in using appropriate aids, such as Matlab.
Content: Mathematical models, design and system analysis. Selected examples of mathematical models with application to realistic problems in science and engineering. The examples will illustrate applications of various fields: differential equations, linear algebra, discrete mathematics, statistics etc. and reflect recent developments as much as possible. Problems will, to some extent, be choses to match students´ specialities and interests. The use of suitable tools, such as Matlab, will be emphasized.

Reading material: *Numerical Analysis, an international edition*. B. Bradie, Pearson.
Teaching and learning activities: Lectures and problem solving sessions each week.
Assessment methods: Will be announced at beginning of class.
Language of instruction: Icelandic.

T-801-RESM RESEARCH METHODS I 4 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Taught for 12 weeks, a total of 30 teaching hours.
Lecturer: Brynjar Karlsson.

Learning outcome: On completion of the course the students should:
• understand how to search, survey and select appropriate literature for formulating and resolving a problem.
• know which information to accept and what to reject.
• plan, structure and write a scientific paper or report.
• formulate arguments in writing for a variety of readerships.
• appreciate when the style of writing is appropriate or inappropriate.
Content:
Overview and approach: Industry and society needs people who can think critically, who can analyse complex situations and who can communicate their findings effectively. This can involve many tasks, including searching for and evaluating the worth of scientific literature and other forms of documentation. In this course, we concentrate on scientific writing and reporting, survey techniques and presentations. It

will prepare students for dealing with the information gathering, analysis and reporting skills that are required for all other courses.
Key topics covered: Literature surveys, search engines and other agencies, scientific writing, academic publishing, thesis writing, reviewing papers, managing a research project.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

T-802-THES THESIS PREPARATION 4 ECTS

Year of study: Second year.
Semester: Fall / Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Core.
Prerequisites: Two semesters study at MSc level.
Schedule: Taught for 12 weeks, a total of 18 teaching hours.
Lecturer: Ólafur Eysteinn Sigurjónsson.

Learning outcome: On completion of the course the students should:
• know which broad approach to adopt when planning research or a study project.
• differentiate between the various methods, tools and techniques available to the researcher and know where each is appropriate.
• distinguish between quantitative and qualitative methods of analysis and where each is more likely to apply than the other.
• know which data to observe and what to reject.
• know what patterns to look for in data and how to analyse them.
• plan and structure a research report or thesis.
• plan, manage and report on a research project.
• understand how performance in a research project will be judged and the basis of the criteria for that judgment.
Content: The goal of the course is to prepare the student to successfully write a masters thesis. The student will prepare a short description of the thesis topic and, using the same topic, will prepare a grant proposal and a news article. Each of the three items serve a specific purpose: First, the short abstract defines the aims and scope of the project; the grant proposal serves to clearly outline the state of the art, equipment and methodology used, analysis and anticipated outcome. At the end of the course the student should be intimately familiar with the topic and be able to clearly rationalize the methods, data analysis and goal of the project. It is imperative that the student has chosen a topic and secured an advisor for his/her masters thesis before the initiation of the course.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: Students turn in three assignments and grade as many assignments from their fellow students. The three assignments (research topic, grant proposal and news article) as well as the reveiw of fellow students´ assignments all count as 10% of the grade (60% in total). The remaining 40% is class participation.
Language of instruction: English/Icelandic.

T-807-QUAL QUALITY MANAGEMENT 6 ECTS

Year of study: First or second year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 4 teaching hours a day for a period of 3 weeks.
Lecturer: Helgi Þór Ingason.

Learning outcome: Students who conclude this course can:
• Explain the nature and meaning of quality management as a scientific discipline, explain its history and main concepts and argue for its utility and limits in the management of organisations.
• Explain the connection between quality management and popular ideas/methods/concepts such as lean and 6 sigma.
• Use the practices of continuous improvement, processes, tools and techniques, in the analysis and solviing of real problems, put forward suggestions for problem solving and explain them verbally and in written text.
• Assess the capability of processes and present simple SPC charts.
• Explain the nature and structure of ISO9001.
• Assess the status of an organization in context with ISO9001, designed a very simplified version of a quality manual and deliver professional output verbally and in written text.
Content: It is assumed that students have at least minimum background in statistics. It is also important that students have finished a BS (or BA) degree or have considerable experience in management. The course covers the quality management as a management science and its important sub disciplines such as lean and 6 sigma. Among the subjects of the course are the quality concept, clients, quality culture, suppliers and quality cost. Management systems, improvement, management standards, quality system design, certificiation and audits. Statistical quality control, use of SPC and process capability.

Reading material: *Gæðastjórnun*, Helgi Þór Ingason, Forlagið 2014.
Teaching and learning activities: N/A
Assessment methods: Project A (20%). A group project in continuous improvement, to be explained more specifically. Groups suggest problems to solve. The assessement will be based on e.g. written report, data and the success of the group in dealing with the problem. The written report will be 10 pages. Project B (40%). Based in ISO9001. An assessment of a real company. The groups deliver a report and present it. The assessment will be based on the understanding of ISO9001 and the context with the situation of the organisation. Final exam (40%) will be based on all the compendium.
Language of instruction: Icelandic.

T-809-DATA DATAMINING AND MACHINE LEARNING 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Engineering Management and MSc Financial Engineering, elective in other programmes.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Jón Guðnason.

Learning outcome:
Knowledge: After the course the students should be able to recall, describe and define, the following terms: Pattern recognition system, classifier design cycle and learning. Statistical pattern recognition, Bayesian decision theory, maximum likelihood and Bayesian parameter estimation. Linear models for classification. Principal component analysis. Multilayer neural networks. Nonparametric methds: k-nearest

neighbours and Parzen kernels. Kernel methods and support vector machines. Unsupervised classification, K-means clustering, Gaussian mixture models and expectation maximization. Combination of classifiers, bagging and boosting.
Skills: After the course the students should be able to apply the data mining methods and implement the machine learning algorithms presented in the course using standard programming languages such as Matlab and software packages such as Weka.
Compentence: After the course the students should be able to design a suitable machine learning algorithm for a real world problem, evaluate its performance, compare different designs and implementations and interpret the results. The students should also be able to present findings and new results in the subject.judgment.
Content: Pattern recognition system, classifier design cycle and learning. Statistical pattern recognition, Bayesian decision theory, maximum likelihood and Bayesian parameter estimation. Linear models for classification. Principal component analysis. Multilayer neural networks. Nonparametric methds: k-nearest neighbours and Parzen kernels. Kernel methods and support vector machines. Unsupervised classification, K-means clustering, Gaussian mixture models and expectation maximization. Combination of classifiers, bagging and boosting.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: Subject to change: Computer exercises and problem solving 35%, Course Project 15%, In groups of three or four Final Exam 50% "Closed-book" but with help sheets. Students must obtain 50% of the marks in each of these catagories to pass the course.
Language of instruction: English.

T-810-OPTI OPTIMIZATION METHODS 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Core in MSc Engineering Management and MSc Financial Engineering, elective in other programmes.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Hlynur Stefánsson.

Learning outcome: After the completion of this course students will be capable of using basic methods of Operations Research for analysing and solving complex decision problems. More specifically the student will be able to: Understand the properties of linear optimization and how it can be used to analyze and solve complex decision problems; Use and analyze different forms of linear optimization models Understand and be capable of analyzing the geometry of linear optimization; Applying systematic methods and algoirthms for analysing and solving decision problems; Understand the importance and usefullness of linear optimization and its applications; Apply software to solve optimization models; Implement solution methods for linear optimization models and have in-depth understanding of the mechanics of the Simplex methods; Practice the use of sensitivity analysis and to derive formulas for sensitivity of model parameters; Understand integer programming and how it can used in decision making Use the main solution methods for integer programming; Understand the special properties of network models and formulate practical problems as network models; Present results in a clear and organized manner.
Content:
Overview and approach: This course introduces the principal algorithms for linear, network, discrete, nonlinear, dynamic optimization and optimal control. Emphasis is on methodology and the underlying mathematical structures.
Key topics: Topics include the simplex method, network flow methods, branch and bound and cutting plane methods for discrete optimization, optimality conditions for nonlinear optimization, interior point

methods for convex optimization, Newton´s method, heuristic methods, and dynamic programming and optimal control methods.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

T-811-PROB APPLIED PROBABILITY 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Core in MSc Engineering Management and MSc Financial Engineering, elective in other programmes.
Prerequisites: Calculus I T-101-STA1; Calculus II T-201-STA2; Mathematics III T-301-MATH; Statistics I T-302-TOLF. Some familiarity with matrices will also be useful and will make the entry easier.
Schedule: 72 teaching hours during a 12 week period.
Lecturer: Sverrir Ólafsson.

Learning outcome: This course will cover some important topics in probability theory with particular emphasis on their application to practical problems. At the end of the course the student will have an appreciation of the important role probability plays in various areas of engineering and be able to apply it to a range of concrete real world problems. This learning outcome can be broken down into the following sub-outcomes:
• Understand the basic concepts of probability distribution functions and their role in the modelling of uncertain outcomes – both in the discrete and the continuous case
• Use expectation values, variances and covariances to model various probabilistic phenomena
• Apply conditional probabilities and Bayes's formula to events in the presence of partial information
• Understand jointly distributed random variables and functions of random variables
• Understand the theoretical basis of moment generating functions and their application to the construction of probability distribution functions
• Understand the theoretical basis of the central limit theorem and the law of large numbers
• Understand Poisson processes, birth and death processes and Markov processes and their roles in the modelling of queues
• Understand different types of queues and their classification
• Be able to estimate the performance of different queueing systems in terms of quantities such as, queue length, expected waiting time or the probability of system blockage
• Use simulation techniques to analyse different queueing systems
• Use hazard rate functions to model the survival rates in natural (humans) and artificial systems (bonds)
Content: The course starts by introducing basic concepts in modern probability theory like events, experiments, probability measures and sigma algebras. Then, the course moves on to discrete and continuous random variables, followed by a discussion of distribution densities and cumulative distributions, both for discrete and continuous cases. Applications include the Bernoulli distribution, Poisson and binomial distribution in the discrete case and exponential, normal and log-normal distributions in the continuous case. Further distributions, such as the gamma distribution, the Pareto distribution and the Weibull distribution will be introduced and their applications to practical problems considered.
Expectation values, variances and covariances will be introduced with applications to time-series followed by conditional probabilities and conditional expectations. Joint distributions and functions of one and more variables will be discussed with applications to various real live scenarios.
Moment generating functions and characteristic functions will be introduced and applied to various concrete examples. Then, we discuss some important inequalities such as, Cauchy-Schwarz, Jensen, Markov, Chebyshev and Kolmogorov inequalities followed by discussion of Chernoff's bounds, large deviation theory and the central limit theorem.
Applications will be considered throughout the course, including queueing theory, financial and insurance models as well as renewal theory, reliability theory, and information theory.

Reading material: Sheldon Ross, *A First Course in Probability* 8th Edition, Pearson 2010, ISBN-13: 978-0-13-607909-5. Sheldon Ross*, Introduction to Probability Models* 11th Edition, Academic Press 2014, ISBN: 978-0-12-407948-9.
Teaching and learning activities: Interactive lectures, class exercises and class or home projects.
Assessment methods: Performance in class exercises and projects (30%) and a final exam (70%).
Language of instruction: English.

T-814-PROD INTEGRATED PRODUCT DEVELOPMENT & ENTREPRENEURSHIP 8 ECTS

Year of study: First or second year.
Semester: Fall. Next taught in fall semester 2015.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Páll Kr. Pálsson.

Learning outcome: Students shall develop the understanding: of the cause of successes and mistakes in innovation within companies, how companies can develop, maintain and increase their skill for innovation and the importance of innovation and entrepreneur thinking for the existence of companies.
Create the knowledge of the technique, strategy and methods for innovation and the connection of these factors for entrepreneur thinking and the development of new products (products and service).
At the end of the course students should have substantial knowledge of the method applied with developing products and innovation in companies and the main factors in entrepreneurship.
Content: We cover the engineering approach to innovation and entrepreneurship in lectures and a practical program in an active company.
Due to increasing freedom in trade and internationalization the competition between companies is boosting. At the same time consumers demand new solutions, and the technology developes, resulting in older solutions becoming obsolete. Such conditions require constant innovation in companies management and an understanding of the nature of innovation and entrepreneurship.
Innovation is not only necessary in technological companies, but in all companies that intend to live and prosper.
The course will cover innovation and the ability companies have for innovation in light of market, science, engineering, planning and financial presumptions. We deal with the terms innovation and entrepreneurship and their significance for modern management and put in context with success. We will also cover the value of knowledge, intellectual property rights and patent rights. Then we cover the internationalization and its impact on the innovation process.
Special emphasis will be put on systematic development of the processes connected to innovation and worked on a project in a real company in this field.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: Four reports, each 17%, total 68%. Verbal exam 32%.
Language of instruction: Icelandic/English.

T-815-FIXE FIXED INCOME AND INTEREST RATE MODELLING 8 ECTS

Year of study: First or second year.
Semester: Fall. Next taught in fall semester 2015.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.

Prerequisites: Students are expected to be familiar with basic interest rate concepts and should be confident in converting from one interest rate presentation to another. They should have some experience in performing cash flow calculations like those relating to present and future values, bond pricing, as well as the amortization of loans. Also, some familiarity with basic binomial trees, stochastic processes and the Black Scholes model would be beneficial
Schedule: 72 teaching hours during a 12 week semester.
Lecturer: Sverrir Ólafsson.

Learning outcome: At the end of the course the student will have an appreciation of the important role fixed income and interest rate models play in financial engineering. The student will be able to apply the methods and techniques learned to a range of concrete real world problems. This learning outcome can be broken down into the following sub-outcomes:
• Understand different cash-flow concepts such as, present – and future values, amortization and indexation
• Be able to value different types of bonds with fixed and floating coupons
• Use important interest rate concepts such as, par yield, yield to maturity, spot rates, forward rates, infinitesimal rates and discount curves
• Use bootstrapping techniques to construct the term structure of interest rates from the prices of various interest rate instruments such as zero coupon bonds, coupon paying bonds, Libor and swap rate contracts
• Understand how structured notes with or without options are priced
• Use basic concepts such as duration, convexity and immunization to manage the risk of bond portfolios
• Use bond immunization techniques to match assets to liabilities
• Understand how to price and risk manage inflation linked bonds and swap contracts
• Use stochastic one-factor models for the pricing of zero coupon bonds and other simple interest rate instruments
• Use the HJM model and Libor market models for the pricing of caps, floors, swaps and swaptions
Content: The focus of this course is on fixed income securities. Various types of bonds will be introduced, such as fixed and variable rate bonds, zero coupon and coupon paying bonds. Also, bonds that include various options, such as equity conversion, withdrawal rights (callable bonds) and sell back rights (putable bonds) will be discussed. Various models for the term structure of interest rates will be introduced as well as techniques to construct the term structure by using a range of different interest rate instruments.
Risk modelling for fixed income securities is an important activity for bond portfolios. We will demonstrate, by the use of models and examples, how value at risk, duration and convexity are applied in managing and quantifying bond portfolio risks. We will discuss the immunization of bond portfolios and the construction of bond portfolios that cover certain future cash flow liabilities. To manage inflation risk we introduce inflation indexed instruments such as bonds and swap contracts.
Finally we will cover basic stochastic processes for fixed income analysis and use both binomial trees and continuous processes for the construction of some well-known interest rate models such as, Vasicek, Hull-White, Ho-Lee, and Black-Derman-Toy. These models will be applied to the construction of the term structure of interest rates and to the pricing of bonds and derivatives on interest rate instruments.

Reading material: Olivier de La Grandville, *Bond Pricing and Portfolio Analysis*, The MIT Press, 2001, ISBN 0-262-54145-9. Pietro Veronesi, *Fixed Income Securities*, John Wiley, 2010, ISBN 978-0-470-10910-6.
Teaching and learning activities: Lectures, class exercises and class or home projects.
Assessment methods: Performance in class exercises/projects (30%) and a final exam (70%).
Language of instruction: English.

T-836-STEY REINFORCED CONCRETE DESIGN III 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.

Type of course: Core in MSc Civil Engineering with specialization in Structural Design, elective in other programmes.
Prerequisites: BSc degree in Civil Engineering with emphasis on Structural Design.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Eyþór R. Þórhallsson.

Learning outcome: On completion of the course the students should:
• Be familiar with the theory of failure criteria for reinforced concrete.
• Be able to design prestressed concrete.
• Have gained some experience in using applicable computer software in analyzing complex reinforced concrete structures.
• Be familiar with the basic principles in Fiber Reinforced Concrete design.
Content:
• Strength and deformation of concrete under various states of stress.
• Failure criteria
• Fracture mechanics concepts
• Short and long term deflections
• Cracking
• Prestressed concrete design
• Parameters that affect ductility.
• Shear resistant mechanisms
• Shear design according to the codes
• Punching shear design
• Introduction to the types and uses of FRC
• High performance concrete materials and their use in innovative design solutions.
• Behavior models and nonlinear analysis.
• Complex systems, bridge structures, concrete shells and containments.

Reading material: N/A
Teaching and learning activities: Lectures, computational exercises and projects.
Assessment methods: Evaluation of project work and written or oral examination.
Language of instruction: Icelandic/English.

T-861-SPEC SPECIAL TOPICS IN BIOMEDICAL ENGINEERING 8 ECTS

Year of study: First or second year.
Semester: Fall / Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: N/A
Lecturer: Haraldur Auðunsson, Paolo Gargiulo.

Learning outcome: The objective of the tutorial is to provide a solid theoretical and/or practical background in a subject that is not taught as a formal course in RU and is needed for the students masters project and/or is a part of the individual students study plan.
Content: This course creates the framework for individual faculty members to prepare a single student or a small group of students in a specific subject, often directly related to the student's masters project. The student's masters project will typically be done under the supervision of the faculty member. Tutorial can also be a part of a previously agreed upon exceptional study plan for a specific student. To register a student for this course the faculty member sends an e-mail to the masters program administrator, with a copy to the program director. The information that must be provided for the student to be registered in the course are the following: The students name and identification number. A brief description of the content of the tutorial. A list of reading materials to be covered in the tutorial. A brief description of how often the

student and teacher will meet and for how long. A list of written and oral assignments to be submitted by the students. The name and affiliation of the referee for the oral final examination. The program manager will register the student in the absence of objection from any of the recipients.

Reading material: N/A
Teaching and learning activities: Teaching methods are as appropriate to the subject of the tutorial.
Assessment methods: N/A
Language of instruction: English.

T-862-TIMA TIME SERIES ANALYSIS 8 ECTS

Year of study: First or second year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Tryggvi Jónsson.

Learning outcome: After the course, the student will be capable of developing statistical time series models for analysis and forecasting. This includes:
• To understand the properties of stationary and non-stationary time series and how to handle time series with those properties
• To understand time series in the time domain and in the frequency domain
• To be able to estimate and interpret auto-correlation function, partial auto-correlation function and cross-correlation functions)
• To be able to perform spectral analysis and interpret a periodogram
• To be able to build and determine the appropriate order of common time series models for expected value: AR, ARMA, ARIMA, ARX, Box-Jenkins, Exponential Smoothing, seasonal model, output error model, and transfer function models.
• To understand and identify persistence and structural breaks
• To be able to estimate model parameters using both least squares and maximum likelihood estimation.
• To be capable of using models to issue forecasts and to estimate and interpret model uncertainty and prediction intervals.
• To be able to derive and work with model in state space
• To be able to use Kalman filter
• To have knowledge of multivariate time series and how to handle them
• To be familiar with heteroskedasticity and models for heteroskedastic time series such as ARCH and GARCH.
• To be familiar with time varying model parameters and non-linear time series models and their applications.
• To be able to use R or similar programs to import and work with data sets and solve data related problems such as missing data and outliers.
• To be able to use R or similar programs to analyse time series, build models and use them for forecasting.
Content: N/A

Reading material: *Time Series Analysis*, James D. Hamilton.
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

T-863-EIIP ENERGY IN INDUSTRIAL PROCESSES 8 ECTS

Year of study: First or second year.
Semester: Fall.
Level of course: 4. First cycle, advanced / 5. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Þórður Magnússon.

Learning outcome: N/A
Content: The course covers the use of energy in industrial processes and society. The principles of mass and energy balance are applied to processes taking into account thermodynamics and thermochemistry. The chemistry of metallurgical processes such as iron and steel production is covered but the main focus is on the industrial processes that are prevalent in Iceland, aluminum and silicon. Also other energy intensive processes are addressed such as cement production, mineral wool, fertilizer and synthetic fuel. The main emphasis is on the student's ability to get an overview over various processes in terms of material and energy flow, raw materials, energy use and efficiency, environmental effects and mitigation. Also the economic background i.e. the cost, profit and market conditions are addressed. Grading is based on problem solving, individual and group projects as well as a final exam. Field trips are an integral part of the course.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English/Icelandic.

T-864-DIAG DIAGNOSTIC TECHNOLOGY 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Biomedical Engineering, elective in other programmes.
Prerequisites: BSc degree in biomedical engineering i.e. adequate coverage of mathematics, physics including modern physics and physiology, electrical theory, electronics, automatic control theory, computers and signal processing.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Þórður Helgason.

Learning outcome: At the end of the course the student should:
• know well the behaviour of the cell voltage, its mathematical description and equivalent circuit.
• know well the tomography image reconstruction methods.
• know well the architecture of computer tomography devices.
• know well the architecture of magnetic resonance imaging devices.
• know well the architecture of positron emitting tomography devices (PET), running cost and clinical advantage.
• know well two diagnostic technique and corresponding devices according to own choose.
• have exercised measurements of bio signals and properties of electrodes.
• know the basics of ultrasound current source imaging, be able to estimate what technology is necessary for its realisation and its diagnostic and monitoring possibilities.
• have exercise in estimating technical properties of tomographic images.
Content: The course covers common technology used for diagnosis and observation of patients. The course begins with mathematical modelling of cell membrane voltage and it equivalent circuit.

Then the main theme is tomography as realised in computer tomography (CT), magnetic resonance imaging (MR) and positron emitting tomography (PET). Emphasis is on methods and algorithms for image reconstruction, sensors and the architecture of the devices.
Students choose two items in the field of diagnostic technology. The goal is that the student acquires a thorough understanding of his themes. Students can choose for example from the following themes: issues from the CT, MRI and ultrasound imaging, recording and processing of bio signals, light and laser, tele-monitoring, implant technology and ultrasound.
One theme will be an emerging technology or technology in development i.e. ultrasound current source imaging. The fundamental physics of the method are covered, main properties and the need for technological developments. Then the possibilities in diagnostic and therapy monitoring will be discussed. Loadstar of the coverage is how physiology, physics, mathematics and electronic are applied to define the system and used for its design.

Reading material: I John Enderle and Joseph Bronzino, *Introduction to Biomedical Engineering*, newest edition. Articles that students and teacher gather during the course are used. Then we refer to the book from John G. Webster, *Medical instrumentation, application and design*, published by John Wiley and Sons 2010. Further material from teacher.
Teaching and learning activities: Weekly exercises: Each student solves a problem once a week, formulated around the week's theme. The goal is to train the student in quantified description of the subject and in calculations. Assignments: Two assignments, both are individual projects. The first assignment is about one technique or device, f. ex. PET. Each students has his own aspects of that technique and reports on that in a written report and in a 20 minute lecture. The goal is that together the students work give a comprehensive description of the nature of the technique, cost and clinical advantage. The second assignment is done individually by each student on a subject of his own choice. Quantified description of the subject, main technical properties and structure of the subject is expected in a report and a 40 min lecture. All assignments are subjects of the oral exam so the reports and power point presentations are distributed to other students of the course. Practical exercises: Two practical exercises, organised in consultation with students.
Assessment methods: 1. Weekly exercises, To acquire right to take the final exam at least 70% of the weekly exercises have to be finished with a minimum average grade of 6,0. 2. Assignments – 30% Two assignments are done in the semester. One assignment is a co-operation project but the other is done by each student independently. The former assignment is about one subject common to all students, f. ex. PET. Each student works on one aspect of the subject, and delivers his report on that, but all students work on the same subject and can share work and information. In the later assignment the students does a work on a subject of his own choice. The two assignments have equal weight in the final note.
3. Practical exercises - 20% Two practical exercises will be done during the semester.
4.Oral exam in the end of the semester – 50%.
Language of instruction: English.

T-864-PROS MECHANICS OF PROSTHETIC DEVICES AND TISSUE 8 ECTS

Year of study: First or second year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: Structural Mechanics T-106-BURD; Materials Science T-407-EFNI; Biomechanics T-561-LIFF.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Magnús Kjartan Gíslason.

Learning outcome: N/A
Content: The mechanics of prostheses will be introduced, in particular the hip and knee, and how the prostheses will affect the motion of the body post-operatively. The properties of the material used for prostheses will be discussed and the interaction between them and the bones in which they connect.

Stress analysis of the prostheses will be covered as well as the failure modes. The design of the prostheses will be examined from an engineering perspective. Other implantable devices such as heart valves, dental implants and arterial stents will be discussed as well as the design criteria of such devices. The interaction of metal and other materials such as silicone with tissue will be discussed and the ethical and legal aspects of implanting material into the human body. Finally the interaction of the stump in amputees with a liner will be covered, in particular the pressure distribution on the stump. The biomechanics of amputee gait will be covered and finally the process of osseointegration of the prosthesis into the bone for lower limb amputees will be discussed.

Reading material: N/A
Teaching and learning activities: Teaching will be in the form of lectures, laboratory work and coursework.
Assessment methods: N/A
Language of instruction: English.

T-865-MADE PRECISION MACHINE DESIGN 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Mechanical Engineering, elective in other programmes.
Prerequisites: Basic PLC, Python, C/C++ or Java programming; Basic electronics (resistors, inductors, capacitors); Understanding of structural analysis (stresses, strains, bending); Familiarity with solid modeling tool (Inventor, Solidworks, etc).
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Joseph Timothy Foley.

Learning outcome: On completion of the course the student should be able to:
• solve complex and open-ended "hard" mechanical design problems using systematic design processes.
• analyze error budgets in machine design and propose improvements
• understand what is "hard" about precision and how to address those challenges
• model complex machines as part of a team
• use computer and paper-based tools to come up with estimations and answers quickly
• create effective design documents including FR/DP, risk assessment, and time assessment
• present their ideas effectively for customers and peer reviews
• design and perform experiments to test design choices
• build prototypes of their designs
• analyze their prototypes to develop suggestions for the next design
• harness creative instincts as part of a deterministic process
• competently use Solidworks, Subversion, , Arduinos/PLCs, and sensors.
Content: A systematic approach to designing machines able to reliably and repeatedly perform a task. Factors that are of minor importance for low-performance machines can quickly become impossible obstacles without the right tools and techniques. I this class these techniques will be applied for designing and building high-perfomance machine(s) with our sponsors. Simple control systems will be built for such machines using the Arduino/ATMega microcontroller platform using 3D design software such as Solidworks for modelling machines. LaTeX/BibTeX introduced for proper documentation and citation generation with Subversion as a mechanism for collaboration. There is a high expectation of documentation and mathematical analysis.

Reading material: *Precision Machine Design*, Slocum, Online.
Teaching and learning activities: Design is a heavily interactive communication process and this will be reflected in the teaching of this class. Students will be given interactive lectures on material then are expected to apply this material to practical problem sets and hands-on labs. During lectures, students will be asked to solve design problems on the board with the help of other students and the lecturer. Students will also be presenting their ideas in design reviews to get proper feedback and develop collaboration

skills. Students will be applying these real-world skills on a term project with an outside sponser to develop a high-end precision machine. We will be using some existing equipment to demonstrate such concepts and building others as part of the course. Expect to get your hands dirty disassembling machinery, programming robotic machines, and building new machinery.
Assessment methods: N/A
Language of instruction: English.

T-866-HIVO HIGH VOLTAGE ENGINEERING 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Electric Power Engineering, elective in other programmes.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Stanislav Ogurtsov.

Learning outcome: The objective of the course is that the student is able to;
- Repeat and use important principles when dimensioning of high voltage apparatus.
- Calculate important component parameters and simple electric fields.
- Solve electrical field problems numerically (FEM and CSM).
- Explain the relevant factors determining permittivity and dielectric loss values.
- Estimate the electrical breakdown strength of different materials i.e. gasses, oils and solid insulating material.
- Explain electrical discharge phenomena and estimate their relevance for electrical insulation systems.
- Explain and discuss principles for component breakdown.
- Explain the gradual degradation mechanisms caused by partial discharges, water trees and electrical trees.
- Repeat and discuss important principles in systems for generation of ac, dc and impulse voltages design.
- Choose and apply suitable equipment for measurement of high voltages and currents.
- Repeat and use important principles in PD measurements.

Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

T-866-MODE STABILITY AND CONTROL MODELS IN POWER SYSTEMS 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Electric Power Engineering, elective in other programmes.
Prerequisites: High Voltage Engineering T-866-HIVO.
Schedule: 4 teaching hours a day for a period of 3 weeks.
Lecturer: Ragnar Kristjánsson.

Learning outcome: A student who has met the objectives of the course will be able to:
- Apply models of electrical transmission lines and components to analyze their transmission characteristics and to study large complex power grids; Apply the mathematical model of the synchronous machine to analyze it under stationary and transient conditions; Describe the structure of a program that

carriers out static analysis of complex electric power systems; Describe the steps involved and information needed to study the dynamic response in complex electric power systems; Analyze given power system conditions by applying load flow and time domain simulations. converters and systems.
Content: To obtain knowledge about how various power system components may be appropriately modelled such they may be used for analysis of large-scale systems. This includes static models of transmission lines, transformers and loads, and dynamic models of the synchronous machine. Furthermore, focus is on applying techniques to analyze power system in steady state and in dynamic state. Students have to write Matlab code to carry out load flow analysis and time domain simulations of large power systems.

Reading material: *Power System Stability and Control*, Prahba Kundur, 1994.
Teaching and learning activities: N/A
Assessment methods: The students will work on three hand-in assignments throughout course. The hand-in reports form the basis for the evaluation of their performance during the semester.
Language of instruction: English.

T-867-POSY POWER SYSTEMS III 8 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Electric Power Engineering, elective in other programmes.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Ragnar Kristjánsson.

Learning outcome: On completion of the course a student should be able to: Work with and formulate positive, negative and zero sequences modelling of transformers, lines and cables in the network; Explain and calculate the impact of different earthing principles; Evaluate and use methods for power system analysis in steady state operation and during faults; Apply symmetrical components for unbalanced fault analysis; To formulate and evaluate load flow calculations and use them for steady-state power system analysis; Discuss and use regular power flow and optimal power flow methods; Understand and perform N-1 steady state contingency analysis; Explain power system operation issues and criteria for economic and secure operation; Apply optimization techniques to solve fundamental operation problems; Understand power system state estimation and the incorporation with phasor measurement units (Smart Grids); Understand basic protective methods and apply basic system protection principles.
Content: N/A

Reading material: N/A
Teaching and learning activities: Lectures and practical sessions.
Assessment methods: N/A
Language of instruction**:** English.

T-868-LISY LINEAR DYNAMICAL SYSTEMS 8 ECTS

Year of study: First year.
Semester: Fall. Next taught in fall semester 2015.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Mechanical Engineering, elective in other programmes.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: NN

Learning outcome: This course gives an introduction to linear systems, applied linear algebra and system dynamics with applications to control systems, circuit analysis, signal processing and commnications systems. The course will address theoretical aspects of linear dynamical systems with emphasis on application.
Content: Linear differential equations as linear systems with practial examples throughout: e.g. Communications Systems, Linear Static Circuit, Total Force on Rigid Body, Cost of Production and Computer Vision. State-space representation, eigenvalues and dynamical interpretation of linear systems. Multiple input multiple output systems. Stability and asymptotic behaviour. Lyapunov functions and the Lyapunov equation. Observability and controllability.

Reading material: N/A
Teaching and learning activities: Lectures, problem solving sections, and computer exercises.
Assessment methods: Final exam 50%, Problem solving 15%, Computer Exercises 35%.
Language of instruction: English.

T-899-MEIS MSC THESIS 30 ECTS

Year of study: Second year.
Semester: Fall / Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Core.
Prerequisites: One year of study at MSc level.
Schedule: N/A
Lecturer: Ingunn Sæmundsdóttir.

Learning outcome: N/A
Content: All MSc students complete a project that results in a formal thesis and an oral examination on the thesis in an open forum. The thesis may be submitted in English or Icelandic and should sufficiently present work in accordance with the number of credits of the MSc project; a 30 ECTS credit thesis completed in the students final semester, or a 60 ECTS credit thesis completed in the students last two semesters. A student may organize his/her work on the thesis over a longer period of time, if scheduled in the students study plan and approved by the supervisor.
A faculty member acts as supervisor for each Master´s thesis. If applicable, there may be two supervisors; a faculty member and an external specialist in the subject area of the thesis. All students take the compulsory course T-802-THES Thesis Preparation.
A 30 ECTS credit thesis shall fulfil the following requirements: ·

- Its subject shall have bearing on the relevant field of engineering and/or address research questions concerning the relevant field of engineering.
- Its preparation shall involve academic use of relevant primary or secondary sources, as appropriate to the subject.
- The thesis shall attain the goals set by the student and approved by the supervisor before the thesis work commenced. The goals shall be clearly stated in the thesis´ introduction.
- The handling of the subject matter shall be such as to demonstrate that at least 750 hours of work for a 30 ECTS credit thesis, or at least 1500 hours of work for a 60 ECTS credit thesis, have been devoted to the work.

The Graduate Studies Council issues rules on the form of MSc theses, their submission, oral examinations and grading. Also rules in further detail on the scope of MSc projects, the requirements an MSc thesis shall fulfill, deadlines, accompanying documents a.o.
See ***Rules for MSc programmes in the School of Science and Engineering*** and ***Rules on the form, submission, defense and grading of MSc Theses in the School of Science and Engineering***, http://en.ru.is/departments/school-of-science-and-engineering/master-studies/masters-thesis/ and http://www.ru.is/tvd/meistaranam/reglur/
The official completion of the MSc thesis is signified by the student submitting the final version of the

thesis, signed by himself/herself, the supervisor(s) and the examiner to the RU library, as well as an electronic version (PDF), see http://en.ru.is/skemman

Reading material: N/A
Teaching and learning activities: Students independent work, with faculty supervision and specialist advice.
Assessment methods: The supervisor(s) shall evaluate the thesis together with an examiner appointed by the Director of Graduate Studies. They shall also submit the candidate to an oral examination on the thesis open to the public. A grade shall be awarded on the School of Science and Engineering´s grading scale, the minimum passing grade for a MSc thesis is 6.0. The following factors shall be taken into account: Significance and originality; Scientific and technological challenge and results; Methodological quality; Presentation. The examiners shall take into account the number of ECTS credits. Thus, significantly more demands in terms of originality, quantity and scientific quality of the work are placed on the student for a 60 ECTS project than a 30 ECTS project.
Language of instruction: English/Icelandic.

T-900-MEIS MSC THESIS 60 ECTS

Year of study: Second year.
Semester: Fall / Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Core.
Prerequisites: One year of study at MSc level.
Schedule: N/A
Lecturer: Ingunn Sæmundsdóttir.

Learning outcome: N/A
Content: All MSc students complete a project that results in a formal thesis and an oral examination on the thesis in an open forum. The thesis may be submitted in English or Icelandic and should sufficiently present work in accordance with the number of credits of the MSc project; a 30 ECTS credit thesis completed in the students final semester, or a 60 ECTS credit thesis completed in the students last two semesters. A student may organize his/her work on the thesis over a longer period of time, if scheduled in the students study plan and approved by the supervisor.
A faculty member acts as supervisor for each Master´s thesis. If applicable, there may be two supervisors; a faculty member and an external specialist in the subject area of the thesis. All students take the compulsory course T-802-THES Thesis Preparation.
A 60 ECTS credit thesis shall fulfil the following requirements: ·

- Its subject shall have bearing on the relevant field of engineering and/or address research questions concerning the relevant field of engineering.
- The thesis shall be the student’s own intellectual exploration, making a notable and independent contribution to the field or fields concerned.
- The thesis shall involve a test of a hypothesis made by the student in response to a research question forming its foundation.
- The thesis shall attain the goals set by the student and approved by the supervisor before the thesis work commenced. The goals shall be clearly stated in the thesis´ introduction, as well as the research question and the research methodology.
- Original and derived sources shall be used to support or refute the student’s hypothetical reply to his or her research question.
- The scope and standard of the thesis shall be such that it could obviously lead to a publishable, peer-reviewed paper.
- The handling of the subject matter shall be such as to demonstrate that at least 750 hours of work for a 30 ECTS credit thesis, or at least 1500 hours of work for a 60 ECTS credit thesis, have been devoted to the work.

The Graduate Studies Council issues rules on the form of MSc theses, their submission, oral examinations and grading. Also rules in further detail on the scope of MSc projects, the requirements an MSc thesis shall fulfill, deadlines, accompanying documents a.o.
See ***Rules for MSc programmes in the School of Science and Engineering*** and ***Rules on the form, submission, defense and grading of MSc Theses in the School of Science and Engineering***, http://en.ru.is/departments/school-of-science-and-engineering/master-studies/masters-thesis/ and http://www.ru.is/tvd/meistaranam/reglur/

The official completion of the MSc thesis is signified by the student submitting the final version of the thesis, signed by himself/herself, the supervisor(s) and the examiner to the RU library, as well as an electronic version (PDF), see http://en.ru.is/skemman

Reading material: N/A
Teaching and learning activities: Students independent work, with faculty supervision and specialist advice.
Assessment methods: The supervisor(s) shall evaluate the thesis together with an examiner appointed by the Director of Graduate Studies. They shall also submit the candidate to an oral examination on the thesis open to the public. A grade shall be awarded on the School of Science and Engineering´s grading scale, the minimum passing grade for a MSc thesis is 6.0. The following factors shall be taken into account: Significance and originality; Scientific and technological challenge and results; Methodological quality; Presentation. The examiners shall take into account the number of ECTS credits. Thus, significantly more demands in terms of originality, quantity and scientific quality of the work are placed on the student for a 60 ECTS project than a 30 ECTS project.
Language of instruction: English/Icelandic.

R-E2 GEOTHERMAL SUBSURFACE EXPLORATION 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 72 teaching hours during a period of 6 weeks.
Lecturer: Svanbjörg H Haraldsdóttir.

Learning outcome: At the completion of the course the students should have acquired an overview of geothermal borehole investigations and in depth knowledge of each of the subfield depending on his background: Geology students – a solid knowledge and understanding of how stratigraphy, alteration state, petrology and mineralogy of drilled strata is obtained from analysis of drill cuttings. The student is also familiar with the geophysical logging methods. Geophysics/engineering students – a solid knowledge and understanding of the use of various geophysical methods for logging of temperature, pressure, resistivity, neutron-neutron, gamma-gamma etc. The student is also familiar with how drill cuttings are used to deduce geological information.
Content: Practical and theoretical course in well logging, emphasizing its use in geothermal prospecting. The course is split into three fields of specialization, borehole geology, borehole geophysics and geochemistry of borehole fluids.

Reading material: N/A
Teaching and learning activities: Lectures on theoretical and practical aspects of well logging, borehole geology, geochemistry of borehole fluids, case histories, use of well logging methods in geothermal prospecting and other types of drilling (oil, gas). Second part of course: Visits to borehole sites, practical hands-on training in well logging, collection of geothermal fluid, visit to geological and geochemical labs.
Assessment methods: N/A
Language of instruction: English.

R-E4 INTRODUCTION TO SURFACE EXPLORATION FOR GEOTHERMAL RESOURCES 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 72 teaching hours during a period of 6 weeks.
Lecturer: Gylfi Páll Hersir.

Learning outcome: N/A
Content: The aim of the course is to give the students a basic knowledge about the main methods used in surface exploration for geothermal resources: geological, geochemical and geophysical methods. A short introduction to reservoir assessment will be given as well. The course will be a combination of lectures, practicals and field work. At the end of the course the students should be familiar with the basic concepts and terminology used in surface exploration – the first steps to a deeper understanding of the methods will be taken. Geology (30%): Geothermal and geological mapping; structural geology, tectonics, volcanology and the relationship with geothermal activity and well siting. Different types of geothermal systems. Mapping and identification of surface geothermal manifestations and hydrothermal alteration. Geological hazards in geothermal environment. This part includes fieldwork. Geochemstry (30%): The role of fluid chemistry in exploration and utilization of geothermal resources. Introduction to sampling, analysis of major constituents and interpretation of the results. Isotope studies in geothermal exploration. Studies of the origin and flow of geothermal fluids. Application of chemical fluid and gas geothermometers and the use of mixing models. The environmental impact of the utilization of geothermal fluids. This part includes fieldwork and a visit to a chemical laboratory. Geophysics (30%): An overview of the geophysical methods will be given; theory, measurement procedures and interpretation methods. This includes the direct methods: thermal methods and resistivity methods (Schlumberger, TEM and MT) and structural methods: magnetics and gravity, and seismic methods. Use of geophysics (gravity, crustal movements (GPS) and seismics) in monitoring geothermal fields. This part includes fieldwork to demonstrate the application of the geophysical methods. Summary: Conceptual modeling and reservoir assessment (10%): A summary of the main lessons that can be drawn from the three exploration methods will be given and discussed with the participation of all the lecturers. Examples will be given and discussed; how these results can be used to construct a conceptual model of a geothermal field based on available exploration results. The basic methods used for evaluating the size of a geothermal field prior to drilling- the Monte Carlo method. Examples of will be demonstrated.

Reading material: N/A
Teaching and learning activities: Lectures, practical exercises and field trips.
Assessment methods: N/A
Language of instruction: English.

R-M1 INTRODUCTORY FIELD TRIP 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Core in MSc Sustainable Energy Engineering.
Prerequisites: No prerequisites.
Schedule: Taught all day, every day for 3 weeks.
Lecturer: Ágúst Valfells.

Learning outcome: Upon completion of this course students will have been exposed to the main issues that drive demand for sustainable energy, and to the factors that may impede or promote meeting that demand. Students will also have seen working systems that utilise sustainable energy.
Content: This course gives an overview of the state of energy matters worldwide, using Iceland as a particular case. Topics include but are not limited to: Characteristics of energy use;qualitative description of geophysical processes important to sustainable development; growth and sustainability; abundance, distribution and usability of energy resources; environmental concerns; technological and economic development. This is a three week course consisting of lectures and site visits. The field trips can vary from year to year depending on the student group, but typically will include visits to geothermal and hydropower plants, district heating stations, places of geological and environmental interest etc.

Reading material: Reading list is provided at the start of the course.
Teaching and learning activities: Lectures; Site visits to power plants and areas of environmental and geoscientific interest; Field trip with overnight stay.
Assessment methods: Essay and trip diary (pass/fail).
Language of instruction: English.

R-M2 INTRODUCTION TO EARTH SCIENCES 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 5 teaching hours a week for 12 weeks.
Lecturer: Þorsteinn Þorsteinsson.

Learning outcome: On completion of the course the students should:
Be familiar with general aspects of Earth processes and their relation to resources and hazards; Be familiar with basic methods of quantitative and qualitative analysis of Earth processes; Be able to relate human activity to the Earth's environment.
Content: The Earth as a system: dynamical interaction between constituents, laws of thermodynamics, physical and chemical cycles, interaction with the sun; The Earth below: internal structure, tectonics, seismicity, rocks and minerals, volcanism and geothermics, dynamics of the Earth's crust; Water and ice: hydrological cycle, streams, groundwater, glaciers, sea ice, permafrost, ocean geography, physical and chemical characteristics of the ocean, ocean cycles, tides, currents, waves, coastal regions; Atmosphere: composition and physical structure of the atmosphere, circulation, weather systems, climate change; Biology: biogeochemical cycles, soil formation and erosion, pollution, living organisms; Resources: fossil fuels, minerals, nuclear fuels, renewable resources, depletion and degradation.

Reading material: Skinner & Murck, *The Blue Planet: An Introduction to Earth System Science*, 3rd Ed., Wiley, 2011. Selected articles, reports a.o.
Teaching and learning activities: Lectures, practical exercises and short field trips.
Assessment methods: Evaluation of project work, in-term written exams and final exam.
Language of instruction: English.

R-M3 INTRODUCTION TO ENERGY TECHNOLOGY 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.

Schedule: 5 teaching hours a week for 12 weeks.
Lecturer: Einar Jón Ásbjörnsson.

Learning outcome: On completion of the course the students should have the ability to:
- Assess power conversion potential from a variety of energy sources
- Understand first and second laws of thermodynamics
- Describe common energy conversion processes
- Understand heat transfer and other limitations in power generation
- Assess magnitude of energy challenges and potential solutions for society
- Discuss economic, social, and environmental limitations of generation types.

Content: This course aims to give an introduction to and an overview of the field of energy by presenting basic concepts and laws of thermodynamics, fluid mechanics and heat transfer. Topics covered include thermodynamic systems, properties of pure substances and phase changes, ideal gas, real gas, state equations and thermodynamic variables, work, heat and the first law of thermodynamics, the second law, reversible and irreversible processes, the Carnot cycle and the Kelvin temperature scale, entropy, heat engines, Otto, Diesel, Brayton and Stirling cycles, steam cycles, refrigeration and heat pumps, heat transfer, heat conduction in one and two dimensions, steady state and transient, convection, free and forced, radiation, the laws of Stefan-Boltzmann and Planck, surface properties, shape factors, and radiation heat exchange between surfaces, heat exchangers, duty and properties.

Reading material: N/A
Teaching and learning activities: Lectures, practical exercises and short field trips.
Assessment methods: 4 assignments count 40%; Term paper 30%; Final examination 30%.
Language of instruction: English.

R-M4 INTRODUCTION TO ENERGY ECONOMICS 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 4 teaching hours a week for 12 weeks.
Lecturer: Jónas Hlynur Hallgrímsson.

Learning outcome: The objective of this course is to introduce fundamental concepts of energy economics. At the end of the course students should be familiar with topics related to energy demand, energy supply, energy prices, environmental consequences of energy consumption and production, and various public policies affecting energy demand, supply, prices, environmental effects, and renewable energy. Basic economic modelling and calculations will be presented in class when appropriate.
Content: This course will give students a broad overview of a variety of theoretical and empirical topics related to energy economics. It is a relatively new course and, as a result, it will have an experimental character to it. We will welcome feedback from the students taking the course to help us continue to make it better.There is no official textbook for this course, but reading material will be provided on a weekly basis and based on official reports and academic research related to energy economics. In addition slides covering the basic need-to-know economic concepts from Mankiw´s Principles of Economics will be provided to students as needed.

Reading material: N/A
Teaching and learning activities: Lectures, hand-in assignments, a group project and an exam.
Assessment methods: Mid-term examination 30%; Final examination 40%; In-class presentation 30%.
Language of instruction: English.

R-M8 ENVIRONMENTAL IMPACT ASSESSMENT 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: 4. Second cycle, introductory.
Type of course: Core in MSc Sustainable Energy Engineering (although not mandatory for students with a background in environmental studies), elective in other programmes.
Prerequisites: No prerequisites.
Schedule: 4 teaching hours a day for a period of 3 weeks.
Lecturer: NN

Learning outcome: Upon completion of this course students will be familiar with the most common forms of environmental impact due to the energy sector, estimation of their severity and understand possible mitigation techniques.
Content: The purpose of this course is to understand how energy conversion processes impact the environment, common problems and how they can be dealt with. Topics include airborne pollution; groundwater; hazardous waste disposal; ecological disruption; climate change; environmental footprint and economic disruption. Basic scientific principles, such as transport processes, mass balance, reaction rates, toxicity and biodiversity will be discussed in context with examples drawn from the energy industry. These can include topics such as reinjection of geothermal brine and sequestration of non-condensible gases; habitat disruption from hydropower plants; nuclear waste disposal; oil spills; and carbon capture and storage.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

L-729-NRLA NATURAL RESOURCE LAW 7,5 ECTS

Year of study: First or second year.
Semester: Fall.
Level of course: 6. Second cycle, advanced.
Type of course: Elective. Taught in the School of Law.
Prerequisites: No prerequisites.
Schedule: 34 class hours per semester.
Lecturer: Kristín Haraldsdóttir.

Learning outcome: By completion of the course the students should be able to: •Explain how the law on natural resources relate to different legal fields and their relations to international law •Describe the law governing property rights to natural resources and the main public law rules governing utilisation of natural resources. •Explain common characteristics of rules governing utilisation of natural resources as well as the main legal aims and methods in regulating exploitation of natural resources •Determine and analyse legal problems related to property rights in natural resources and exploitation licenses.
Content: The course is mainly concerned with property rights and natural resources. It is divided into three main parts. The first part deals with the subject matter of natural resources law and general questions on sovereignty over natural resources and natural resources management. In the second part legislation governing ownership of ground resource is examined. Special focus is on energy resources. Legal issues concerning ownership and public law limitations of exploitation of ground resources are considered. The third part is concerned with the living resources of the sea. Legal questions concerning total allowable catch (TAC), fishing quotas and property rights are examined.

Reading material: N/A
Teaching and learning activities: Lectures and discussions.
Assessment methods: Written assignemnt 60%, oral presentation 20% and participation in class 20%.
Language of instruction: Icelandic.

Courses taught in Spring Semester

T-423-ENOP ENGINEERING OPTIMIZATION 6 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: (1) Basic knowledge of Matlab programming, and (2) Calculus (elementary linear algebra, in particular, vector/matrix operations and linear systems, as well as basic knowledge of derivatives, including Taylor expansion).
Schedule: 4 teaching hours a day for a period of 3 weeks.
Lecturer: Slawomir Koziel.

Learning outcome: Upon completing the course, the students should be able to: (1) Formulate engineering optimization problem, corresponding objective functions and constraints, (2) Select appropriate optimization/modeling methodology, (3) Implement basic optimization and modeling procedures as well as develop necessary Matlab code, (4) Solve problems using existing packages, in particular Matlab and Matlab's Optimization Toolbox, (5) Visualize the optimization process and the results.
Content: The course introduces the concept and methods of engineering optimization. Major topics discussed throughout the course are: formulation of unconstrained and constrained optimization problems, objective functions, classification of optimization methods, first- and second-order optimality conditions, gradient-based search methods, derivative-free optimization, stochastic search methods including multi-agent systems and evolutionary algorithms, multi-objective optimization, surrogate-based optimization with focus on space mapping, functional and physical surrogate modeling, design of experiments, model selection and validation, as well as solving real-world engineering optimization problems with interfacing of commercial simulators. The relevant material concerning Matlab programming as well as calculus in the scope necessary for the course will also be given.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: Grades are based exclusively on the assessment of the solutions to the practical exercises. Requirement regarding the solution format and other details will be given during the first lecture.
Language of instruction: English.

T-535-MECH MECHATRONICS II 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: Mechatronics I T-411-MECH.
Schedule: 6 hours a week for 12 weeks.
Lecturer: Baldur Þorgilsson.

Learning outcome: On completion of the course students should:
• acquire knowledge on Mechatronics design
• learn how to interface sensors to computers
• have good knowledge & skills in integrating software and hardware into single solution.
• acquire knowledge on signal conditioning & DSP´s used in Mechatronics.

• learn how to optimize Mechatronic systems.
Content: This course is an extension of Mechatronics1 (T – 411 – MECH). The unit provides an introduction to PID control loops, LabVIEW sequencial, measurements and control programming, servo motor controls, incremental encoders, high-speed control loops and inverted pendulum.

Reading material: *Introduction to Mechatronic Design*, Edward Carryer, R Mathew Ohline, Thomas W. Kerry, International edition, Pearson, 2011.
Teaching and learning activities: Lectures and practical sessions.
Assessment methods: 5 lab works count 50%, a 3 hour written examination counts 50% of the final grade.
Language of instruction: Icelandic.

T-640-FCTA FINANCIAL COMPUTER TECHNIQUES 6 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: Distance learning, with 30 in-class teaching hours during a period of 12 weeks.
Lecturer: Úlf Viðar Níelsson.

Learning outcome: To successfully complete this course a student is expeced to be able to demonstrate knowledge and understanding in computer based finance. This involves being able to analyze and evaluate financial data and present intuitive and meaningful results that are directly interpretable and clear. The student should be able to work comfortably with many different models within finance (CAPM, Markowitz, etc.), all asset types (equity, bonds, derivatives), various methodologies (event studies, estimation of interest rate term structure, etc.) and risk measures (volatility prediction, VaR & EVT, etc.). The student must be capable of achieving these goals in the spreadsheet environment of Excel and in the coding environment of Matlab and Visual Basic.
Content: The purpose of the course is that students learn to apply financial theory in a practice. The course will present how to approach real world problems by using theory in the spreadsheet environment of Excel (and partly in the coding environment of Visual Basic and Matlab). At completion of the course, students should be comfortable with pricing securities (bonds, stock, derivatives) and perform various types of risk evaluations. Students should also be able to perform term structure estimation, assess fund management performance, present portfolios on the efficient frontier, assess equilibrium price models, etc. In short, the purpose of the course is that students adopt the tools necessary to use financial theory in a practical way which will benefit them in any finance or research related position. The main topics to be covered in the course are: • Interest rate calcul., term structure estim., pricing of bonds, immunization strategies • Portfolio theory and choice/management (e.g. efficient frontier) • Stock pricing models of finanical markets (e.g. CAPM, APT) • Option pricing (European, American, Asian and Bermuda options) • Volatility predictions; standard deviation, MA, EWMA, ARCH, GARCH models • In addition to the spreadsheet environment of Excel, the course will introduce how to apply Visual Basic Application (in Excel) to conveniently solve some problems. • Introduction of Matlab; introduced in relation to measuring risk with the “Value at Risk” methodology. Also an introduction to the main financial databases available online will be presented.

Reading material: *Financial Modeling*, Simon Benninga.
Teaching and learning activities: Lectures will be take either in classrooms (during weekends) or through e-lectures, see detailed schedule. Lectures will review (introduce) financial theory and show how this knowledge may be exploited to solve practical, real world problems in Excel (VBA/Matlab). Office hours will be on lecture days (straight after lecture). Numerous assignments will be given to students and solutions to those will be provided online.

Assessment methods: Grading will be based on assignments which consist of 10% of the final grade (this is a “hands on” course, but only a fraction of the assignments must be handed in for grading, i.e. 2 out of 14). An open book exam (4 hours) counts towards 90% of the grade.
Language of instruction: Icelandic/English.

T-802-THES THESIS PREPARATION 4 ECTS

Year of study: Second year.
Semester: Fall / Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Core.
Prerequisites: Two semesters study at MSc level.
Schedule: Taught for 12 weeks, a total of 18 teaching hours.
Lecturer: Ólafur Eysteinn Sigurjónsson.

Learning outcome: On completion of the course the students should:
• know which broad approach to adopt when planning research or a study project.
• differentiate between the various methods, tools and techniques available to the researcher and know where each is appropriate.
• distinguish between quantitative and qualitative methods of analysis and where each is more likely to apply than the other.
• know which data to observe and what to reject.
• know what patterns to look for in data and how to analyse them.
• plan and structure a research report or thesis.
• plan, manage and report on a research project.
• understand how performance in a research project will be judged and the basis of the criteria for that judgment.
Content: The goal of the course is to prepare the student to successfully write a masters thesis. The student will prepare a short description of the thesis topic and, using the same topic, will prepare a grant proposal and a news article. Each of the three items serve a specific purpose: First, the short abstract defines the aims and scope of the project; the grant proposal serves to clearly outline the state of the art, equipment and methodology used, analysis and anticipated outcome. At the end of the course the student should be intimately familiar with the topic and be able to clearly rationalize the methods, data analysis and goal of the project. It is imperative that the student has chosen a topic and secured an advisor for his/her masters thesis before the initiation of the course.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: Students turn in three assignments and grade as many assignments from their fellow students. The three assignments (research topic, grant proposal and news article) as well as the reveiw of fellow students´ assignments all count as 10% of the grade (60% in total). The remaining 40% is class participation.
Language of instruction: English/Icelandic.

T-803-VERK PROJECT MANAGEMENT AND STRATEGIC PLANNING 8 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 4. Second cycle, introductory.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Þórður Víkingur Friðgeirsson.

Learning outcome:
Knowledge
1. To understand the principles of traditional and modern project management as discipline.
2. Learn to apply the tools, methods and techniques of project management and related disciplines in context of diagnosing, preparing, planning, executing, controlling, changing and closing a project.
3. Learn to place projects within organizations in context of organizational behaviour and the project lifecycle.
4. To understand the systems governing the project lifecycle in different situation.
5. To understand group dynamics.
6. To understand how to deal with risk and uncertainty in projects.
7. To understand the importance of “customer value” in projects.
Skills
1. To be able to lead project preparation and execution in teams.
2. To be able to participate in teams in a productive manner.
3. To be able to communicate results and other relevant information in a
4. To be able to prioritize and select options from point of rational thinking.
Attitudes
1. To understand and respect the value of professionalism and integrity.
Content: The use of projects and project management continues to grow in our society and its organizations. We are able to achieve goals through project organization that could be achieved only with the greatest of difficulty if organized in traditional ways. Business regularly uses project management to accomplish unique outcomes with limited resources under critical time constraints. In the service sector of the economy, the use of project management to achieve an organization’s goals is even more common. A relatively new growth area in the use of project management is the use of projects as a way to accomplishing organizational change. The course of project management quickly moves from theory to practice, allowing students to expand their knowledge base of projects in the context of managerial perspective. The classroom activities include both the traditional lecture approach along with student team-based problem based learning techniques. Students enrolling in this course must have successfully completed a basic managerial course.

Reading material: *Effective Project Management*, R. W. Wysocki, 6th edition, Wiley, 2012.
Teaching and learning activities: All in all, the course is divided into 21 sections. A section is either a lectures, exercises (the teacher works on the whiteboard), exams or project work. One site visit is planned and at least one guest lecturer will address the class.
Assessment methods: Class Participation and attendance 5%, Case study 20%, Technical exams (2x10%) 20 %, Final exam 55 %. Class participation is strongly encouraged to make this course a success for both you and the instructor. Attendance lists will be, as a rule, circulated in the beginning of each lecture. In case of illness notify the teacher by e-mail.
Language of instruction: English/Icelandic.

T-806-HAGN APPLIED PROJECT IN OPERATION RESEARCH 6 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 6. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: Optimization Methods T-810-OPTI and/or Optimization Applications T-814-OAPP.
Schedule: 4 teaching hours a day for a period of 3 weeks.
Lecturer: Hlynur Stefánsson.

Learning outcome: The course provides training in practical opreations research to solve actual problems. Upon completion of the course the student should be able to demonstrate knowledge, skills and competencies as follows:

1 Identify the process of analyzing and solving complex tasks.
2 Identify and understand the use of Operations management and decision-making in companies and organizations.
3 Have received training on designing models in the field of Operations research and utilize them and realize the potential but also the limitations of such models.
4 Have got insight and training in using action research under field conditions.
Content: The course is designed to provide students with training in the use of Operations research methods to solve real problems. Students work together in small groups and go systematically through the processes of solving complex tasks, from definition to solution. Students bring their own proposals for projects or work on projects at the initiative of teachers. It is desirable that the project is carried out in collaboration with a company / organization, but not essential. Projects and groups must be available at the start of the course.

Reading material: N/A
Teaching and learning activities: The course is taught in three weeks in the spring semester . At the start of the course will cover the methodology employed in operation research projects. After that the instruction is in the form of guidance and assistance as needed . Students submit a report at the end of the first and second week. At the end of the third week of the course the students a presentation on the project and its results . Also, students submit a written final report on the project. Course grade is based on activity and initiative of students along with the presentation and final report.
Assessment methods: Course grade is based on activity and initiative of students along with the presentation and final report. Further breakdown: Work and initiative of students 20%, Presentation 40%, Final report: 40%. Status reports are a factor in the assessment of the first item in the learning assessment.
Language of instruction: English/Icelandic.

T-807-VALU VALUE ENGINEERING & MANAGEMENT 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 60 teaching hours during a period of 3 weeks, partly through distance learning.
Lecturer: Jón S. Möller, Marcus Grönqvist, Teresa Davenport.

Learning outcome: After completing the course the student shall:
• Understand the difference between Value Engineering og Value Management .
• Understand how Value Management og Value Engineering are applied in Projects.
• Be able to plan and facilitate a Value Engineering Workshop.
• Understand how the results of a Value Study can be used in Projects.
• Know the LCC concept in Construction Engineering and its importance.
• Be able to set up and complete a LCC comparison study.
• Know and understand methods to estimate Total Project Cost.
Content: The Value Engineering & Value Management course is structured into two parts, a Foundation Element and an Advanced Element.
Foundation Element – The element covers the basic terms and ideas of Value Engineering and Value Management. This part consists of Lectures and Exercises at the start of the Term on one hand and an eLearning part that is based on self study over the Internet on the other hand.
The Learning is structured into a number of modules covering:
• The development of Value Engineering (VE) and Value Management (VM) in construction and manufacturing as well as introducing national and international VM standards.
• The Job Plan – Structured Problem Solving.
• VM application at a strategic level.
• Strategic Function Analysis and its application.

• Clients value systems and how to establish it.
• The most common intervention points for VM and VE on a project.
• Issues that affect facilitation.
• Teams and team dynamics and why VM tends to be carried out in a workshop format.
Advanced Element – This element provides hands on experience in applying VM tools and techniques together with facilitation skills and the preparation of VM studies. Risk Management is a key theme, along with other advanced techniques. The learning objectives encompass:
• Team-working, team leading and integrating the team into the organisation, including advanced facilitation skills.
Defining stakeholder needs, and developing and communicating value criteria
• Establishing a study and defining the deliverables
• Select, apply and develop VM specific and related tools and techniques.
• Applying and promoting business and project Risk Management
The Advanced Element will be covered by a four day workshop.

Reading material: The following literature is recommended for the course: *Value Management of Construction Projects*, 2007, Kelly, Male and Graham. *Value Management Practice*, 1997, Michel Thiry. *The Value Management Benchmark: A good practice framework for clients and practitioners*, 1998, Male S, Kelly J, Fernie S, Grönqvist M & Bowles G. *The OGC VM Case Studies* which can be downloaded for free at: http://www.ogc.gov.uk/documents/CP0152ValueManagementInConstruction.pdf
Teaching and learning activities: The course consists of two parts:
• Foundation Element – The Foundation Element covers the basic terms and ideas of Value Engineering and Value Management. This part consists of Lectures and Exercises at the start of the Term on one hand and an eLearning part that is based on self study over the Internet on the other hand.
• Advanced Element – This element provides hands on experience in applying VM tools and techniques together with facilitation skills and the preparation of VM studies. Risk Management is a key theme, along with other advanced techniques. The Advanced Element will be covered by a four day workshop.
Assessment methods: The Student Evaluation (marks) is based on the following: Completion and evaluation of the eLearning Element, weight 5 % (Short presentation); Individual assignment presented Wednesday 05.09, weigth 10% (Afternoon Session); Group assignment presentation, weigth 15% (Afternoon Session); Individual Report (ca 3500 word), weight 50%; Workshop Evaluation (Advanced Element), weight 20%. All evaluations moments must be completed and passed.
Language of instruction: English.

T-808-NOLI APPLYING MODELS IN MANAGEMENT 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Elective.
Prerequisites: Calculus I T-101-STA1; Statistics I T-302-TOLF; Operation Research T-403-ADGE; Simulation T-502-HERM.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Páll Jensson, Matthías Sveinbjörnsson.

Learning outcome: Upon completion of the course the student should be able to demonstrate knowledge and skills in the following:
1. Understanding the fundamentals of the application of models in management.
2. Be able to develop and use models and know about the possibilities and limitations of these.
3. Have an overview over the most important types of practical models in Operations Research and training in designing them and applying in the various fields of management.
4. Be able to develope OR models for managers with Excel and also other tools like MPL and Simul8. 5. Having had the training and developed the necessary insight to use mathematical models in real life situations.

Content: This course is thought as a final course in the field of Operations Research ans Operations Management. Vey few new methods will be covered, the objective is rather to train students in designing and applying mathematical OR models in real life management. In each week we study a particular field of management, we analyse the role of this manager and his needs for quantitative methods and we try to search for his possibilities of applying mathematical models more than is done today. These particular fields will be marketing, inventory management, production, distribution, service, financing, quality, executive manager and finally government. This takes 8 sessions with one home assignment after each session. There is also group work where students solve a self selected real life case
Prequisites: The students must have a good knowledge in the field of Operations Research and Operations Management, including courses like Operations Research, Simulation, Operational Analysis and Management II, or a similar knowledge from other courses. It is assumed that the students have already learned OR methods like Linear Programming, Simulation, Network Models, Queueing Theory, Forecasting Models, Integer Programming, Nonlinear Programming, Decision Theory etc. Also that they are have been exposed to some fields of Management like Quality Management, Production Management, Project Management and Financial Management.

Reading material: *Management Science Modeling*, Winston & Albright Note that we will not follow the textbook chapter by chapter as it is organized in a different way than the course. Further reading: *Optimization in Operations Research*, Ronald L. Rardin.
Teaching and learning activities: Lessons will mostly be used for discussions. The teacher will start the discussions with examples/case studies that show applications of models in real life management. After that there will be discussions analyzing the needs for models in the field of management under consideration. Each session will end with a discussion about next home assignment.
Assessment methods: The Revenue Management is 25% of the final grade, weekly home assignments are 50% and group project is 25%, i.e. report and a presentation.
Language of instruction: English.

T-814-DERI DERIVATIVES AND RISK MANAGEMENT 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Financial Engineering, elective in other programmes.
Prerequisites: This course assumes undergraduate knowledge in calculus I, II, and III, statistics and some probability. Some familiarity with matrices will also be useful and will make the entry easier.
Schedule: 72 teaching hours during a period of 12 weeks.
Lecturer: Hreggviður Ingason.

Learning outcome: After completing the course the students will have good knowledge of how to identify, quantify and manage different types of risk. The students will learn to use risk management and hedging techniques to manage risks across different markets and also how to measure the efficiency of different hedging techniques. They will have a clear appreciation of the different types of risk that emerge and need to be managed in corporate and financial environments, specially those that have become the focus point of risk management in recent years. The learning outcome can be broken down into the following sub-outcomes:
- Understand basic concepts in risk identification and risk management
- Appreciate different ways in managing risk such as through hedging, diversification or insurance contracts
- Become familiar with the basics concepts of Basel II & III regulatory framework for financial institutions
- Understand the benefits and disadvantages of applying different derivatives contracts in pricing and managing risk
- Be able to price various derivatives contracts, such as options, futures and swaps, from a risk neutralising perspective
- Be able to hedge and manage a portfolio of derivatives.
- Be able to use derivatives in formulating and pricing credit risk

• Understand statistical techniques for analysing default probabilities and their use in the credit rating of corporate debt
• Understand term structure models, credit risk and Interest rate swaps
• Be able to construct and use credit default swaps, CDO's and similar credit contracts intuitively
Content: The core focus of this course is 1) study the use of derivatives in risk management and corporate finance, 2) analyse a whole range of hedging strategies in corporate and investment banking environment and 3) study credit risk, credit risk models, their usage by companies and financial institutions and their potential implications for systemic risk and financial stability.
To begin with we will go through basic concepts in risk management and the relevant regulatory framework. We will discuss the importance of derivatives in managing risk exposure as well as the fundamentals of derivative pricing from a risk neutralising perspective. We will discuss how the theory of options can be applied to evaluate equity, cost of capital and investment opportunities. We will discuss the evaluation and origin of risk capital. Other topics will include the quest for optimal risk management strategy and the evidence that risk management strategies can deliver quantifiable value. We will view that evidence in the context of the Modigliani and Miller propositions. Towards the latter half of the course we will discuss credit risk in detail and develop some of the maths required for the quantification of default probabilities. We will study credit derivatives and some of the credit risk models available. Also, we analyse the impact default correlation has across individual firms, sectors and different economic regions with implications for financial stability.
Several case studies will be discussed and analysed. We will look at real world cases and discuss "hot" topics in risk and risk management during the progress of the course.

Reading material: Lecture notes and other study material will be distributed in class.
Teaching and learning activities: Interactive lectures, class exercises and class or home projects.
Assessment methods: Performance in class exercises and projects (30%) and a final exam (70%).
Language of instruction: English.

T-814-INVE INVESTMENTS 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 72 teaching hours during a period of 12 weeks.
Lecturer: Eva Sóley Guðbjörnsdóttir.

Learning outcome: N/A
Content: This course teaches how to make sound investment decisions through in-depth knowledge of the financial markets, rigorous analytical thinking and precise mathematical derivation. The focus of this course is on financial theory and empirical evidence for making investment decisions. Topics include: portfolio theory; equilibrium models of security prices (including the capital asset pricing model and the arbitrage pricing theory); the empirical behavior of security prices; market efficiency; performance evaluation; and behavioral finance. Also, students gain hands-on experience with optimization, data analysis, and other quantitative techniques by completing group assignments.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

T-814-OAPP OPTIMIZATION APPLICATIONS 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: Optimization Methods T-810-OPTI.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Eyjólfur Ingi Ásgeirsson.

Learning outcome: After completing the course, students should: - know how to use commercial solvers and program simple problems in GNU Mathprog or similar languages. - know nonlinear optimization and nonlinear optimality conditions. - know gradient methods, including Newton's method, conjugate gradient and affine scaling. - know convex programming and the difference between convex and non-convex problems. - be familiar with semidefinite programming. - know stochastic optimization, including robust optimization and Monte Carlo sampling. - know dynamic programming and when it is applicable. - be familiar with approximation algorithms and how to use them - know metaheuristics such as simulated annealing, tabu search and genetic algorithms. - be able to use commercial solvers to find solutions to optimization problems. - be able to use Newton's method for finding local optima for complicated problems. - be able to use conjugate gradient method and affine scaling for simple problems. - be able to implement interior point methods for simple problems. - be able to implement Monte Carlo sampling for simple problems. - be able to set up dynamic programming models for simple problems. - be able to use approximation algorithms for known NP-Complete problems. - be able to implement simple metaheuristic methods. - be able to select appropriate metaheuristics for selected problems. - be able to set up metaheuristics algorithms for complicated problems. - be able to select the appropriate optimization method for specific problems.
Content: This is a graduate course focusing on operations research and optimization. The goal of the course is to introduce various advanced optimization techniques. Material covered in the course includes: Nonlinear optimization, convex optimization, stochastic optimization, dynamic optimization, approximation algorithms and metaheuristics. Students will use commercial solvers as well as implementing their own algorithms to solve problems.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: Homework assignments (x4) 20%; Paper introduction and extended abstract 10%; Programming assignment / project 20%; Final exam 50%.
Language of instruction: English.

T-815-STOC STOCHASTIC PROCESSES IN FINANCIAL ENGINEERING 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: This course assumes undergraduate knowledge in calculus I, II and III, statistics and probability theory. Students would also benefit from having completed the course T-811-PROB Applied Probability.
Schedule: 72 teaching hours during a period of 12 weeks.
Lecturer: Sverrir Ólafsson.

Learning outcome: At the end of the course students should have a good working knowledge of stochastic processes and their application to financial and operational engineering. This includes applications to various vanilla and exotic options in financial engineering as well as to stochastic optimal control, which finds applications both in financial and operational engineering. The learning outcome can be broken down into the following sub-outcomes:

• Understand the basic concepts in stochastic processes and their role in the modelling of phenomena that have time-dependent probability distributions
• Be able to apply Poisson and Wiener stochastic processes to various problems in operational and financial engineering
• Understand the principles of stochastic calculus and appreciate its differences to conventional calculus
• Understand Itô's Lemma and its very important applications in financial engineering
• Be able to use Itô's Lemma to solve stochastic differential equations
• Appreciate the role of the Feynman-Kač method in solving partial differential equations (PDEs) that emerge from stochastic differential equations (SDEs)
• Understand the connection between Itô processes, risk neutral measures, PDEs and the pricing of vanilla options
• Understand and be able to apply the first passage time distribution to the pricing of various exotic options
• Appreciate the important role of martingales in the pricing of derivatives

Content: Stochastic processes play an important role in all areas of science, engineering and finance. In this course we will mainly focus on financial engineering applications, particularly risk scenarios and the pricing of various financial instruments. However, some attention will be given to operational engineering, including applications to performance analysis of queuing systems. From the very beginning we will develop theoretical concepts in parallel to practical considerations.
After a general introduction to discrete and continuous stochastic processes, such as random walks, Poisson processes, birth-death processes and renewal processes, we introduce diffusion processes such as Brownian motion and geometric Brownian motion.
Via Itô's Lemma we move on to stochastic calculus and use the risk-neutral method to derive the Black-Scholes equation. Other important processes in financial engineering, such as mean reverting stochastic processes will also be discussed. Applications to vanilla and exotic derivatives and term structure models will also be considered.
One important area of stochastic calculus considered in the course will be stochastic optimal control with applications to asset and liability management and portfolio theory. We will discuss the mutual fund theorem and its applications to modern pension fund management.
The lectures will be extended with hands-on practical tutorial and computational exercises.

Reading material: Tomas Björk, *Arbitrage Theory in Continuous Time* 3rd Edition, Oxford University Press, 2009, ISBN978-0-19-957474-2
Steven E. Shreve, *Stochastic Calculus for Finance II*, Springer Verlag 2004, ISBN 978-0-387-40101-0
Lecture notes and other study material will be distributed in class.
Teaching and learning activities: Interactive lectures, class exercises, class or home projects.
Assessment methods: Performance in class exercises and projects (30%) and a final exam (70%).
Language of instruction: English.

T-822-JARH EARTHQUAKE-RESISTANT DESIGN 8 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Jónas Þór Snæbjörnsson.

Learning outcome: On completion of the course the students should:
• Be familiar with the general theory of structural dynamics, incl. the behavior of SDOF and MDOF systems.
• Be able to analyze the response of structural systems to dynamic action, esp. regarding response to earthquake.
• Have gained some experience in using applicable computer software in analyzing structural response to earthquake action.

• Be familiar with the basic principles and codes covering earthquake resistant design of reinforced concrete structures.
Content: • The principles of structural vibrations;
• Dynamic properties of structural systems, incl. the effect of stiffness and damping on natural frequencies,
• SDOF and MDOF systems, degrees of freedom.
• The basic principles of structural response to dynamic action.
• The application of suitable software in analysing natural frequencies and forces resulting from dynamic action.
• The application of Eurocode 8, including the proportioning and structural detailing of reinforced concrete buildings subjected to earthquake action.

Reading material: N/A
Teaching and learning activities: Lectures, computational exercises and projects.
Assessment methods: Evaluation of project work and written or oral examination.
Language of instruction: Icelandic/English.

T-824-FEMM FINITE ELEMENT METHOD IN ENGINEERING ANALYSIS 8 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Civil Engineering with specialization in Structural Design, elective in other programmes.
Prerequisites: Differential Equations and Numerical Analysis T-800-MATH, or equivalent..
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: NN

Learning outcome: On completion of the course the students should:
• Be familiar with common tools used in the analysis and design of structures.
• Be able to recognize the main sources of computational errors and to compare different methods, including the computational reliability of those methods.
• Be able to build up the stiffness matrices of beam-, slab- and shear elements, and to construct the total stiffness matrices of the structural system.
• Be able to define the proper boundary conditions and solve the relevant systems of equations.
• Be able to evaluate errors and deviations in FEM analyses.
Content: • Simple methods for checking major deviations and errors.
• The basic principles of Finite Element analysis, the theoretical basis and use of energy methods.
• Setting up FEM models capable of dealing with non-linear an dynamic problems.
• The students work out projects where they draw up computer models of specific concrete structures, analyse that model using FEM software and check relevant results using hand calculations.

Reading material: N/A
Teaching and learning activities: Lectures, computational exercises and projects.
Assessment methods: Evaluation of project work and written or oral examination.
Language of instruction: Icelandic/English.

T-860-MALS SEMINAR IN BIOMEDICAL SCIENCES 8 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Biomedical Engineering, elective in other programmes.
Prerequisites: No prerequisites

Schedule: 4 teaching hours a week for 12 weeks.
Lecturer: Haraldur Auðunsson a.o.

Learning outcome: At the end of the course students should: • Have the ability to analyze and evaluate peer reviewed scientific articles in their field of study. • Have done a detailed analysis of selected research. • Have gained experience in giving oral presentations about research topics to their peers. • Be better able to participate in critical scientific discussion. • Be aware of several topical research areas in biomedical engineering.
Content: This course is mainly based upon reading and analysis of peer reviewed scientific papers in subject areas related to the students field of study, and to some degree their anticipated masters projects. In addition, papers concerning biomedical engineering will be the subject of study. Working scientists will present their research to the students and discuss general aspects of research with the students.

Reading material: N/A
Teaching and learning activities: Student presentations, discussion sessions, group work, projects and guest lectures.
Assessment methods: The final grade is pass/failed and is based on active participation in the course.
Language of instruction: Icelandic/English.

T-861-ELSI ELECTRICAL STIMULATION AND NEUROMODULATION 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Þórður Helgason.

Learning outcome: N/A
Content: Fundamental issues: Fick law, diffusion, Nernst equation, electrical properties of neural, heart and muscle fibre membrane, equivalent circuit models, Hodgkin-Huxley, quantitative description of information transfer in the neural system, neural adaptability, peripheral nerve system, spinal cord, eye, brain. Electrodes and electrical stimulation: surface electrodes, implantable electrodes, cuff electrodes, muscle electrodes, electrodes for heart stimulation, electrodes for brain stimulation, stimulation pulses, stimulation techniques, drug diluting systems Stimulators: stimulating output stage, realisation of different pulse shapes, man-machine interface, microprocessor control Implantable Microsystems: minimisation, capsulation, testing Neuroprosthetics: control, auto regulation, biological-technical interface, Application of electrical stimulation: Movement regeneration (FES), pain, spasticity, motor disorders, bladder control, cochlea implant, eye implant.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

T-861-NEDY NEURODYNAMICS AND NEUROSTIMULATION 6 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites

Schedule: 4 teaching hours a day for a period or 3 weeks.
Lecturer: Ceon Ramon.

Learning outcome: The objective of the course is to learn the genesis of the electrical activity of a single neuron, a group of neurons in hypercolumns (~ 1 mm resolution) and of the whole cortex. Also learn how the brain can be stimulated by implanted electrodes and/or noninvasively by electric or magnetic fields to treat depression, control of epilepsy and Parkinson's disease.
Content: Topics to be covered Neuroanatomy, spiking neuron models, neural mass-models, genesis of EEG, ECoG (ElectroCorticograms) and MEG (Magnetoencephalograms) from the electrical activity of the whole cortex, different EEG bands, alpha, beta, delta and gamma rhythms, time series analysis of EEG signals, EEG phase synchronization and phase transitions states, normal and abnormal EEG activity, Electric and magnetic stimulation of brain and computer models of brain stimulation. Applications to epilepsy, language and memory studies will be covered.

Reading material: N/A
Teaching and learning activities: Lectures and interactive problem solving.
Assessment methods: Performance in homeworks 50% and a project report 50%.
Language of instruction: English.

T-861-SPEC SPECIAL TOPICS IN BIOMEDICAL ENGINEERING 8 ECTS

Year of study: First or second year.
Semester: Fall / Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: N/A
Lecturer: Haraldur Auðunsson, Paolo Gargiulo.

Learning outcome: The objective of the tutorial is to provide a solid theoretical and/or practical background in a subject that is not taught as a formal course in RU and is needed for the students masters project and/or is a part of the individual students study plan.
Content: This course creates the framework for individual faculty members to prepare a single student or a small group of students in a specific subject, often directly related to the student's masters project. The student's masters project will typically be done under the supervision of the faculty member. Tutorial can also be a part of a previously agreed upon exceptional study plan for a specific student. To register a student for this course the faculty member sends an e-mail to the masters program administrator, with a copy to the program director. The information that must be provided for the student to be registered in the course are the following: The students name and identification number. A brief description of the content of the tutorial. A list of reading materials to be covered in the tutorial. A brief description of how often the student and teacher will meet and for how long. A list of written and oral assignments to be submitted by the students. The name and affiliation of the referee for the oral final examination. The program manager will register the student in the absence of objection from any of the recipients. Taught in English (unless all enrolled students are Icelandic speaking).

Reading material: N/A
Teaching and learning activities: Teaching methods are as appropriate to the subject of the tutorial.
Assessment methods: N/A
Language of instruction: English.

T-863-HEAT HEAT TRANSFER 8 ECTS

Year of study: First year.

Semester: Spring.
Level of course: 3. First cycle, advanced / 4. Second cycle, introductory.
Type of course: Core in MSc Mechanical Engineering, elevtive in other programmes.
Prerequisites: Mathematics III T-301-MATH; Thermodynamics T-507-VARM; Fluid Dynamics T-536-RENN.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: NN

Learning outcome: On completion of the course the students should:
Understand the concepts of heat transfer, and relations between fluid flow and heat transfer.
Be able to design heat exchangers and other components subjected to thermal loading.
Understand the basic thinking involved in process design.
Content: In this course the concepts of heat transfer are introduced:
• Heat conduction: One dimensional steady state heat conduction, solution of the Fourier equation for steady state and transient problems. Lumped analysis using thermal resistance. Application of numerical techniques.
• Convective heat transfer: Natural convection, empirical relations in free convection. Forced convection, laminar and turbulent convective heat transfer analysis in external and internal flows, such as flows between parallel plates, over a flat plate and in a circular pipe. Condensation and boiling heat transfer.
• Empirical relations, application of numerical techniques in problem solving.
Radiative heat transfer: Introduction to the physical mechanism, radiation properties, radiation shape factors black body radiation, and deviation from black body radiation, radiation from gases.
• Heat exchangers: Classification of heat exchangers, temperature distribution ,overall heat transfer coefficient, and fouling. Heat exchanger analysis using LMTD method and NTU method.

Reading material: N/A
Teaching and learning activities: Lectures and problem solving sessions.
Assessment methods: N/A
Language of instruction: English/Icelandic.

T-864-FEMM ADVANCED FINITE ELEMENT ANALYSIS 8 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Mechanical Engineering, elective in other programmes.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Indriði Sævar Ríkharðsson.

Learning outcome: On completion of the course the students should be able to: ·
• Use the principle of virtual work to set up finite element equations. ·
• Implement the finite element method for truss, beam and continuum problems. ·
• Apply the finite element method to the solution of static and dynamic mechanical, thermal, fluid and electrical problems.
• Solve material and geometrically non-linear problems by use of explicit and implicit solution methods. Optimize mechanical structures based on finite element calculations
• Verify correctness of calculations based on test problems and comparisons with analytical solutions Evaluate the quality of a finite element model when the exact solution is unknown.
• Set up non linear and coupled field FEM analysis in commercial code (ANSYS or similar)
• Present results of finite element analyses in a clear and efficient form.
Content: The principle of virtual work. The Finite Element Method. Truss and beam elements. The principle of virtual vork. Isoparametric elements and numerical integration. FEM analyses and modeling of thermal, fluid and electrical systems. Large systems of equations. Explicit and implicit methods of solution. Geometrical and material non-linearity. Optimization methods. Coupled field analysis. Students

will build their own finite element code in MATLAB and apply it to simple geometries. Commercial codes (ANSYS or similar) will be used for more complex analyses.

Reading material: *The Finite Element Method in Engineering*, Singiresu S. Rao, 5th edition, Elsevier Inc. 2011.
Teaching and learning activities: Lectures and project work.
Assessment methods: Individual assignments 30%; Group projects 40%; Final exam 30%.
Language of instruction: Icelandic/English.

T-865-THER THERAPEUTIC TECHNOLOGY 8 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Biomedical Engineering, elective in other programmes.
Prerequisites: Knowledge from the basics of biomedical engineering i.e. physiology, physics, modern physics, mathematics, signal processing, automatic control, electronics and instrumentation.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Þórður Helgason.

Learning outcome: By the end of the course a student should:
- master chosen subjects in therapy technology.
- know well the function and construction of different therapy devices and methods.
- be able to describe the above in a quantitative way.
- know well the economical side of therapy
- know well the ethical side of therapy.
- have training in promoting therapy technology.
- have training in chosen subjects of therapy technology.

Content: The course covers common technology used for treatment of illnesses or accidents. The first theme is high frequency surgery technique, its properties and dangers. It contains different types of cut, effects of current density, model of surgery circumstances, safty capacitor, crest ratio, unipolar and bipolar cutting and other treatment of tissue with electricity. Next theme is electrical stimulation, basics and application. Depolarisation of cell membrane, effects of current density and direction, IT-curve, electrodes, recruitment of cells, absolute and relative refractory period, fatigue, functional electrical stimulation (FES) of upper and lower extremities, automatic control and drop foot. Radiation therapy for cancer treatment. Effects of ionising radiation on tissue, type of radiation, energy loss in tissue, radiation dose, treatment planning, linear accelerators, ray modulation, safety. The Heidelberg Ion-Beam Therapy, HIT. Synchrotron, effects of heavy ions on tissue and gantry for heavy ion radiation. Students do two assignments on themes of own choice. The first assignment is smaller and is delivered by a 20 minute introduction to a poster and a report. The other is bigger and is delivered in a 40 minute lecture, power point presentation and an in depth report. The material of the assignments is subject of an oral exam at the end of the semester. The material made by the students is distributed among them. Participants of the course should have knowledge from the basics of biomedical engineering. That is a. o. physiology, physics, modern physics, mathematics, signal processing, automatic control, electronics and instrumentation.

Reading material: Material from teacher. New books on each subject. Students and teacher gather new material during the course.
Teaching and learning activities: Weekly exercises: Each student is supposed to solve a problem once a week. The problems are formulated around the week's theme and are to be delivered in the next week. They can only be delivered on the home page of the course. The goal is to train the student in quantified description of the subject and in calculations. Assignment: Two assignments are done in the semester by each student. Each student chooses subjects for investigation according to his interests.

The first assignment is smaller and delivered in form of a report and a poster. Each student introduces his poster in 20 minutes at the middle of the semester. The second assignment is bigger. It is delivered in a 40 minute lecture, power point presentation and an in depth report. The student comes with a quantified description of the subject, on the main technical properties and construction of equipment.
Practical exercises: Two practical exercises are done at Landspitali in the semester.
Assessment methods: 1. Weekly exercises, at least 70% have to be delivered with an average note of at least 6,0 to give right to enter the oral exam. 2. Assignments – 30%. Two assignments are done during the semester: One is smaller and is delivered in form of a report and a poster. Each student represents his poster in 20 minutes around the centre of the semester. The other is a bigger assignment. It is delivered at the end of the semester in form of a lecture and an in-depth going report. It should have at least one thorough quantitative description of a quantitative aspect of the technology. The smaller assignment counts 10% and the bigger 20%. 3. Practical exercises - 20%, two practical exercises. 4. Oral exam at the end of the semester – 50%.
Language of instruction: English/Icelandic.

T-865-TISS TISSUE ENGINEERING 8 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: Molecular and Cell Biology T-106-LIFV; Chemistry T-204-EFNA; Physiology I T-206-LIFE; Physiology II T-306-LIFE; Materials Science T-407-EFNI.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Ólafur Eysteinn Sigurjónsson.

Learning outcome: N/A
Content: Tissue engineering To give students insight into tissue engineering both as a tool for medical development but also for basic research in how cells differentiate and tissues are formed. The course will be divided into theoretical parts (lectures and literature review) and a practical part, aimed at introducing to the students technology used in tissue engineering. The course will be in 4 parts: 1) Cellular models, 2) Biomaterials, 3) Tissue engineering as a research tool, 4) Tissue engineering in clinical therapy.

Reading material: N/A
Teaching and learning activities: Lectures, discussion groups and practical experiments.
Assessment methods: An essay 50%, practical part 50%.
Language of instruction: English.

T-866-POEL POWER ELECTRONICS II 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Ragnar Kristjánsson.

Learning outcome: On completion of the course the student should be able to:
Formulate and discuss basic theory of power electronic energy conversion; Evaluate different converter topologies for specific use; Calculate the switching loss, conducting loss, and cooling of semiconductors; Formulate and repeat design critieria of snubber circuits for switching elements; Evaluate and describe possibilities of control circuits for power converters; Model and analyze complex systems within power electronics; Perform simulation of power electronic converters and systems.

Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

T-867-STAB STABILITY AND CONTROL IN ELECTRIC POWER SYSTEMS 8 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Ragnar Kristjánsson.

Learning outcome: A student who has met the objectives of the course will be able to:
Explain the principal causes of power system stability problems (frequency, transient rotor angle, small-signal rotor angle and voltage stability problems); Reflect on how the power system stability problems are affected by grid related limitation for the transfer of active power and the machine related limitation for the injection of active and reactive power; Explain the key concepts for primary frequency control in power systems; Analyze rotor angle small-signal stability problems by applying small-signal analysis; Analyze transient stability problems and describe means to protect the system against transient stability problems; Analyze voltage stability problems by applyingcontinuation power flow.
Content: To obtain knowledge about conditions in electric power systems that can lead to stability problems, to understand which physical mechanisms are the cause of power system instability, and to give the student insight in the theoretical background for analysis methods used for assessment of system stability. Numerical simulations and analysis will be carried out on different stability problems where the students implement the appropriate models and methods for analysis in Matlab. The course "Power system modeling and simulations" is a prerequisite for attending this course.

Reading material: *Power System Stability and Control*, Prahba Kundur, 1994.
Teaching and learning activities: Lectures and practical sessions.
Assessment methods: The students will work on four hand-in assignments throughout the semester. The hand-in reports form the basis for the evaluation of their performance during the semester.
Language of instruction: English.

T-870-INTE INTEGRATED PROJECT IN ELECTRICAL & MECHANICAL ENGINEERING 14 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Mechanical Engineering and MSc Electrical Engineering.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week during a 12 week period and 4 teaching hours a day during a 3 week period.
Lecturer: NN

Learning outcome: On completion of the course the students should:
• have the ability to undertake a substantial design and/or modelling project, from the initial concept to a working end product.
• have experience in using the methodology of iterative design-analysis-testing.

• know how to build prototypes and/or system models
• be accustomed to the „hands on“ aspects of engineering.

Content:
Overview and approach: This course is meant to give students an immediate feel for practical aspects of engineering; the design process; the need for analysis and simulation, its benefits and limitations; familiarity with prototyping, modelling, experimentation and testing etc. The course is built around a challenging design and/or modelling project that calls for a range of tools from electrical and mechanical engineering. The project is integrated with relevant, specialized courses.
Course content: The aim of this course is that the students get an experience in working on a complex project that involves the design/modelling, implementation and testing, and requires cooperation of different groups.The project varies from year to year, and the exact content varies as well. Basic project management techniques will be taught, as well as basic experimental protocol.

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: Icelandic/English.

T-899-MEIS MSC THESIS 30 ECTS

Year of study: Second year.
Semester: Fall / Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Core.
Prerequisites: One year of study at MSc level.
Schedule: N/A
Lecturer: Ingunn Sæmundsdóttir.

Learning outcome: N/A
Content: All MSc students complete a project that results in a formal thesis and an oral examination on the thesis in an open forum. The thesis may be submitted in English or Icelandic and should sufficiently present work in accordance with the number of credits of the MSc project; a 30 ECTS credit thesis completed in the students final semester, or a 60 ECTS credit thesis completed in the students last two semesters. A student may organize his/her work on the thesis over a longer period of time, if scheduled in the students study plan and approved by the supervisor.
A faculty member acts as supervisor for each Master´s thesis. If applicable, there may be two supervisors; a faculty member and an external specialist in the subject area of the thesis. All students take the compulsory course T-802-THES Thesis Preparation.
A 30 ECTS credit thesis shall fulfil the following requirements: ·

- Its subject shall have bearing on the relevant field of engineering and/or address research questions concerning the relevant field of engineering.
- Its preparation shall involve academic use of relevant primary or secondary sources, as appropriate to the subject.
- The thesis shall attain the goals set by the student and approved by the supervisor before the thesis work commenced. The goals shall be clearly stated in the thesis´ introduction.
- The handling of the subject matter shall be such as to demonstrate that at least 750 hours of work for a 30 ECTS credit thesis, or at least 1500 hours of work for a 60 ECTS credit thesis, have been devoted to the work.

The Graduate Studies Council issues rules on the form of MSc theses, their submission, oral examinations and grading. Also rules in further detail on the scope of MSc projects, the requirements an MSc thesis shall fulfill, deadlines, accompanying documents a.o.
See ***Rules for MSc programmes in the School of Science and Engineering*** and ***Rules on the form, submission, defense and grading of MSc Theses in the School of Science and Engineering***,

http://en.ru.is/departments/school-of-science-and-engineering/master-studies/masters-thesis/ and http://www.ru.is/tvd/meistaranam/reglur/
The official completion of the MSc thesis is signified by the student submitting the final version of the thesis, signed by himself/herself, the supervisor(s) and the examiner to the RU library, as well as an electronic version (PDF), see http://en.ru.is/skemman

Reading material: N/A
Teaching and learning activities: Students independent work, with faculty supervision and specialist advice.
Assessment methods: The supervisor(s) shall evaluate the thesis together with an examiner appointed by the Director of Graduate Studies. They shall also submit the candidate to an oral examination on the thesis open to the public. A grade shall be awarded on the School of Science and Engineering´s grading scale, the minimum passing grade for a MSc thesis is 6.0. The following factors shall be taken into account: Significance and originality; Scientific and technological challenge and results; Methodological quality; Presentation. The examiners shall take into account the number of ECTS credits. Thus, significantly more demands in terms of originality, quantity and scientific quality of the work are placed on the student for a 60 ECTS project than a 30 ECTS project.
Language of instruction: English/Icelandic.

T-900-MEIS MSC THESIS 60 ECTS

Year of study: Second year.
Semester: Fall / Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Core.
Prerequisites: One year of study at MSc level.
Schedule: N/A
Lecturer: Ingunn Sæmundsdóttir.

Learning outcome: N/A
Content: All MSc students complete a project that results in a formal thesis and an oral examination on the thesis in an open forum. The thesis may be submitted in English or Icelandic and should sufficiently present work in accordance with the number of credits of the MSc project; a 30 ECTS credit thesis completed in the students final semester, or a 60 ECTS credit thesis completed in the students last two semesters. A student may organize his/her work on the thesis over a longer period of time, if scheduled in the students study plan and approved by the supervisor.
A faculty member acts as supervisor for each Master´s thesis. If applicable, there may be two supervisors; a faculty member and an external specialist in the subject area of the thesis. All students take the compulsory course T-802-THES Thesis Preparation.
A 60 ECTS credit thesis shall fulfil the following requirements: ·

- Its subject shall have bearing on the relevant field of engineering and/or address research questions concerning the relevant field of engineering.
- The thesis shall be the student's own intellectual exploration, making a notable and independent contribution to the field or fields concerned.
- The thesis shall involve a test of a hypothesis made by the student in response to a research question forming its foundation.
- The thesis shall attain the goals set by the student and approved by the supervisor before the thesis work commenced. The goals shall be clearly stated in the thesis´ introduction, as well as the research question and the research methodology.
- Original and derived sources shall be used to support or refute the student's hypothetical reply to his or her research question.
- The scope and standard of the thesis shall be such that it could obviously lead to a publishable, peer-reviewed paper.

- The handling of the subject matter shall be such as to demonstrate that at least 750 hours of work for a 30 ECTS credit thesis, or at least 1500 hours of work for a 60 ECTS credit thesis, have been devoted to the work.

The Graduate Studies Council issues rules on the form of MSc theses, their submission, oral examinations and grading. Also rules in further detail on the scope of MSc projects, the requirements an MSc thesis shall fulfill, deadlines, accompanying documents a.o.
See ***Rules for MSc programmes in the School of Science and Engineering*** and ***Rules on the form, submission, defense and grading of MSc Theses in the School of Science and Engineering***, http://en.ru.is/departments/school-of-science-and-engineering/master-studies/masters-thesis/ and http://www.ru.is/tvd/meistaranam/reglur/

The official completion of the MSc thesis is signified by the student submitting the final version of the thesis, signed by himself/herself, the supervisor(s) and the examiner to the RU library, as well as an electronic version (PDF), see http://en.ru.is/skemman

Reading material: N/A
Teaching and learning activities: Students independent work, with faculty supervision and specialist advice.
Assessment methods: The supervisor(s) shall evaluate the thesis together with an examiner appointed by the Director of Graduate Studies. They shall also submit the candidate to an oral examination on the thesis open to the public. A grade shall be awarded on the School of Science and Engineering´s grading scale, the minimum passing grade for a MSc thesis is 6.0. The following factors shall be taken into account: Significance and originality; Scientific and technological challenge and results; Methodological quality; Presentation. The examiners shall take into account the number of ECTS credits. Thus, significantly more demands in terms of originality, quantity and scientific quality of the work are placed on the student for a 60 ECTS project than a 30 ECTS project.
Language of instruction: English/Icelandic.

R-B2 PROFITABILITY ASSESSMENT AND FINANCING 6 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 6 teaching hours a week for 12 weeks.
Lecturer: Páll Jensson.

Learning outcome: After the course students will be able to develop computer models to assess the profitability/feasibility of investments. This main Learning Outcome can be broken down into the following sub-outcomes:
• Understand the theoretical basis for profitability assessment and the time value of money · Use and calculate the main measures of profitability including Net Present Value and Internal Rate of Return · Use the three point method budgeting and investment cost estimations
• Understand what working capital is
• Know and calculate the main ways to finance a project
• Build up Operating Statement, Cash Flow and Balance Sheet for a planned operation
• Understand the relations and the difference between these financial statement
• Discuss and explain with the concepts and principles of accounting and financial management Calculate the most important financial ratios
• Present and interpret the results of profitability calculations
• Perform sensitivity analysis including impact analysis and scenario analysis of projects
• Do Monte Carlo simulations for risk assessment of projects

• Use Decision Trees as a method for making investment decisions
• Understand Multi Criteria Decision Making and apply the AHP method
• Understand the difference between feasibility studies and business plans and the objectives of each
• Write a good business plan including the economical calculations for profitability assessment of an investment project

Content: The basic concepts and principles of project finance with emphasis on profitability assessment of projects and feasibility studies. Among items are project profitability measures, planning cash flow, company operating statements, balance sheets and financial ratios. During the course the students develop themselves an Excel model including measures of profitability assessment. The teaching is mainly computer work and group work exercising project feasibility studies, sensitivity analysis and risk assessment applied to a real world case study.

Reading material: N/A
Teaching and learning activities: This course is based on the method learning by doing so there is no reading material except slides and photocopies distributed in lectures, and a paper by PJ: "Profitability Model and Project Finance"
Assessment methods: In the course there will be a group project, parallel to the lectures. In the beginning of the course, all students are divided into work groups that work together through the semester and deliver a common report. The evaluation factors for the course grade are Profitability Report 70% and Examination 30%.
Language of instruction: English.

R-E3 SPECIAL TOPICS IN ENGINEERING 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Core in MSc Sustainable Energy Engineering, elective in other programmes.
Prerequisites: Thermodynamics and fluid dynamics are required. Previous courses covering topics like turbomachinery, Engineering Equation Solver (EES), engineering drafting software, or powerplant technology would be helpful.
Schedule: 4 teaching hours a day for a period of 3 weeks.
Lecturer: William Scott Harvey.

Learning outcome: Upon completion of this course students should have the ability to:
• Understand some of the major design point selection processes of a thermal power plant
• Design piping and pumping stations, with technical and economic considerations
• Perform technical and economic optimizations of major equipment
• Describe and understand the major conceptual drawings that describe a process plant
• Understand basic construction and maintenance safety considerations

Content: The purpose of this course is to expand student mastery of thermodynamics, fluid dynamics and turbomachinery as it applies to the detailed design of an industrial process facility, such as a geothermal powerplant or chemical process plant. The overall design project management structure will be discussed and developed. Students will perform conceptual-level and detailed design, such as development of process flow diagrams, piping design, equipment selection and optimization. Case studies will be used as the foundation of the course. Students will form design subgroups to cooperate in executing conceptual design for facilities. Students should load EES before the start of classes, and some practice using it is advised. This can be a useful tool for Master´s thesis or lokaverkefni work. Taught in English.

Reading material: *Geothermal Power Plants*, DiPippo, 2nd or 3rd, Elsevier.
Teaching and learning activities: Lectures, independent reading, periodic assignments, frequent beatings, and independent project work.
Assessment methods: Attendance and in-class participation 30%, Project work 70%.
Language of instruction: English.

R-E5 GEOTHERMAL RESERVOIR ENGINEERING 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: N/A
Lecturer: N/A

Learning outcome: N/A
Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

R-E6 APPLIED GEOTHERMAL SUBSURFACE EXPLORATION 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: Geothermal Subsurface Exploration R-E2.
Schedule: N/A
Lecturer: NN

Learning outcome: N/A
Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

R-E7 APPLIED GEOTHERMAL SURFACE EXPLORATION 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: Introduction to Surface Exploration for Geothermal Resources R-E4.
Schedule: N/A
Lecturer: NN

Learning outcome: N/A
Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A

Language of instruction: English.

R-E8 APPLIED GEOTHERMAL RESERVOIR ENGINEERING 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: Geothermal Reservoir Engineering R-E5.
Schedule: N/A
Lecturer: N/A

Learning outcome: N/A
Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

R-M5 OVERVIEW OF SUSTAINABLE ENERGY SYSTEMS 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 5 teaching hours a week during a 12 week period.
Lecturer: Einar Jón Ásbjörnsson.

Learning outcome: N/A
Content: (1) To give students an understanding of the nature of sustainability and (2) how to implement sustainable use of energy resources. Topics include: Renewability, sustainable use of non-renewable systems, the role of innovation, time-scales and severity of environmental effects, security of supply, chicken-and-egg problems, international and regional agreements, effects of subsidies, etc.

Reading material: N/A
Teaching and learning activities: The course is based on lectures and case studies.
Assessment methods: N/A
Language of instruction: English.

R-M6 INTERDISCIPLINARY PROJECT COURSE 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 3 teaching hours a day for a period of 3 weeks.
Lecturer: Árni Ragnarsson.

Learning outcome: N/A

Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English.

R-M7 INTERNSHIP ISE 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: 5. Second cycle, intermediate.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: N/A
Lecturer: Halla Hrund Logadóttir.

Learning outcome: N/A
Content: N/A

Reading material: N/A
Teaching and learning activities: N/A
Assessment methods: N/A
Language of instruction: English/Icelandic.

L-808-UMHR ENVIRONMENTAL LAW 7,5 ECTS

Year of study: First or second year.
Semester: Spring.
Level of course: 6. Second cycle, advanced.
Type of course: Elective. Taught in the School of Law.
Prerequisites: No prerequisites.
Schedule: 32 class hours per semester.
Lecturer: N/A

Learning outcome: Comprehensive knowledge on concepts and principles of environmental legislation and on how to apply them.
Content: The course deals with Icelandic laws concerning the protection of the environment and natural resources, be it of land, sea or air. The main areas are public administration, public access to environmental information, rules regarding climate change, land use plans, environmental impact assessments, and potential liability on account of pollution damage. Special emphasis will be on the link between Icelandic legislation, European legislation and international conventions.

Reading material: N/A
Teaching and learning activities: Lectures and discussions.
Assessment methods: Assignments 50%, final exam 50%.
Language of instruction: Icelandic.