Bachelor of Science Programs in Engineering
180 ECTS credits
Biomedical Engineering
Engineering Management
Financial Engineering
Mechanical Engineering
Mechatronics Engineering

Course Catalogue 2016-2017
Revised Dec. 13 2016
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BSc in Engineering

3 year programs of 180 ECTS credits

The programs in BSc engineering at Reykjavik University provide students with a strong theoretical background on which to build their graduate studies, as well as specialised training in analysis and design. Students are exposed to faculty research and they often work on projects in cooperation with industry.

After completing a three year BSc degree, studies towards an MSc degree take two years. Reykjavik University’s programs in engineering are designed to fulfill the requirements for qualifying to be registered as a chartered engineer in Iceland on completion of the MSc degree.

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 of their studies, graduates will have become accustomed to the process of design, implementation and operation which they will face in their future careers.

The programs are structured as follows: 84 ECTS credits in core courses which are the same for all the BSc engineering programs, 66-72 ECTS credits in core courses which are specific to each program, 24-30 ECTS credits electives.

There are two semesters a year, spring and fall, the semester structure as follows: A 12 week teaching period in which a student takes 4 courses; a 2 week exam period; a 3 week teaching period in which a student takes one intensive course. All undergraduate programs are taught in Icelandic. A limited number of undergraduate courses taught in English are available for visiting exchange students.

This catalogue contains descriptions of all undergraduate level courses offered within the BSc engineering programs for students who commence their studies in the academic year 2016-2017. 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/. The following table shows the program schedule for students that enrolled fall 2016. Schedules for other graduation classes can be found at ru.is/tvd.

For information on specific BSc programs in engineering s.a.admission, programme structure, study plans, admission, rules and regulations a.o. see http://en.ru.is/departments/school-of-science-and-engineering/undergraduate-programmes/engineering/

For further information contact Hjördís Lára Hreinsdóttir, program administrator for undergraduate studies in engineering, tvd@ru.is
# BSc in Engineering - 180 ECTS program - emphasis on preparation for further studies at MSc/PhD level

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* Students in their 6th semester in Mechatronics Engineering must take either T-535-MECH Mechatronics II or T-507-VARM Thermodynamics

** Students in their 6th semester in Mechanical Engineering either take T-606-NUFF Numerical Fluid Flow and Heat Transfer, and T-606-LABB Thermo and Hydraulics Lab. The courses are taught every other year.
Course descriptions

Courses taught in 1st year, 1st semester - Fall semester

T-102-EDL1  PHYSICS I  6 ECTS

Year of study:  First year.
Semester:  Fall/Spring.
Level of course:  First cycle, introductory.
Type of course:  Core.
Prerequisites:  No prerequisites.
Schedule:  Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. Three lab work sessions during the semester and one home experiment. Weekly support classes are also offered as part of this course.
Supervising teacher:  Sigurður Ingi Erlingsson.
Teachers:  Sigurður Ingi Erlingsson (fall semester), Vilhelm Sigfús Sigmundsson (spring semester). Gunnar Þorgilsson og Andrei Manolescu (lab work sessions).

Learning outcome:  At the end of the course the student should know the concepts and solve problems related to:

- Motion in one dimension and using vectors to describe motion in 2 and 3 dimensions
- Newton's laws of motion, force diagrams and decomposing forces into components
- Work and how it connects kinetic and potential energy
- Conservation of momentum and impulse and describing simple collisions
- Kinematic of rotation, angular momentum and moment of inertia
- Statics and properties of static fluids and fluid motion
- Free, damped and driven oscillations and simple wave motion
- Heat and temperature and the 1st and 2nd laws of thermodynamics
- Performing measurements, quantitative error analysis and report writing

Content:  Physics is a cornerstone to the traditional engineering disciplines but its methodology extends much further into e.g. biology, economics and finance. In the course students will be trained in describe simple motion using Newtonian mechanics and the basics of thermodynamics.

Reading material:  H.D Young and R.A Freedman, University Physics with Modern Physics.

Teaching and learning activities:  Lectures four times a week where the teacher covers the course material. Problem classes two times a week where selected problems are solved by students in groups. In support classes a teacher covers the the problems. Weekly homework assignments need to be turned in.

Assessment methods:  Three hour written final exam accounts for 60% of the final grade and the students have to pass the exam. No material is allowed in the exams (apart from a formula set that will be supplied) and only Casio FX-350 og FX-570 calculators are allowed. Mid-term exams account for 10% (best grade out of three), problem session participation 10%, and homework assignments 10%. Lab work and reports accounts for 10%. All reports have to be turned in (three reports and one home experiments) to acquire the right take the final exam.

Language of instruction:  Icelandic.
Year of study: First year.
Semester: Autumn.
Level of course: First cycle. (Introductory)
Type of course: Core.
Prerequisites: None.
Schedule: Runs for 12 weeks – 4 lectures and 2 problem-solving classes each week. Weekly homework online.
Supervising teacher: Halldór G. Svavarsson.
Lecturer: Halldór G. Svavarsson.

Learning outcome

After completion of the course the student should:

- know the atomic structure and the atomic model
- know the chemical symbol of the most common and best known elements
- know the IUPAC nomenclature of organic and inorganic material
- know the name of the most common composite ions
- know intermolecular and intramolecular chemical bonds
- be well familiar with orbital hybridization and be able to identify molecular structure
- be well familiar with the ideal-gas equation and confident of its use
- be well familiar with stoichiometry and know how to balance chemical equations
  - redox reactions
  - combustion reactions
  - acid-base reactions (for week and strong acid and bases)
  - precipitation reactions
  - nuclear reactions
- know the relation between light and energy
- be familiar with quantum numbers
- know how to calculate enthalpy, entropy and free energy in chemical reactions
- be able to identify organic compounds on the basis of their functional groups

Content: General chemistry for engineering students. The fundamentals of chemistry are covered including: state and matter, atomic structure and the periodic table, chemical reactions and stoichiometry, chemical bonding, thermodynamics, and chemical equilibrium. A brief introduction to nuclear and organic chemistry is given.

It is assumed that students have previous knowledge in chemistry, corresponding to 1-2 courses on high-school levels.

Reading Material: Chemistry, Raymond Chang, McGraw Hill
Teaching and learning activities: Lectures, problem-solving classes and laboratory work.
Assessment methods: 3 hours written final exam accounts for 65% of the final grade. Weekly homework 10%, three mid-term exams 5% each (total of 15%). Three laboratory reports weigh 10% in total. The students have to turn in all three lab reports to be allowed to take the final exam. A minimum grade of 5.0 is required in the final exam.
Language of instruction: Icelandic.
AT FOR 1003  PRACTICAL COMPUTER SCIENCE  6 ECTS

Year of study:  First year.
Semester:  Fall.
Level of course:  First cycle, introductory.
Type of course:  Core.
Prerequisites:  None.
Schedule:  Taught 6 hours a week for 12 weeks.
Supervising teacher:  Magnús Kjartan Gíslason.
Lecturer:  Magnús Kjartan Gíslason.

Learning outcome: The aim is that students will:
- Know the basics of programming and understand the associated concepts.
- Be able to use the Matlab programming environment to solve mathematical problems and various other technical assignments.

Content: In this course students learn the basic principles of programming. Emphasis is on the students understanding of basic programming concepts, such as variables, calculations, assignment of variables, statements, loops, command scripts, subroutines or functions and algorithms. Students learn to program in the Matlab program environment and are trained in the use of Matlab as a tool for solving technical problems. Methods in handling data and reporting results through graphics using Matlab are also introduced.

Reading material:  Stormy Attaway, Matlab: a practical introduction to programming and problem solving.
Teaching and learning activities: Lectures and exercise classes.
Assessment methods:  10% 6 courseworks handed in weekly, 20%: 3 semester exams, the lowest grade is not counted. 30%: 1 larger programming assignment. 40%: Final exam. Students are required to pass the final exam.

Language of instruction:  Icelandic.
**Year of study:** First year.

**Semester:** Fall.

**Level of course:** First cycle, introductory.

**Type of course:** Core.

**Prerequisites:** No prerequisites.

**Schedule:** Intensive course, taught all day for 3 days.

**Supervising teacher:** Haraldur Auðunsson.

**Lecturer:** Haraldur Auðunsson, Aldís Ingimarsdóttir, Hafðín Kristjánsdóttir, Hera Grímsdóttir, Hlynur Stefánsson, Joseph Timothy Foley, Kristján Halldórsson, Margrét Lilja Guðmundsdóttir, Sveinn Þorgeirsson, Þórdur Vikingur Friðgeirsson.

**Learning outcome:** At the end of the course the student should:

- Have experienced teamwork and understand the importance of cooperation and diversity in a group.
- Have experienced an organized approach to brainstorming.
- Have experienced diversity in the presentation of solutions.

**Content:** The course is based on brainstorming and group work. Students in the first semester of BSc Engineering, BSc Applied Engineering and BSc Sports Science work for three days on formulating a solution to a practical problem proposed to them. During a 3-week period at the end of the semester (late November until mid-December) the engineering students continue to develop their solutions using engineering methodology such as computer-aided design and project management.

The course focuses on the student learning a structured approach to brainstorming and teamwork, and becoming acquainted with different methods of presenting their ideas. Teachers monitor the students work and provide mentoring as needed.

Each group presents its idea at the end of the course, including using poster, and answer questions as appropriate. Students must have completed the course before entering the third year of study.

**Reading material:** Handout from teachers.

**Teaching and learning activities:** Teachers give short presentations on teamwork, brainstorming and various methods of presenting ideas. Students work in groups of 5-6 under the guidance of teachers.

**Assessment methods:** The final grade is either “Pass” or “Failed” and is based on active participation in the course.

**Language of instruction:** Icelandic.
T-116-VERK  INTRODUCTION TO ENGINEERING  6 ECTS

Year of study:  First year.
Semester:  Fall.
Level of course:  First cycle, introductory.
Type of course:  Core.
Prerequisites:  No prerequisites.
Schedule:  Every day for a period of three weeks.
Supervising teacher:  Haraldur Auðunsson.
Lecturer:  Haraldur Auðunsson, Hera Grímsdóttir, Joseph Timothy Foley, Þórður Vikingur Friðgeirsson.

Learning outcome: After completing the course the student should:

- be able to use design software, like Inventor, Revit and AutoCAD, to draw and design simple structural objects.
- have been introduced to good standard practice regarding technical drawings
- be able to describe the engineering methods of work an and project management.
- be able to keep a workbook according to standard practice
- be able to identify and to solve a problem in his field of study.
- have some experience with teamwork and understand the importance of cooperation and the benefits of diversity of group members.
- be able to make a well argumented decision on solutions to assignments and propose solutions.
- be familiar with various methods of presenting results, such as oral presentation, poster, a short film and a structural model
- have been introduced to some ethirical issues in engineering.

Content: The course is based on teamwork were first year students in the BSc programs in engineering and applied engineering work on solving a practical project for three weeks. In the course an emphasis is placed on computer based design, project management and presentation. At the end of the course, each group will submit drawings, logbook and a short film about the project. To construct a model is optional.

Reading material: Material will be provided by the teachers.
Teaching and learning activities: Lectures, assignments to be solved either by each student or by a group, and teamwork.
Assessment methods: The following will be evaluated: projects using computer aided design and drawings participation and contribution in group work, workbooks, and presentation of the results, including presentations, poster and a short video.
Language of instruction: Icelandic.
T-101-STA1  
CALCULUS I  
6 ECTS

Year of study:  
First year.

Semester:  
Fall/Spring.

Level of course:  
First cycle, introductory.

Type of course:  
Core.

Prerequisites:  
No prerequisites.

Schedule:  
Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. Weekly support classes are also offered as part of this course.

Supervising teacher:  
Ingunn Gunnarsdóttir.

Lecturer:  
Ingunn Gunnarsdóttir (fall), Hlynur Arnórsson (spring).

Learning outcome: In Calculus I (stærðfræði I) we learn about functions of one variable. On completion of the course students should:

Knowledge:
- Know complex numbers and basic operations with complex numbers.
- Know polar representation and roots of complex numbers.
- Know basic functions and their characteristics.
- Know mathematical induction.
- Know limits, continuity and differentiability.
- Know the Intermediate-value theorem and the Mean-value theorem.
- Know integrals and graphical interpretation.
- Know inverse functions.
- Know integration by parts, the method of substitution, partial fractions and finding the area between the curves of two functions.
- Be acquainted with improper integrals.
- Know the fundamental theorem of Calculus.
- Know how to find extreme-values of functions.
- Know linear approximation.
- Know Taylor Polynomials.
- Know initial value problems.
- Be acquainted with simple first order differential equations and their solution.
- Know separable differential equations.
- Know second order differential equations with constant coefficients and their solution.

Skills:
- Be able to calculate with complex numbers.
- Be able to write complex numbers in polar coordinates and draw them in the complex plane (Argand diagram).
- Be able to find the roots of a complex number.
- Be able to use mathematical induction.
- Be able to determine basic properties of functions.
- Be able to find the limit of a function and determine if its continuous and/or differentiable.
- Be able to use the Intermediate-value theorem and the Mean-value theorem in solving mathematical problems.
- Be able to evaluate integrals of basic functions.
- Be able to use integration by parts, the method of substitution, partial fractions to evaluate integrals.
- Be able to find the area between two curves of functions.
- Be able to use the fundamental theorem of Calculus.
- Be able to evaluate an improper integral.
- Be able to find functions extreme values.
- Be able to find the linear approximation of a function and evaluate the error term.
- Be able to find a functions Taylor polynomial and evaluate the Lagrange remainder.
- Be able to solve a initial value problem.
- Be able to solve a differential equation with separation of variables.
Be able to find the solution of a second order differential equation with constant coefficients.
Be able to read and understand mathematical reasoning and proofs.

**Abilities:**
- Be able to use mathematical symbols and reasoning to present a solution in a clear and precise manner.

**Content:** Calculus of real-valued functions of one variable. We talk about the most important functions and their properties, including; limits, continuous functions, differentiation, integration, linear approximations and Taylor-polynomials. Also we look at some simple differential equations, learn about induction proofs and some properties of complex numbers (polar coordinates and roots). Students should be able to use mathematical symbols and reasoning.

**Reading material:** Robert A. Adams, *Calculus, A Complete Course.*

**Teaching and learning activities:** Lectures, problem solving sessions and group work. Problem solving session assignments, homework assignments and tests.

**Assessment methods:**
- Final written examination counts 80%.
- Problem solving class assignments counts 10% (can only raise the grade, 8 times give a full grade).
- Homework counts 10%. Tests over the semester counts 10% (best out of two).

It is necessary to pass the written final exam. The tests and the final exam are NOT open book. Students will be given a formula sheet and are allowed to bring a calculator (Casio Fx-350/570) to the tests/exam.

**Language of instruction:** Icelandic.
Courses taught in 1\textsuperscript{st} year, 2\textsuperscript{nd} semester - Spring semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>ECTS</th>
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<tbody>
<tr>
<td>T-202-EDL2</td>
<td>PHYSICS II</td>
<td>6</td>
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</table>

Year of study: First year.  
Semester: Spring  
Level of course: First cycle, introductory.  
Type of course: Core.  
Prerequisites: Calculus I (T-101-STA1), Physics I (T-102-EDL1).  
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. Three lab work sessions during the semester and one home experiment. Weekly support classes are also offered as part of this course.  
Supervising teacher: Sigurður Ingi Erlingsson.  
Lecturer: Sigurður Ingi Erlingsson, Gunnar Pogilsson (lab work sessions).

Learning outcome: At the end of the course the student should know the concepts and solve problems related to:
- Properties of electric charge and Coulomb's law
- Electric flux and using Gauss law to calculate electric fields
- Electrostatic potentials, capacitance, capacitors and the properties of dielectrics
- Electric current, resistance, EMF, internal resistance and Ohms law
- Using Kirchhoff's law in direct current circuits
- Magnetic field, magnetic force and sources of magnetic field
- Faraday's law, mutual inductance, self-inductance, inductors and simple AC circuits
- Maxwell equations, electromagnetic waves and the basic properties of light
- Performing measurements, quantitative error analysis and report writing

Content: Electrics and telecommunication systems all rely on the basics properties of the electric charge and how it interacts with electric and magnetic fields. In this course we will learn about the basic properties of electric charges, electric fields, electric currents and magnetic fields. We will learn how these concepts are related and how they can be used to calculate various properties of electrical systems from simple circuits to antenna.

Reading material: H.D Young and R.A Freedman, University Physics with Modern Physics.

Teaching and learning activities: Lectures four times a week where the teacher covers the course material. Problem classes two times a week where selected problems are solved by students in groups. In support classes a teacher covers the the problems. Weekly homework assignments need to be turned in.

Assessment methods: Three hour written final exam accounts for 60% of the final grade and the students have to pass the exam. No material is allowed in the exams (apart from a formula set that will be supplied) and only Casio FX-350 og FX-570 calculators are allowed. Mid-term exams account for 10% (best grade out of three), problem session participation 10%, and homework assignments 10%. Lab work and reports account for 10%. All reports have to be turned in (three reports and one home experiments) to acquire the right take the final exam.

Language of instruction: Icelandic.
Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core Financial Engineering.
Prerequisites: Calculus (T-101-STA1).
Schedule: Runs for 12 weeks – taught in intensive sessions, an average of 6 teaching hours per week.
Supervising teacher: Sverrir Ólafsson.
Lecturer: Sverrir Ólafsson.

Learning outcome: At the end of the course we expect the students to have a solid understanding of the essential tools of modern financial engineering. Different market models, interest rate concepts, risk free and risky assets will be introduced and applied to the analysis of practical problems. The students will understand how basic market instruments, such as the term structure of interest rates and swap contracts can be used for the construction of synthetic cash flows and forward rate agreements. They will also learn how to design the financial instruments that present the best opportunities for any given situation and how to evaluate and manage their associated risks. Applications will be considered both in the corporate and banking environment. The learning outcome can be broken down into the following sub-outcomes:

- Appreciate the financial implications of market globalisation
- Understand different ways to construct synthetic cash flows and how to quantify and manage their risks
- Know how to construct risk-free and corporate spot and forward term structures
- Understand the implications of no-arbitrage for the pricing of synthetic cash flows
- Be able to construct binomial trees and use them for the pricing of different financial instruments
- Appreciate the role of replicating portfolios for the construction and the pricing of risk-free portfolios
- Be able to design and price a different range of swap contracts
- Know how to hedge different long and short positions in derivative contracts
- Be able to construct alternative cash flows to match liabilities

Content: Financial engineering is the application of basic financial instruments such as forwards, futures, swaps and options to create new financial instruments with different synthetic cash flows in order to achieve particular financial goals, mostly for the management of financial risks. Financial engineering relies heavily on the use of mathematical modelling and simulation techniques. The engineering aspects of the discipline are based on the fact that it constructs composite instruments from other more elementary components. The idea is that the new composite instruments have different properties and provide benefits that cannot be created by the basic financial components alone. The goal of the course is to provide students with a solid understanding of the financial and the mathematical techniques used in financial engineering and to show how these can be used to create solutions to a whole range of financial problems. A number of practical problems and case studies will be considered. Most numerical calculations and simulations presented during the course will be done in Excel and/or Matlab.

Reading material: To be decided.
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: Icelandic.
T-211-LINA  LINEAR ALGEBRA  6 ECTS

Year of study:  First year.
Semester: Spring.
Level of course:  First cycle, introductory.
Type of course: Core.
Prerequisites:  No prerequisites.
Schedule:  4 lectures and 2 discussion/problem solving classes for 12 weeks.
Supervising teacher: Ingunn Gunnarsdóttir.
Lecturer: Ingunn Gunnarsdóttir.

Learning outcome: On completion of the course students should:

Knowledge:
- know basic matrix operations.
- have basic knowledge of methods for solving systems of linear equations.
- be familiar with vector operations and their utilization in geometry.
- know methods for computing determinants, cross product and inverse of a matrix.
- know eigenvalues and eigenvectors and are familiar with its use.
- have learnt methods for the diagonalization of matrices.
- Have learnt methods to determine if vectors are linearly dependent or independent.
- know fundamental concepts for linear transformations.
- be acquainted with the use of matrix transformations in computer graphics.
- know the vector space \( \mathbb{R}^n \) and its subspaces.
- know dimension and basis of a subspace
- be familiar with vector projection and orthogonal basis.
- be familiar with vector spaces in general and know some examples of vector spaces.

Skills:
- be able to solve systems of linear equations with Gaussian elimination and find the corresponding elementary matrices.
- be able to compute dot products and cross products and write equations for lines and planes.
- be able to utilize vectors to prove theorems in geometry.
- be able to compute determinants and inverse matrices.
- be able to find eigenvalues and eigenvectors for a matrix.
- be able to determine whether a matrix can be diagonalized and if so find the relevant matrices.
- be able to determine if a given set of vectors are linearly dependent or independent.
- be able to determine if a given set is a subspace.
- be able to find the dimension of a subspace as well as a basis, in particular an orthogonal basis.
- be able to find matrices for linear transformations in two and three dimensional spaces.
- be able to use homogeneous coordinates to perform transformations in computer graphics.
- be able to determine basic properties of a simple vector space.
- be able to use the Cauchy-Schwarz inequality to prove theorems.
- be able to construct proofs for topics in the course using mathematical reasoning.

Abilities:
- have the ability to use mathematical reasoning to prove simple rules and theorems in linear algebra.
- be familiar with the role of linear algebra in solving problems in engineering and computer science.

Content: Basics of geometry, equations of a line and plane in \( \mathbb{R}^3 \). Matrix algebra and its utilization, e.g. in solving systems of linear equations. Further the course deals with determinants, eigenvalues and eigenvectors. The course covers matrix transformations with references to computer graphics. Additionally the course covers vectorspaces in general.
Reading material: Lay, Lay and McDonald, *Linear Algebra and its Applications*

Teaching and learning activities: Lectures, exercise/problem classes. Homework assignments and tests.

Assessment methods: Final examination 60%. Written assignments 10%. Tests 30%

Language of instruction: Icelandic.
Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Lectures, teamwork, taught for 3 weeks at the end of semester.
Supervising teacher: Hrefna Sigríður Briem.
Lecturer: Hrefna Sigríður Briem a.o.

Learning outcome: Upon completion of this course, students should

• Understand the importance of a team in launching a new company
• Understand how teams are formed and how they react
• Understand where ideas come from and techniques of idea generation
• Understand the use of innovation and creativity in a new business
• Understand the concept of idea validation
• Understand the format and content of a business plan
• Understand which factors make a business plan successful

Content: The course is divided into 4 modules: Ideas, innovation & creativity; Business planning and Starting a new venture; Making a business plan. Students attend class for 13 weeks. During those first 13 weeks they are supposed to identify and develop a business idea and prepare a business plan. After this the students get 3 weeks to complete the business plan, prepare a presentation and a web-site for the new company. No classes are taught during those 3 weeks. The students are divided into teams and each team is assigned a mentor from the business community who is to guide them through the idea generation process. The student teams are to meet twice with their mentors and the mentors do have input into a portion of the students' grade.

Reading material: Osterwalder, Alexander & Pigneur, Yves, Business Model Generation.
Teaching and learning activities: 2 lectures per week and business plan project for three weeks.
Assessment methods:
Language of instruction: Icelandic.
Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core RV.
Prerequisites: No prerequisites.
Schedule: Runs for 12 weeks – 6 lectures per week.
Supervising teacher: Páll Kristján Pálsson.
Lecturer: Páll Kristján Pálsson and Þórdís Jóhannsdóttir Wathne.

Learning outcome:
At the end of the course the students should have reliable knowledge of the methods used when operating a company from an engineering point of view and technical thinking. Knowing and understanding when managing, how the thought and methods of optimisation are applied, especially in the following categories:

- Strategic planning, goal and result measurements. Understanding the methods and the process of Strategic planning and being able to explain them.
- Expenses and profit calculations and managing companies balance sheet. Knowing the common methods used in this case and be able to calculate basic measurements.
- Management: The role and service of the managements, organisation charts, and staff-policy. Be able to talk about and explain the common terms in these categories.
- Analyse the customer and the competition, also analysing the market and the marketing operations. Have the oversight and means to substantiate most procedures in this field.
- The process of creating value: Purchasing, stock control, production planning and product management. Understanding and knowing how optimisation is applied in purchasing and stock managing as well as production management.
- Technology, technical development, research and innovation. Understanding the value of innovation for the company and the community.

Also:
- Be able to express themself on above mentioned issues and authenticate his views.
- Be able to present and interpret their views on projects that concern the above mentioned episodes with the methodology and the instruments of engineering.
- Understanding the total connection of business relating to the complicated environment of the variables.
- Understanding the functions of demand and profit.
- Knowing and understanding companies methodology and the life span procedure of companies.

Content: The purpose of the course is that students get a view over the work and tasks of engineers in management. We cover: Strategic planning, objectives formulation, management, the work and function of boards, organization charts and employee matters. The clientele, competition analysis, like market research and marketing and sales planning. We also cover cost analysis and cost supervision contribution analysis, profit, dividend and balance sheet. We cover supplies and supply management, product and production planning and managing. Research, technical development and innovation.


Teaching and learning activities: Lectures and practical sessions.
Assessment methods: 3 hrs written exam (65 %) and project work (35%).
Language of instruction: Icelandic.
T-106-LIFV MOLECULAR AND CELL BIOLOGY 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core HEV.
Prerequisites: No prerequisites.
Schedule: Runs for 12 weeks – 6 lectures per week.
Supervising teacher: Karl Ægir Karlsson.
Lecturer: Karl Ægir Karlsson and Ólafur Eysteinn Sigurjónsson

Learning outcome: At the end of the course the student will have an understanding of the chemistry of cells, protein biology, the structure of DNA and its translation to proteins, the structure and function of the cell membrane, cell organelles, cell signalling and cell-to-cell communication.

Content: In addition to lab work, the course is divided in four parts
Part 1: Introduction to cell biology, biochemistry of the cell and proteins (chapters 1-3)
Introduction to cell biology. A general overview of the cell, its components and function.
Biochemistry of the cell. Basic introduction into biochemistry. Go over the main laws of chemistry and physics that apply to cells. Covalent and non-covalent bonds. ATP and other energy transport molecules. How food is metabolized into energy molecules and building blocks of the cell. Glycolysis, Krebbs cycle and energy storage. Building blocks of proteins. Aminoacids and peptide bonds.

Part 2: Molecular genetics. Genome and chromosomes. DNA replication, DNA repair and DNA recombination. DNA transcription and RNA translation. Basic concepts of gene regulation (chapters 4-6).
Genome and chromosomes. The building blocks of the genome and how it is packaged into chromosomes. Nucleic acids, adenine, cytosine, guanine og thymine. Double stranded DNA and the DNA double stranded helix and how base pairing secures correct replication of DNA.
DNA replication, DNA repair and DNA recombination. How does DNA replication take place, the role of different DNA polymerases in DNA replication and the main proteins and molecules that are used in DNA replication.
DNA transcription. The main processes that control DNA replication in prokaryotes and Eukaryotes. Different RNA molecules and the role they play in the cell, e.g. how they can control DNA replication. The role of different RNA polymerases in eukaryotes.
RNA translation. The main processes that control the translation of RNA into protein. The differences between mRNA and tRNA molecules. Protein reading frame, how 20 different amino acids can form all the proteins in the cells. Ribosomal(r)RNA and the Ribosomal complex. How the ribosomal complex, tRNA, mRNA and amino acids from the peptide chain and how peptide chains get folded into proteins.

Part 3: Cell membrane and transport across membranes, inner structure of the cell, vesicular transport, energy, cell signalling and the cytoskeleton (chapters 10-13 and 15 – 16).
Cell membrane. The building blocks and formation of the membrane. Cellular transport (channels and transporters). The electrical properties of cell membranes will be given special attention.
Cell organelles. Structure and function of all major cell organs will be discussed. Vesicular transport and cell-to-cell signaling and intracellular signaling pathways. Function and form of the cytoskeleton.

Part 4: Special topics in stem cell biology, tissue engineering and neural engineering.
Basic concepts and recent developments explained. Readings from latest scientific publications (provided by teachers).

Reading material: Alberts et al, Essential Cell Biology.
Teaching and learning activities: Lectures, discussions and tutorials.
Assessment methods: Mandatory attendance to tutorials; three lab reports (5% each). Three semester tests (10% each but only the top two are used for final grade) and final exam (65%).

Language of instruction: Icelandic.
T-201-STA2  
CALCULUS II  
6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: Calculus I (T-101-STA1), Physics I (T-102-EDL1).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.
Supervising teacher: Ingunn Gunnarsdóttir.
Lecturer: Ingunn Gunnarsdóttir.

Learning outcome: On completion of the course students should:

Knowledge:
- Know basic characteristics of sequences and series
- Know 4 tests to determine convergence of series: The integral test, the comparison test, the limit comparison test and the ratio test.
- Know geometric series, p-series, power series, telescoping series and Taylor series.
- Know the parametric representation of basic curves, e.g. a line and a circle.
- Be acquainted with the parametric representation of the intersection of simple surfaces.
- Know the parametric representation of a particle’s position in 3 space and how to represent it’s speed, velocity and acceleration.
- Know how to find curve length and line integrals.
- Know basic characteristics of functions of several variables: Limits, continuity and differentiability.
- Know partial derivatives, directional derivatives, derivatives, chain rule, linear approximation and extreme values of functions of several variables.
- Know double integrals in Cartesian and polar coordinates.
- Be acquainted with improper integrals.
- Know triple integrals in Cartesian, spherical and cylindrical coordinates.
- Be acquainted with a general change of variables in 2 and 3 dimensions.
- Be acquainted with field lines of vector fields.
- Know conservative fields, the potential of a vector field and line integrals.
- Be acquainted with the parametrization of a surface in 3 space.
- Know Green’s theorem, Stoke’s theorem and the Divergence Theorem.

Skills:
- Be able to determine basic properties of series and sequences.
- Be able to use an appropriate convergence test to determine if a series converges or diverges.
- Be able to find the parametric representation of basic curves and the intersection of basic surfaces.
- Be able to describe a particle in 3 space by a parametric curve and find its speed, velocity and acceleration.
- Be able to set up and evaluate a integral to find arc length and line integral.
- Be able to determine basic properties of functions of several variables; find its limit, determine convergence and differentiability.
- Be able to calculate partial derivatives and directional derivatives and know how to interpret them graphically.
- Be able to find the derivative of functions from m-space to n-space and use the chaine rule.
- Be able to find a linear approximation of functions of several variables.
- Be able to find extreme values of functions of several variables.
- Be able to set up and evaluate double integrals in Cartesian and polar coordinates.
- Be able to set up and evaluate triple integrals in Cartesian, spherical and cylindrical coordinates.
- Be able to find field lines.
- Be able to determine if vector fields are conservative and if so find a potential.
- Be able to evaluate line integrals of vector fields.
- Be able to use Stoke’s Theorem, Green’s Theorem and the Divergence theorem when appropriate.
Ability:

- Be able to read and understand mathematical reasoning and derivation of mathematical theorems.
- Be able to use mathematical symbols and reasoning to present solutions to problems in the subject.


Reading material: Robert A. Adams, Calculus, A Complete Course.
Teaching and learning activities: Lectures and practical sessions.
Assessment methods:
Written examination counts 80%.
Home projects 10%.
Best of 2 test during the semester 10%.
The student must pass the written exam. In the tests and final exam students are allowed to bring a calculator (if the calculator is a TI-nspire CAS, this must be in press-to-test mode). Students are also allowed to bring 1 formula sheet, containing formulas, theorems and definitions, but no examples.
Language of instruction: Icelandic.
T-106-BURD  STATICS AND MECHANICS OF MATERIALS  6 ECTS

Year of study:  First year/second year.
Semester:  Spring.
Level of course:  First cycle, introductory
Type of course:  Core HÁV, VV (1st year); Core HEV (2nd year).
Prerequisites:  Calculus I (T-101-STA1), Physics I (T-102-EDL1).
Schedule:  Runs for 12 weeks – 6 lectures per week.
Supervising teacher:  Ármann Gylfason.
Lecturer:  Benedikt Helgason og Ármann Gylfason.

Learning outcome:  Students will gain knowledge of the relationship between static loads of simple structures and the resulting stress and strains as well as the relation between stress and strains in common materials. Main emphasis is on the student’s competence in performing equilibrium calculations of structures and their analysis according to traditional beam theories. Students will gain skills in evaluating reaction forces, internal forces, stresses, strains and deflections of simple structures such as columns, beams and axles under axial loads, torsional loads and point or distributed normal loads.
Student will gain basic skills in aspects of machining, in using manual lathe and mill, as well as gaining basic knowledge of strain guages and their use.

Content:  Course content: Forces and moments, equilibrium of forces and moments, composite structures; stresses and strains; material behavior; 2D and 3D stress and strain analysis and Mohr circle; deformation due to forces and moments, torsion and bending moments, axial and shear forces; deflection of beams; statically determinate and indeterminate structures, buckling.
Prerequisites:  Calculus 1 T-101-STA1 og Physics 1 T-101-EDL1 or comparable.

Teaching and learning activities:  Lectures, sections and labs.
Assessment methods:  I Exam 40%, preliminary exams 30%, labs 30%.
Three preliminary exams will be held during the semester, of which two with the highest grades will be counted towards the final grade. (There are no make-up exams) (the exams are held in lectures).
The students must participate in all laboratory assignments to complete the course - timing advertised later.
Four homework assignments during the semester. Students must return three to complete the course.
The final exam and the preliminary exams are in closed book - closed notes format. The Teacher provides a sheet with formulas. A simple calculator is allowed, Casio Fx350. A minimum grade of 4.75 in the exam is required for other factors to count in for final grade.
Language of instruction:  Icelandic.
Courses taught in 2\textsuperscript{nd} year, 3\textsuperscript{rd} semester  

Fall semester

\begin{itemize}
\item T-534-AFLF  
\item CLASSICAL DYNAMICS
\end{itemize}

\begin{tabular}{|l|}
\hline
\textbf{Year of study:} & Second year. \\
\textbf{Semester:} & Fall. \\
\textbf{Level of course:} & First cycle, intermediate. \\
\textbf{Type of course:} & Core HÁV, VV. \\
\textbf{Prerequisites:} & Physics I (T-102-EDL1), Calculus II (T-201-STA2). \\
\textbf{Schedule:} & Runs for 12 weeks – 6 lectures/problem solving classes per week. \\
\textbf{Supervising teacher:} & Andrei Manolescu. \\
\textbf{Lecturer:} & Andrei Manolescu. \\
\hline
\end{tabular}

\textbf{Learning outcome:} At the end of the course students should be able to solve problems related to:
\begin{itemize}
\item The application of Newton's laws for system of particles. Relative motion, impulse, linear momentum and angular momentum
\item Kinematics of rigid bodies, angular velocity, torque and moment of inertia
\item Rotation in three dimensions, precession and other types of motion related to rotating machine parts
\item Free and forced vibrations, both undamped and damped
\end{itemize}

\textbf{Content:} The goal of the course is to enhance the student's skill in applying Newton laws of motion. Great emphasis will be put on problem solving. Various forms of Newton's laws will be used to solve problems related to complex motion in two and three dimensions.


\textbf{Teaching and learning activities:} Lectures and problem solving classes. The lectures will be often based on examples. The students will build workbooks with problems solved by themselves.

\textbf{Assessment methods:} One hour written test every other week and individual workbooks will account for 30% and the final exam accounts for 70% of the final grade.

\textbf{Language of instruction:} English.
Year of study: Second and third year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core HEV.
Prerequisites: Calculus I (T-101-STA1), Physics II (T-202-EDL2).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. Additionally, each student will perform 5 practical experiments.
Supervising teacher: Haraldur Auðunsson.
Lecturer: Haraldur Auðunsson.

Learning outcome: After completing the course, the student should be able explain and solve simple tasks concerning:
• propagation of light, such as geometric attenuation, intensity, reflection, refraction and polarization
• refraction of lenses and properties of mirrors, and practical use of some optical devices
• interference of waves from two sources and possible wave-patterns
• diffraction and wave-patterns due to slits and reflecting stripes, and practical use
• relativity, time dilation and length contraction, and energy conservation
• duality of light, photons, photoelectric effect and Compton effect, spectrum of radiation and Bohr’s atomic model
• wave properties of particles, de Broglie ideas and diffraction of particles
• quantum mechanics, wave functions and their interpretation, Schrödinger’s equation and simple quantum systems
• condensed matter, energy bands and semiconductors
• nuclear physics and nuclear processes, nuclear magnetic resonance, nature and application of radioactivity, and biological effects of radiation
• measurement of light and of nuclear processes, including radioactivity.

Content: Physics provides a better understanding of our environment, nature and technology, and insight that encourages and supports creative thinking in solving problems. Technological advances of the last century, and today, are largely based on an understanding of small particles like photons and electrons, and their wave-particle duality. Optics are important, as may be seen for example in the increasing application of laser light and imaging of all sorts. Radioactivity is involved whether in medical diagnosis and therapy, or in environmental issues and potential energy sources of the future - and therefore it is natural to look into the special theory of relativity. The material covered in this course is based largely on the work of scientists in the early 20th century, and hence it is often referred to as "modern physics".

Reading material: Young and Freedman, University Physics With Modern Physics
Teaching and learning activities: Lectures and practice sessions, experiments and projects.
Assessment methods: Final grade is based on a) the written final exam (60%), b) all lab reports (20%) and c) regular quizzes (20%). The student has to turn in all lab reports (five) to be allowed to take the final exam. More details will be given at the beginning of the course.
Language of instruction: Icelandic.
T-512-FRBI PRODUCTION AND INVENTORY MANAGEMENT 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core RV.
Prerequisites: No prerequisites.
Schedule: 6 hours of classes each week for 12 weeks.
Supervising teacher: Páll Jensson.
Lecturer: Guðmundur Elías Níelsson

Learning outcome: Students should get comprehensive understanding of the supply chain management and the main problems related to supply chains, inventory and resource control and logistics. Students should be capable of using models for decision making, such as forecasting models, inventory and purchasing models and logistics models, as well as being capable of estimating the quality of forecast models and know the basics of production management.

Content: The course focuses on supply chain management, forecasts and planning. The supply chain topics include supply chain management, communication and planning. The forecasting topics include mainstream statistical models, collaboration planning within companies and the role of planning in companies. The class covers the estimation of forecasting and planning quality, inventory management, logistics and models such as EOQ, VRP and relevant optimization models. Production control, resource planning and procedures, MRP, short-term vs long term planning and lean management are also covered.

Reading material: Silver E.A, Pyke D.F, Peterson R, Inventory Management and Production Planning and Scheduling.
Teaching and learning activities: Mainly lectures and homework. Excel will be used. There will be five guest lecturers from the industries and 3-4 visits to production companies.
Assessment methods: Home assignments: 20%. Quizzes 20%. Written exam 60%. This can change.
Language of instruction: Icelandic.
T-316-GAVI  DATA PROCESSING  6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate
Type of course: Core FV, RV.
Prerequisites: Programming for Engineering (T-208-FOR2).
Schedule: Taught every day for three weeks.
Supervising teacher: Eyjólfur Ingi Ásgeirsson.
Lecturer: Eyjólfur Ingi Ásgeirsson.

Learning outcome: After completing the course, students should:
- know how to use scripting languages, such as Python, to gather information stored in textfiles.
- know the SQL query language, especially how to use select and join.
- know the main database systems, such as SQL Server, PostgreSQL and MySQL.
- know the idea of using indices in databases.
- know how entity-relationship diagrams work.
- be familiar with database normalization and understand its objective.
- be familiar with the use of triggers in databases.
- be able to write simple programs in Python to gather data from textfiles.
- be able to use the SQL query language to collect information from databases.
- be able to draw entity-relationship diagram for a simple database.
- be able to collect information from textfiles or Excel files, design a simple database for the information, and use the Python programming language to move the information into the database.

Content: This course looks at efficient methods of using data. Scripting languages, such as Python, will be introduced, and how they can be used to work with data stored in text files or Excel files. Database systems, such as SQL Server, PostgreSQL and MySQL will be introduced, as well as the SQL query language. One of the main focus of the course is the use of SQL to gather information from databases.

Reading material:
Teaching and learning activities: Lectures and Project work for 3 weeks.
Assessment methods: Individual assignments, mid-term exam after 2 weeks and a group project. A passing grade from the mid-term exam is required for participation in the group project. There is no final exam.
Language of instruction: Icelandic.
T-306-RAS1  ANALOG CIRCUIT ANALYSIS  6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core HEV, HAV, VV.
Prerequisites: Calculus I (T-101-STA1), Physics II (T-202-EDL2).
Schedule: Runs for 12 weeks- 6 teaching hours per week.
Supervising teacher: Mohamed Abdelfattah.
Lecturer: Mohamed Abdelfattah and Paolo Gargiulo.

Learning outcome:
- This course presents the fundamentals of electric circuits, the basic concepts of voltage, current, power and energy and circuit elements, including different types of sources and circuit analysis methods.
- After successful completion of the course, Students should understand the basic laws, including Ohm’s and Kirchhoff’s laws.
- Students should be able to analyze different types of electric circuits using suitable circuit analysis methods, such as node voltage and mesh current methods, and apply suitable circuits theorems, superposition, source transformation, Thevenin’s and Norton’s.
- Students should be familiar with the operational amplifiers (Op-Amp) and its basic circuits, and should understand the energy conservation in inductive and capacitive elements.
- Students should understand the concepts of phasors and impedances for AC sinusoidal analysis, and be able to apply the concepts of phasors and impedances with suitable circuits methods and theorems for AC sinusoidal circuit analysis.
- Students should be able to analyze, design and evaluate simple electric circuits. They should gain adequate experimental experience, for building simple circuits, and skills of using computer programming and simulation, e.g. by using PSpice, to analyze and design simple circuits.
- Students’ individual skills are also expected to be improved by using individual assignments.

Content:
- Basic concepts of charge, current, power and energy.
- Circuit elements, including different types of sources.
- Basic laws, including Ohm’s and Kirchhoff’s laws.
- Series and parallel connections, and Delta and Wye transformations.
- Circuit analysis methods; node voltage and mesh current methods.
- Circuit theorems; superposition, source transformation, Thevenin’s and Norton’s theorems and maximum power transfer.
- Operational amplifiers (Op-Amp) and its basic circuits.
- Inductors and capacitors and series and parallel combinations.
- First order RL and RC circuits, and the natural, forced and steady-state responses.
- Second order series and parallel RLC circuits.
- Concepts of phasors and impedances for AC sinusoidal analysis.
- Circuits methods and theorems for AC sinusoidal steady-state and AC power analysis.

Reading material:
- Lectures slides
- Experiments manual

Teaching and learning activities:
- Lectures; for the presentation of the fundamentals and theory.
- Exercises (problem solving); for the development of the analytical skills.
- Lectures and exercises group discussions; for thinking, brainstorming and understanding and for supporting the knowledge exchange and team work skills.
- Computer simulations exercises, e.g. by using PSpice, for the development of the simulation skills to investigate the behavior of the circuits.
- Individual experiments assignment for the development of experimental skills.
- Individual homework assignments for the development of the self-learning skills.

**Assessment methods:**
- Midterm-Exam-1
- Midterm-Exam-2
- Assignments; homework problems and experiments.
- Final-Exam

In order to pass this course, you need 50% or higher on the Final-Exam grade and 50% or higher on the total grade, of the Final and Midterm Exams.

**Language of instruction:** English.
Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core HAV.
Prerequisites: Analog Circuit Analysis (T-306-RAS1), Mathematics III (T-301-MATH Stærðfræði III).
Schedule: Taught every day for three weeks.
Supervising teacher: Mohamed Abdelfattah.
Lecturer: Mohamed Abdelfattah.

Learning outcome:
- Students should learn the fundamentals of the frequency response in AC circuits, including resonance conditions. They should be able to analyze the transfer function, use bode plots and design frequency filters. They should understand the Laplace and Fourier transform methods and how to apply it for electric circuit analysis. They should be familiar with the concept of the two-port network and how to propose and determine the suitable parameters for analyzing different networks connections mainly series, parallel and cascaded connections.
- Students should be able to analyze, design and evaluate simple electric circuits. They should gain adequate experimental experience and skills of using computer programming and simulation to analyze and design simple circuits.
- Students' individual skills are expected to be improved by using individual assignments and projects. On the other hand, their group work experience is expected to be developed by using group discussions and tasks and presenting their work.

Content:
- Frequency response; transfer function and frequency filters
- Laplace transform and the inverse Laplace transform; definition and properties.
- Laplace transform applications in electric circuit analysis.
- Fourier series; definition and properties.
- Fourier transform and the inverse Fourier transform, and concept of applying Fourier series to circuit analysis.
- Two-port networks; the relationship between input and output currents and voltages, network parameters and different combinations of networks connections.

Reading material:
- Lectures slides and Experiments manual

Teaching and learning activities:
- Lectures; for the presentation of the fundamentals and theory.
- Exercises/problem solving; for the development of the analytical engineering skills.
- Group discussions; for thinking, brainstorming and understanding.
- Computer simulations; for the investigation of the behavior of the circuits.
- Group work presentations; for supporting the knowledge exchange and team work skills.
- Individual projects; for the development of the self-learning and individual skills.
- Workbook; every day record of work done, completed and planned.

Assessment methods:
- Experiments (group work)
- Projects (group work)
- Assignments (individual task)
- Examination (written, oral and/or on-line)
- Workbook (every day record of work done, completed and planned)

N.B. The active participation is mandatory.

Language of instruction: English
T-206 LIFE  PHYSIOLOGY I  6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core HEV.
Prerequisites: Molecular and Cell Biology (T-106-LIFV)
Schedule: Runs for 12 weeks – 4 lectures and 2 practical lab sessions per week.
Supervising teacher: Karl Ægir Karlsson.
Lecturer: Björg Porleifsdóttir, Atli Jósepsson, Logi Jónsson.

Learning outcome: The primary goal of the course is to prepare the student for further studies and eventually a career in the biomedical sciences.
By the end of the course the student should have acquired competence and skills in the following areas:
- Ability to recognize and to describe basic concepts in physiology, the structure and function of cells, tissues, organs and organ systems, and research methods and techniques.
- Ability to explain physiological processes.
- Ability to measure physiologic variables and analyze the results.
- Ability to interpret the results obtained by oneself and others in a critical manner.
- Ability to apply knowledge of physiology in formulating hypotheses that can be tested experimentally.
- Ability to discuss and present one’s point of view with references to published results, and to be able to distinguish between facts and conclusions.
- Ability to participate actively in working groups engaged in solving physiological practica

Content: Taught in icelandic. Lectures, seminars and laboratory hours are held according to a time table presented at the beginning of each term.
Laboratory hours: 1) Bioelectrical recordings (EMG and EEG), 2) Muscles, 3) Electrocardiography (ECG). All laboratory exercises are compulsory. The grade from the course is combined marks from the final exam (50%), laboratories/reports (30%) and average grade of the best three out of four tests during the course (20%).

Reading material: D.U Silverthorn, Human physiology: An Intergrated Approach.
Teaching and learning activities: Lectures, sections and labs.
Assessment methods: A final examination at the end of the term, which has to be passed with a minimum grade 5.0. It constitutes 50% of the final mark.
Lab exercises have to be passed with a minimum grade of 5.0. It constitutes 30% of the final mark.
If both above mentioned parts are passed, online projects and other assignments are evaluated and then included in the final marks. It constitutes 20% of the final mark.
Should there be a change in the above mentioned assessments students will be informed at the beginning of the course.
Language of instruction: Icelandic.
T-316-LABB  MEASUREMENT SYSTEMS  6 ECTS

Year of study:  Second year.
Semester:  Fall.
Level of course:  First cycle, intermediate.
Type of course:  Core ME.
Prerequisites:  Physics I (T-102-EDL1), Statics and mechanics of materials (T-106-BURD), Classical dynamics (T-534-AFLF).
Schedule:  Taught every day for three weeks.
Supervising teacher:  Árman Gylfason.
Lecturer:  Yonatan Afework Tesfahunegn.

Learning outcome:

Knowledge: After completing this course the students will have knowledge on:
- Principles of operation of commonly-encountered transducers
- Uncertainty analysis
- Sampling and spectral analysis
- Data acquisition systems

Skills: After completion of this course the students will have skills on:
- Confidently encounter a sensor or experimental system for the first time
- Planning and executing experiments
- Designing experiments
- Report writing

Content: This course introduces the essential general characteristics of measuring devices, data acquisition systems, uncertainty analysis, on how to use uncertainty analysis as a tool to design experiments, and sampling and spectral analysis. Planning and executing experiments, and report writing are also covered.

Reading material:

Teaching and learning activities: Mini-labs, workshops, and experiments.

Assessment methods:
- Mini-labs  25%
- Experiment 1 report  30%
- Experiment 2 design talk  45%

Language of instruction: English
T-316-STA   DIGITAL ELECTRONICS       6 ECTS

Year of study:        Second year.
Semester:             Fall.
Level of course:      First cycle, intermediate.
Type of course:       Core HEV.
Prerequisites:        Calculus I (T-101-STA1), Physics I (T-102-EDL1), Linear Algebra (T-211-LINA), Analog Circuit Analysis (T-306-RAS1).
Schedule:             Taught every day for three weeks.
Supervising teacher:  Paolo Gargiulo.
Lecturer:             Paolo Gargiulo.

Learning outcome: At the end of the course students should be able to:
• Explain and manipulate the representation of numbers in binary form and other codes e.g. signed forms of binary, hexadecimal.
• Describe basic digital logic components and use and/or interpret their representation in truth tables.
• Move between and make use of the different representations of digital circuits: truth tables, circuit diagrams and logical word descriptions.
• Explain ways of transmitting and storing data, especially the concepts of computer buses and addressing and multiplexing/de-multiplexing.
• Explain the operation of simple sequential circuits, including counters and shift registers.
• Use laboratory equipment such as power supplies, digital components, cables, oscilloscopes.
• Build and test simple digital circuits.
• Understanding the importance of digital electronics in medical device

Content: This course it is an introduction to digital electronics with link to Biomedical engineering applications. It covers combinational and sequential logic circuits. Topics include number systems, Boolean algebra, logic families, medium scale integration (MSI) and large scale integration (LSI) circuits, analog to digital (AD) and digital to analog (DA) conversion, and other related topics such as applications in Medical devices.

Reading material:
Teaching and learning activities: Lectures, projects and practical exercises.
Assessment methods: The course assessment is based on the practical exercises that will be performed in the electrotechnical lab (40-50%) and a final exam based on questions with multiple answers (50-60%)
Language of instruction: English
### T-301-MATH

**MATHEMATICS III**

<table>
<thead>
<tr>
<th>Year of study:</th>
<th>Second year.</th>
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<tbody>
<tr>
<td>Semester:</td>
<td>Fall.</td>
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<tr>
<td>Level of course:</td>
<td>First cycle, intermediate.</td>
</tr>
<tr>
<td>Type of course:</td>
<td>Core.</td>
</tr>
<tr>
<td>Prerequisites:</td>
<td>Calculus I (T-101-STA1), Calculus II (T-201-STA2). Linear Algebra (T-211-LINA) is advised.</td>
</tr>
<tr>
<td>Schedule:</td>
<td>Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.</td>
</tr>
<tr>
<td>Supervising teacher:</td>
<td>Ingunn Gunnarsdóttir.</td>
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<tr>
<td>Lecturer:</td>
<td>Ingunn Gunnarsdóttir.</td>
</tr>
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</table>

**Learning outcome:** On completion of the course students should:

**Knowledge:**

- Know the term general solution to a differential equation and particular solution to an Initial Value Problem (I.V.P.)
- Know differential equations with separable variables.
- Know 1. order linear differential equations.
- Know exact differential equations and integrating factors.
- Know homogeneous differential equations and the Bernoulli equation.
- Know a fundamental set of solutions of a second order differential equation with constant coefficients and know how to calculate a Wronski determinant.
- Know the method of undermined coefficients and the method of variation of parameters.
- Know the Laplace transform and how to use it to solve a I.V.P.
- Know the Heaviside function and the Dirac delta function.
- Know power series solutions of a I.V.P.
- Know Fourier series, Fourier Sine Series and Fourier Cosine Series.
- Be acquainted with the Fourier transform.
- Know 1. order system of linear differential equations.
- Be acquainted with how to find a real-valued solution to Systems of Linear First-Order Differential equations.
- Be acquainted with how to change a n-th order differential equation to a first order system of linear equations.
- Be acquainted with partial differential equations, e.g. the wave equation and the heat equation.

**Skills:**

- Be able to find a solution to a differential equation with separable variables.
- Be able to find a solution to a first order linear differential equation.
- Be able to find a solution to an exact differential equation and find integrating factors.
- Be able to use a change of variables to solve homogeneous differential equations and the Bernoulli equation.
- Be able to determine which method above is suited to solve a first order differential equation.
- Be able to find a fundamental set of solutions of a second order differential equation with constant coefficients.
- Be able to use a Wronski determinant to determine if two solutions are linearly independent.
- Be able to use the method of undermined coefficients and the method of variation of parameters.
- Be able to solve I.V.P. using the Laplace transform, including I.V.P. with the Heaviside function and the Delta dirac function.
- Be able to find a solution to an I.V.P. using the Laplace-transform. Including problems with Heaviside functions and the Dirac Delta function.
- Be able to find a power series solution to an I.V.P.
- Be able to find a functions Fourier Series, Fourier Cosine Series and Fourier Sine Series.
- Be able to find a functions Fourier transform.
- Be able to find a real-valued solutions to systems of linear first-order differential equations.
- Be able to change a n-th order differential equation to a first-order system of differential equations.
- Be able to solve partial differential equations, e.g. the heat equation and the wave equation.
Abilities:

- Be able to use mathematical symbols and reasoning to present a solution in a clear and precise manner.
- Be familiar with the role of differential equations in solving problems in engineering.


Teaching and learning activities: Lectures and problem solving sessions.

Assessment methods: Written final exam 70%, homework assignments 10%, test 10% (best out of two) and a presentation of a practical use of a differential equation 10% (more info in MySchool). The student must pass the written final exam to pass the course. The lowest homework assignment grade will not be counted in the final grade. In the tests and final exam the student can use a calculator. TI-nspire CAS (or cx CAS) calculators need to be in Press-To-Test mode. The students can bring 3 formula sheets to the test and the final exam, of size A4. Each student should make their own formula sheet.

Language of instruction: Icelandic.
Year of study: Second year/third year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core RV, FV (2nd year); Core HÁV, VV, HEV (3rd year).
Prerequisites: Calculus I (T-101-STA1).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.
Supervising teacher: Sigurður Freyr Hafstein.
Lecturer: Ólafur Birgir Davíðsson.

Learning outcome: On completion of the course students should:

Knowledge
The students will know:
• basics of probability and statistics
• samples and random variables
• joint distributions
• error propagation
• most common probability distributions and the processes they model
• Central Limit Theorem
• confidence intervals
• hypothesis testing

Skills
The students will learn to:
• put down simple statistical experiments and interpret the results
• find out whether distributions are dependent or independent
• compute error propagation
• decide which probability distribution is appropriate to describe the data at hand
• compute confidence intervals for different distributions
• use hypothesis testing to reject hypothesis in different contexts

Content: Collection, analysis and presentation of data. Population, sample and description of data. Probability and probability distributions. The central limit theorem. Confidence intervals. Hypothesis testing. Correlation and regression. Information theory. Data and projects will be selected based on the students’ field of study.

Reading material: Navidi, Statistics for Engineers and Scientists.
Teaching and learning activities: Lectures, practical sessions and projects.
Assessment methods: Homework 20% and final exam 80%. Students need a grade of at least 5 in the final to pass as well as a total grade of 5.
Language of instruction: Icelandic.
Year of study: Second year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core FV.
Prerequisites: Calculus I (T-101-STA1), Introduction to Financial Engineering (T-101-INNF).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.
Supervising teacher: Sverrir Ólafsson.
Lecturer: Bjarki Andrew Brynjarsisson, Viðar Ingason.

Learning outcome: Following this course the student will have fundamental understanding of the most common types of securities and the main methods used for valuation and risk analysis. Also the student will gain good understanding of different methods to compare investment options and use of optimization tools for selecting the best investment choices. Finally, the student will gain good understanding of the balance between risk and reward in portfolios of securities and obtain the knowledge to use mathematical methods to define portfolios with given boundary conditions.

This learning outcome can be broken down into the following sub-outcomes:

• Understand the basic concepts and methods of valuation of the most common types of securities (not including options) and investment options.
• Selection of best investment opportunity by applying integer optimization.
• Understand the concepts of interest rates, yield curves, forward rates and the interaction of the same.
• Understand the concept of duration of cash flow series.
• Have knowledge of and capability to use the Markowitz model to define securities portfolios.
• Be able to apply the method of Lagrange to find portfolios with pre-defined boundary conditions.
• Understand the interplay between risk and reward and be able to plot and explain the efficient frontier as the best possible solution.
• Know and apply the CAPM model to value investment opportunities.
• Know the main types of options.
• Know the main methods to stress test financial institutes.

Conclude a significant project where the above items are utilized to solve applied problems.

Content: The course will introduce main types of securities, i.e. equities, bonds, currencies and derivatives. The function of stock exchanges and stock trading will be explained.

Reading material: David Luenberger, Investment Science.
Teaching and learning activities: Lectures and problem solving sessions.
Assessment methods: Projects (30%), mid-term exam (10%), final exam (60%)
Language of instruction: Icelandic.
T-208-FOR2 PROGRAMMING FOR ENGINEERING 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Runs for 12 weeks - 4 lectures and 2 problem solving classes each week. Additionally, a weekly support class is offered as a part of the course.

Supervising teacher: Eyjólfur Ingi Ásgeirsson.
Lecturer: Eyjólfur Ingi Ásgeirsson.

Learning outcome: On completing the course, students should be able to:
• Analyse and explain the behaviour of simple programs involving the fundamental programming constructs covered by this unit.
• Modify and expand short programs that use standard conditional and iterative control structures and functions.
• Design, implement, test, and debug a program that uses each of the following fundamental programming constructs: basic computation, simple I/O, standard conditional and iterative structures, and the definition of functions.
• Choose appropriate conditional and iteration constructs for a given programming task.
• Apply the techniques of structured (functional) decomposition to break a program into smaller pieces.
• Describe the mechanics of parameter passing.
• Discuss the importance of algorithms in the problem-solving process.
• Identify the necessary properties of good algorithms.
• Create algorithms for solving simple problems.
• Use pseudo code to analyse simple problems.
• Use programming language to implement, test, and debug algorithms for solving simple problems.
• Describe strategies that are useful in debugging.
• Discuss the representation and use of primitive data types and built-in data structures.
• Write programs that use each of the following data structures: arrays, records, strings.

Content: T-208-FOR2 is a basic programming course. The student will be able to write simple programs, using basic programming techniques. Material covered: Software development tools, compiling, linking, interpreted languages. Input and output statements, type of variables, type casting. Control statements i.e. if statements, switch statements and loops. Arrays, strings and string processing. Static functions, dividing functions. Debugging and using debuggers. The course will be taught mostly in Icelandic. Non-Icelandic speaking students will receive course material and tutorial sessions in English.

Reading material: Walter Savitch, Problem Solving with C++.
Teaching and learning activities: Lectures and problem solving sessions.
Assessment methods: Final exam: 50-60%, mid-term exams: 20%, larger assignments: 20%, smaller assignments: 10% (only considered if the average grade from these assignments pulls up the student’s average grade for the course).
Note: The student is required to pass the final exam in order for the grades from the mid-term exams and assignments to be considered.
Language of instruction: Icelandic.
Courses taught in 2\textsuperscript{nd} year, 4\textsuperscript{th} semester - Spring semester

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<tr>
<th>T-403-ADGE</th>
<th>OPERATION RESEARCH</th>
<th>6 ECTS</th>
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<tr>
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<td>Semester:</td>
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<td>Level of course:</td>
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<td>Type of course:</td>
<td>Core FV, RV.</td>
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<tr>
<td>Prerequisites:</td>
<td>Calculus I (T-101-STA1), Statistics I (T-302-TOLF).</td>
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<tr>
<td>Schedule:</td>
<td>Runs for 12 weeks – 4 lectures and 2 practical classes each week.</td>
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<tr>
<td>Supervising teacher:</td>
<td>Hlynur Stefánsson.</td>
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<tr>
<td>Lecturer:</td>
<td>Drífa Pórarinsdóttir.</td>
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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 capable of:

- Using standardized processes to work on complex decision problems
- Applying systematic methods and algorithms for analysing and solving decision problems
- Understand how to use data and quantitative methods for decision making
- Understand the importance and usefulness of linear optimization and its applications
- Applying commercial software to solve optimization models with particular emphasis on MS Excel and MPL
- Solving optimization models with Simplex method
- Understand the use of sensitivity analysis
- Understand integer programming and how it can be used in decision making
- Identify traditional transportation and distribution problems and be able to solve problems with the relevant methods
- Understand the special properties of network models
- Formulate and solve network models from practical problems
- Apply methods from decision science to solve simple practical problems
- Present results in a clear and organized manner

Content: Introduction to standard Operations Research methods. Linear programming and sensitivity analysis, integer programming, dynamic programming, queuing theory, scheduling, networks. Using software for modelling and optimisation Taught mostly in Icelandic. Non-Icelandic speaking students will receive course material and tutorial sessions in English.

Reading material: Hillier & Lieberman, \textit{Introduction to Operation Research}.

Teaching and learning activities: Lectures and problem solving classes.

Assessment methods: 

Language of instruction: Icelandic.
T-407-EFNI MATERIALS SCIENCE 6 ECTS

Year of study: 2nd / 3rd year.
Semester: Spring.
Level of course: First cycle (Introductory).
Type of course: Mandatory for VV and HÁV.
Prerequisites: Chemistry T-204-EFNA
Schedule: Runs for 12 weeks – 4 lectures and 2 problem-solving classes each week. Weekly homework.
Supervising teacher: Halldór G. Ssvavarsson.
Lecturer: Þröstur Guðmundsson.

Learning outcome: On completion of this course, the student should:

- know the main crystal lattice systems and their relations to the electrical and mechanical properties of solids
  - Miller indices system
- be able to describe the main characteristics and materials properties of polymers, ceramics, metals and composites
- know the basic production steps of iron, steel and aluminum, polymers and ceramics
- know the basic forming and casting methods of metals, polymers and ceramics
- know the main methods use for measuring mechanical properties
- be familiar with solid state diffusion
- be able to analyze and identify corrosion of metals and alloys
- be able to identify phases and phase compositions from binary phase diagram
- know the main concepts of nanotechnology
  - nanolithography
- be familiar with the electrical and electronic properties of semiconductors.
  - carrier concentration
  - carrier’s mobility
  - electrical conductivity/resistance
  - activation energy
- understand the principles of electronic microscope (SEM), atomic force microscope (AFM) and X-ray diffraction (XRD)

Chemistry T-204 EFNA is a recommended prerequisite

Content: The fundamentals of the properties and structure of materials utilized in the practice of engineering are presented. The groups of materials studied include metals and alloys, ceramics, polymers and multiphase systems. Theoretical basis is given for the understanding of the behavior of materials where their electrical, mechanical, thermal and chemical properties are related to their molecular and crystalline structure. A brief introduction to biomedical applications is given. Methods for analyzing and testing of materials’ properties are studied as well as the methods used for controlling them, e.g. heat treatment, grain refinement and alloying. Corrosion and its prevention are studied and an introduction to binary and ternary phase diagrams is given. An insight into Micro-Electro-Mechanical Systems (MEMS) and nano-systems is also provided.

Reading Materials: William F. Smith and Javad Hashemi, Foundation of Materials Science and Engineering

Assessment methods: 3 hours written final exam (weights 60% in the final grade), one laboratory training (weighs 20% in the final grade), weekly homework (weights 10% in the final grade) and two pop quiz (the higher of the two grades weights 10% in the final grade). A minimum grade of 5.0 is required in the final exam.

Language of instruction: Icelandic
Year of study: Second year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Core FV.
Prerequisites: Calculus I (T-101-STA1), Calculus II (T-201-STA2), Statistics I (T-302-TOLF)
Schedule: Runs for 12 weeks - 6 teaching hours each week.
Supervising teacher: Sverrir Ólafsson.
Lecturer: Örvar Snær Óskarsson.

Learning outcome: At the end of the course we expect the students to have a good understanding of basic concepts in probability and stochastic processes and how these find applications in various areas of engineering. They will be able to work with probability densities, cumulative distribution functions and expectation values. Also, they will appreciate the importance of variances and co-variances particularly in the analysis of data presented in terms of time series. Students will learn to work with sums of random variables and functions of random variables and be able to construct their distribution functions from the input variables.

Students will learn the connections between stochastic processes, such as Brownian motion and Itô processes and the corresponding partial differential equations such as the diffusion equation and the Fokker Planck equation. Further topics will include Markov processes and queueing theory. The learning outcome can be broken down into the following sub-outcomes:

- Appreciate the role of probability and stochastic processes in engineering
- Understand and be able to apply distribution functions to engineering applications
- Be able to estimate the probability of defined occurrences from given distribution functions
- Be able to calculate expectation values, variances and co-variances
- Understand how to estimate the distribution of a sum of random variables, given the distributions of the basic random variables
- Be able to work out the distribution of functions of random variables, given the distributions of the input random variables
- Be able to apply simple queueing models to realistic commercial and engineering situations
- Appreciate the applicability of random walks to financial engineering and decision making processes
- Understand the connection between stochastic processes and differential equations in various engineering frameworks

Content: The goal of this course is to introduce students to various important concepts in probability and stochastic processes. Starting with probability spaces we move on to various discrete distributions such as binomial and Poisson distributions as well as continuous ones including the exponential, normal and log-normal distributions. Expectations, variance and covariance will be discussed and applied to various relevant cases. We will emphasize the importance of moment generating functions and their application to various practical calculations. Basic stochastic processes such as Poisson and Wiener processes will be introduced with some relevant applications. There will be a brief discussion of the connection between stochastic processes and partial differential equations with applications to financial engineering.

Most numerical calculations and simulations presented during the course will be done in Excel and/or Matlab.

Reading material: Sheldon Ross, A First Course in Probability, Z Brzeźniak and T Zastawniak, Basic Stochastic Processes

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: Icelandic/English.
**T-609-LAEL**  **MEDICAL IMAGING**  **6 ECTS**

**Year of study:** 2nd year / 3rd year.

**Semester:** Spring.

**Level of course:** First cycle, advanced.

**Type of course:** Mandatory for students in biomedical engineering.

**Prerequisites:** Practical Programming (AT FOR1003), Signal Processing (T-306-MERK), Physics III (T-307-HEIL).

**Schedule:** Runs for 12 weeks - 6 teaching hours each week.

**Supervising teacher:** Haraldur Auðunsson.

**Lecturer:** Haraldur Auðunsson, Valdís Guðmundsdóttir, Jónína Guðjónsdóttir.

**Learning outcome:** At the end of the course students should:

- be able to describe the elements of an digital image, size and depth, both greyscale and color, and most common formats like jpeg and dicom.
- be able to describe adjustments of brightness and contrast, spatial filtering and frequency filtering of digital images, and use them effectively
- know the most common modalities in medical imaging, i.e radiography, x-ray computed tomography, magnetic resonance imaging, ultrasonic imaging and nuclear medicine imaging, and explain the basic physical principles underlying each modality.
- explain the main principles of image reconstruction used in computed tomography
- understand the importance of radiation safety and list some of the methods used to reduce radiation.
- be aware of some new emerging modalities and been introduced to an imaging department or clinic.

**Content:** This medical imaging course will cover medical imaging instrumentations for different imaging modalities and the underlying physics: digital image analysis, radiography and X-ray computed tomography, nuclear medicine imaging, magnetic resonance imaging, ultrasonic imaging, other types of imaging and multi-modal imaging. At the beginning of the course basic digital imaging processing will be reviewed.

**Reading material:** Paul Suetens, *Fundamentals of Medical Imaging*.

**Teaching and learning activities:** Lectures, problem oriented classes, projects and visits to medical imaging sites.

**Assessment methods:** The final grade is based on exams during the semester, project and home work. There will be no final exam.

More detailed description will be given when the class starts.

**Language of instruction:** Icelandic.
T-306-MERK  SIGNAL PROCESSING  6 ECTS

Year of study:  Second year.
Semester:  Spring.
Level of course:  First cycle, intermediate.
Type of course:  Core HEV, HÁV.
Prerequisites:  Practical programming (AT FOR 1003), Analog Circuit Analysis (T-306-RAS1), Calculus III (T-301-MATH).
Schedule:  Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. 5-6 practical lab sessions during the semester.
Supervising teacher:  Jón Guðnason.
Lecturer:  Jón Guðnason.

Learning outcome:
Knowledge:
After the course the students should be able to recall, describe and define the following terms:

Skills:
After the course the students should be able to apply and implement signal processing methods to real world engineering problems using standard software packages like Matlab or Python.

Compentence:
After the course the students should be able to interpret physical systems signal processing

Content:

Reading material:  Oppenheim, Willsky og Nawab, Signals and Systems.
Teaching and learning activities:
Assessment methods:
Language of instruction:  Icelandic.
<table>
<thead>
<tr>
<th><strong>T-509-RAFT</strong></th>
<th><strong>ELECTRONICS</strong></th>
<th><strong>6 ECTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year of study:</strong></td>
<td>Second year.</td>
<td></td>
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<tr>
<td><strong>Semester:</strong></td>
<td>Spring.</td>
<td></td>
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<tr>
<td><strong>Level of course:</strong></td>
<td>First cycle, intermediate.</td>
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<tr>
<td><strong>Type of course:</strong></td>
<td>Core HEV, HÀV.</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>Analog Circuit Analysis (T-306-RAS1).</td>
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<tr>
<td><strong>Schedule:</strong></td>
<td>Runs for 12 weeks – 4 lectures + 2 hours of problem solving sessions per week, as well as 2 lab sessions during the semester.</td>
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<tr>
<td><strong>Supervising teacher:</strong></td>
<td>Slawomir Koziel.</td>
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<tr>
<td><strong>Lecturer:</strong></td>
<td>Slawomir Koziel.</td>
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</table>

**Learning outcome:** On completion of the course students should:
- understand the operation of basic electronic devices, including diodes, transistors and operational amplifiers.
- be able to analyze and design elementary transistor stages.
- be familiar with the concept, parameters and design of basic types of analog circuits including amplifiers, converters and filters.


**Reading material:** A.S Sedra, K.C Smith, *Microelectronics Circuits*.

**Teaching and learning activities:** Lectures, and practical sessions.

**Assessment methods:** Lectures and practical sessions. 4 lectures and 2 problem solving sessions per week for 12 weeks. 2x2 hours experimental work during the term. Grades are based on the following criteria: 1. Assignments (10%); 2. Laboratory exercises (10%); 3. Homeworks (10%); 4. Quizzes (10%); 5. Midterm exam (20%); 6. Final exam (40%). Attendance of the laboratory sessions is mandatory, absence automatically result in grade zero for the laboratory part of the final grade.

**Language of instruction:** English.
<table>
<thead>
<tr>
<th><strong>T-106-BURD</strong></th>
<th><strong>STATICS AND MECHANICS OF MATERIALS</strong></th>
<th><strong>6 ECTS</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Year of study:</strong></td>
<td>First year/second year.</td>
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<tr>
<td><strong>Semester:</strong></td>
<td>Spring.</td>
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<tr>
<td><strong>Level of course:</strong></td>
<td>First cycle, introductory.</td>
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<tr>
<td><strong>Type of course:</strong></td>
<td>Core HAV, VV (1st year); Core HEV (2nd year).</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>Calculus I (T-101-STA1), Physics I (T-102-EDL1).</td>
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<tr>
<td><strong>Schedule:</strong></td>
<td>Runs for 12 weeks – 6 lectures per week.</td>
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<tr>
<td><strong>Supervising teacher:</strong></td>
<td>Ármann Gylfason.</td>
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<tr>
<td><strong>Lecturer:</strong></td>
<td>Benedikt Helgason og Ármann Gylfason.</td>
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</table>

**Learning outcome:** Students will gain knowledge of the relationship between static loads of simple structures and the resulting stress and strains as well as the relation between stress and strains in common materials. Main emphasis is on the student’s competence in performing equilibrium calculations of structures and their analysis according to traditional beam theories. Students will gain skills in evaluating reaction forces, internal forces, stresses, strains and deflections of simple structures such as columns, beams and axles under axial loads, torsional loads and point or distributed normal loads. Student will gain basic skills in aspects of machining, in using manual lathe and mill, as well as gaining basic knowledge of strain gauges and their use.

**Content:** Course content: Forces and moments, equilibrium of forces and moments, composite structures; stresses and strains; material behavior; 2D and 3D stress and strain analysis and Mohr circle; deformation due to forces and moments, torsion and bending moments, axial and shear forces; deflection of beams; statically determinate and indeterminate structures, buckling.

**Prerequisites:** Calculus 1 T-101-STA1 og Physics 1 T-101-EDL1 or comparable.

**Reading material:** J. M Gere, B.J Goodno, *Mechanics of Materials*.

**Teaching and learning activities:** Lectures, sections and labs.

**Assessment methods:** Exam 40%, preliminary exams 30%, labs 30%. Three preliminary exams will be held during the semester, of which two with the highest grades will be counted towards the final grade. (There are no make-up exams) (the exams are held in lectures).

The students must participate in all laboratory assignments to complete the course - timing advertised later. Four homework assignments during the semester. Students must return three to complete the course.

The final exam and the preliminary exams are in closed book - closed notes format. The Teacher provides a sheet with formulas. A simple calculator is allowed, Casio Fx350. A minimum grade of 4.75 in the exam is required for other factors to count in for final grade.

**Language of instruction:** Icelandic.
T-406-TOLU NUMERICAL ANALYSIS 6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Core.
Prerequisites: Practical Programming (AT FOR1003), Calculus I (T-101-STA1), Calculus II (T-201-STA2), Calculus III (T-301-MATH). Linear Algebra (T-211-LINA) is advised.
Schedule: Runs for 12 weeks - 4 lectures and 2 problem solving classes each week.
Supervising teacher: Gunnar Þorgilsson.
Lecturer: Gunnar Þorgilsson.

Learning outcome:
Knowledge and understanding
On completion of the course the student should know:
• the fundamental concepts of numerical analysis,
• approximations, error estimation, and the order of approximations,
• numerical solutions of equations and optimization,
• solutions of linear and nonlinear systems of equations,
• matrix factorization, e.g. PLU-factorization,
• polynomial interpolation and linear regression,
• numerical approximations of differentiation and integration,
• numerical solutions of initial- and boundary value problems for ordinary differential equations with discretization,
• the basic concepts of the finite element method for solving differential equations.

Skills
On completion of the course the student should be able to:
• make algorithms that approximate solutions for simple mathematical problems,
• program and implement algorithms on computers,
• estimate the error of the approximations made with numerical methods,
• estimate the amount of time needed to complete numerical algorithms.

Abilities
On completion of the course the student should:
• be able to use numerical methods to solve problems in mathematics and engineering,
• be familiar with the role of numerical analysis in solving problems in engineering.

Content: The fundamental concepts of numerical analysis and their applications will be covered. Topics will e.g. be approximations and estimation of error. Methods to approximate numerical solutions of equations and find minimum of functions. Solutions of linear and nonlinear systems of equations, e.g. with PLU-factorization. Methods to make polynomial interpolation. Linear regression analysis for sets of data. Methods to approximate differentiation and integration. Approximations of solutions for initial- and boundary value problems for ordinary differential equations and the basic concepts of the finite element method for solving differential equations.
Taught mostly in Icelandic. Non-Icelandic speaking students will receive course material and tutorial sessions in English.

Reading material: Timothy Sauer, Numerical Analysis.
Teaching and learning activities: Lectures and problem solving classes. Hand-in assignments.
Assessment methods: The final grade will consist of:
8 homework problems that accounts for 10%,
3 large projects that accounts for 40%,
1 final exam that accounts for 50%.
The final exam must be past to pass to the course.
The final exam is not open book. The student can bring a Casio Fx-350/570 calculator.

Language of instruction: Icelandic.
Year of study: Second year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core VV, recommended elective HÁV.
Prerequisites: Calculus I (T-101-STA1), Physics I (T-102-EDL1).
Schedule: Runs for 12 weeks - 4 lectures and 4 problem solving classes each week.
Supervising teacher: Ágúst Valfells.
Lecturer: Ágúst Valfells.

Learning outcome: Upon completion of the course students should have:
• a good understanding of the fundamental concepts of thermodynamics.
• the ability to apply the laws of thermodynamics to practical problems.

Content: Introduction to the fundamental concepts of engineering thermodynamics: State, temperature, etc. The first law of thermodynamics, work, heat, efficiency. Properties of pure substances, phase change, ideal gas, real gas, equations of state. Thermodynamic analysis of open and closed systems e.g. turbines and heat exchangers. Second law and its applications. Reversible and irreversible processes, Carnot cycle etc. Entropy, the Clausius inequality and the third law. Exergy and its applications for analysis.

Reading material: Yunus A. Cengel, Michael A. Boles, Thermodynamics: An engineering approach.

Teaching and learning activities: Lectures, and practical sessions.

Assessment methods:
Projects 20%. Two 4-in-a-group will be handed in. In addition students shall solve and explain one homework problem to fellow students.
Mid-term exams 2x15%. Three exams will be given, only two will count towards final grade. Make up exams will not be offered. Details given later.
Final Exam 50%. Three hours. Students must pass final exam (4.75/10) to receive a passing grade for the course. Note, students may pass final, but still fail the course (4.75/10) due to mid-term exams and projects.
The plan is to allow only the text book and a calculator in all exams.

Language of instruction: Icelandic.
PROJECT MANAGEMENT 6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Runs for 3 weeks.
Supervising teacher: Hera Grímsdóttir
Lecturer: Hera Grímsdóttir.

Learning outcome: On completion of the course students should be able to:
• Manage projects and use different tools of project management.
• Understand the role of the project and project management.
• Understand the relationship between time, project characteristics and cost.
• Prepare and defined tasks.
• Break down the project into WBS.
• Make schedules regarding time, cost and resources.
• Monitor project progress.
• Make a formal project closure

Content:
Project management is the overall planning, control and coordination of a project, from inception to completion, aimed at meeting a client’s requirements in order that the project will be completed on time, within the authorized cost and to the required quality standards. This unit serves as an introduction to project management as a fundamental skill. It offers an overview of the framework, processes and key knowledge areas of project management.

The aim of this unit is to provide the key concepts and foundation knowledge in project management. Definition of projects, project lifetime, project schedule and progress as well as reporting will be taught.

Reading material: Gray & Larson, Project Management: The managerial process.
Teaching and learning activities: Lectures and practical sessions.
Assessment methods:
    Participation of 15%:
    Group assignments = 35%.
    Personalized placement tests = 50%

Note: Individual items may change

Language of instruction: Icelandic.
T-401-VELH  MACHINE ELEMENTS  6 ECTS

Year of study: Second/third year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core VV (2nd year); Core HÁV (3rd year).
Prerequisites: Introduction to Engineering Design (T-116-VERK (or AI TEI1001 and VI HON1001)), T-106-BURD, Classical Dynamics (T-534-AFLF).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. Laboratory experiments.
Supervising teacher: Maria S. Guðjónsdóttir.
Lecturer: Maria S. Guðjónsdóttir.

Learning outcome: A student who has met the objectives of the course will be able to:
- show skills in the design of machine components, and their analysis with respect to fixed and varied loads, as well as their performance, by applying the methods of mechanical engineering design as well as applying CAD analysis.
- perform lifetime and load analysis of bearings; force and power analysis of breaks and joints as well as selection criteria for contact materials.
- design belts and chain drives by from force and power requirements and selection from manufacturer specification.
- design systems of gears by load and gear ratio requirements; analysis of loads on shafts and bearings in gear systems based on power transfer.
- design coiled and leaf springs from constraints in deformation and strength;
- design welded joints and bolted joints under steady and variable load.

Content: Course contents include load- and stress analysis of beams, shafts, and plates; Common fracture and fatigue theories for mechanical components under steady and varying loads; Mechanical design of bolts, welds and springs; Analysis, design and life time of journal bearings and ball bearings; Mechanical components such as gears, chain and belt drives, breaks and couplings.

Reading material: Budynas and Nisbett, Shigley’s Mechanical Engineering Design, 10. edition.
Teaching and learning activities: Lectures, problem solving sessions and laboratories.
Assessment methods: Home assignments 10%, design project 20%, final exam 70%.
Language of instruction: Icelandic.
Courses taught in 3rd year, 5th semester - Fall semester

<table>
<thead>
<tr>
<th>T-603-AKVA</th>
<th>DECISION ANALYSIS FOR MANAGEMENT</th>
<th>6 ECTS</th>
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<tbody>
<tr>
<td>Year of study:</td>
<td>Third year.</td>
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<tr>
<td>Semester:</td>
<td>Fall.</td>
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<tr>
<td>Level of course:</td>
<td>First cycle, advanced.</td>
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<tr>
<td>Type of course:</td>
<td>Elective.</td>
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<tr>
<td>Prerequisites:</td>
<td>Statistics I (T-302-TOLF).</td>
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<tr>
<td>Schedule:</td>
<td>Runs for 12 weeks - 4 lectures and 2 problem solving classes each week.</td>
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<tr>
<td>Supervising teacher:</td>
<td>Þórður Vikingur Friðgeirsson.</td>
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<tr>
<td>Lecturer:</td>
<td>Þórður Vikingur Friðgeirsson.</td>
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</table>

Learning outcome:

**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:** 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, negation skills and authentic leadership.

**Reading material:** Goodwin & Wright, *Decision Analysis for Management Judgment (5ed).*

**Teaching and learning activities:**
The course is structured in lectures and exercise classes intended for academic exercises, case studies, teamwork and status exams.

**Assessment methods:**
Individual final exam 65%; Assignments/Status exams (3 * 15%), wo best results counts in the final grade; Class participation 5%.
Observe: assessment methods are under revision.

**Language of instruction:** English.
Learning outcome: At the end of this course students will have a deep understanding of the inner workings of corporations and will be able to assess their worth. This main objective can be broken down into the following:

- Understand the Balance sheet, income statement and cashflow statement and how each affects the others. By reading such statements the students should be able to understand the companies business and assess its current position.
- Be able to calculate a company's key statistics (e.g. P/E, P/B, EBITDA etc.), understand their informational value and limitation.
- Be able to compare two companies through key statistic measures and assess their standing against one another.
- Understand how the market a company operates in defines it and can complicate comparisons between companies in different segments.
- Generate an insightful projection of the future development of a company and by using present value calculations assess its worth.
- Understand what weighted average cost of capital (WACC) is and what it means. Be able to calculate what is the appropriate WACC of a company and understand how the combination of equity and debt influence it.
- Be able to calculate the cost of equity.
- Perform a sensitivity analysis of a company's present value result and in that way quickly see where the main risk of the wrong projection resides.

Content: Emphasis is on developing an understanding of corporate finance, financial markets and capital budgeting. Students will learn about the interaction between corporates and the financial markets, structuring of the balance sheet and account analysis, working capital management, valuation of capital and projects, stocks and bonds. The course will consist of lectures, homework and 1-2 larger projects.

Reading material: Robert Parrino, David Kidwell, Fundamentals of Corporate Finance.
Teaching and learning activities: Lectures and problem solving classes
Assessment methods:
Home assignments 10%
Midterm exam 10%
Group assignment 20%
Final exam 60%
A minimum grade of 5,0 for the final exam is required as well as an overall average of 5,0
Language of instruction: Icelandic
<table>
<thead>
<tr>
<th><strong>T-105-HAGF</strong></th>
<th><strong>ECONOMICS</strong></th>
<th><strong>6 ECTS</strong></th>
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<tbody>
<tr>
<td><strong>Year of study:</strong></td>
<td>Third year.</td>
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<tr>
<td><strong>Semester:</strong></td>
<td>Fall.</td>
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<tr>
<td><strong>Level of course:</strong></td>
<td>First cycle, introductory.</td>
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<tr>
<td><strong>Type of course:</strong></td>
<td>Core FV, RV.</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>No prerequisites.</td>
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<tr>
<td><strong>Schedule:</strong></td>
<td>Runs for 12 weeks – 6 lectures per week.</td>
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<tr>
<td><strong>Supervising teacher:</strong></td>
<td>Sverrir Ólafsson.</td>
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<tr>
<td><strong>Lecturer:</strong></td>
<td>Bolli Héðinsson.</td>
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</table>

**Learning outcome:** The course’s aim is to enhance the students understanding of economics and its widespread (often unnoticed) influence on our daily lives and business. The students should be capable of applying the methods of economic thinking to subjects in their other studies as well as in current and future practise.
- Understanding of the economic principles and how they interact
- The circular flow in the economy
- Knowing the factors of production and the production possibility frontier
- Comparative advantage, specialisation and absolute advantage
- Knowing what affects supply and demand
- The elasticises of supply and demand
- The causes of government interferences in the forces of supply and demand
- Consumer and producers’ surplus, deadweight loss
- Classification of private goods, public goods and common resources
- Classic descriptions of the types of cost, fixed, variable, average and marginal
- Different types of markets and its characteristics
- The theory of consumer choice, marginal rate of substitution and goods classification
- Governmental statistics, measure of domestic product, indexes, cost of living and the labour market
- The limits to growth and aspects of its development
- The foundations of the financial system

**Content:** Main principles from microeconomics and macroeconomics. National economics and price development, long term national product, economic growth and unemployment, money, money markets and inflation, availability and demand and the influence of economic control actions. Emphasis is on connecting the above to Icelandic circumstances.

The course will consist of lectures, homework and 1-2 larger projects.

**Reading material:** Mankiw & Taylor, *Economics*.

**Teaching and learning activities:** Lectures, class participation and assignments.

**Assessment methods:** Class participation (10%), mid-term exam (10%), project work (30%), final exam (50%)

**Language of instruction:** Icelandic.
Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core RV.
Prerequisites: Calculus I (T-101-STA1), Statistics I (T-302-TOLF), Probability and Stochastic Processes (T-606-PROB).
Schedule: 12 weeks, six lectures per week.
Supervising teacher: Páll Jensson.
Lecturer: Ágúst Þorbjörn Þorbjörnsson.

Learning outcome:
The focus of the course is discrete-event simulation using Simul8, a widely used simulation modeling language for a variety of application areas. We then look at Monte-Carlo simulation in Excel to clarify the advantages and limitations of simulation in a spreadsheet. Skills that should be acquired or developed include:

- Understand the discrete-event simulation process.
- Demonstrate a basic understanding of how simulation software computes its answers.
- Analyze a real situation, model it, and build a simulation model to test hypotheses.
- Define methods for validating and verifying a simulation model.
- Specify ways a computer can generate uniform and non-uniform random numbers.
- Awareness of problems that can cause bias in simulation models.
- Select statistical models from simulation input.
- Use statistical techniques to determine which of two simulated systems is better.

Content:
The focus of the course is to develop understanding of simulation concepts, and to clarify the advantages and limitations of simulation. We then look at discrete-event simulation using Simul8, a widely used simulation modeling language for a variety of application areas.

Reading material:
- Based on the standard simulation book Simulation Modeling and Analysis by Averill Law but buying the book is not required.
- In addition to above book by Law, other material such as:
  o Presentations on the internet.
  o Operations management books by Russel, Heizer, and more.
  o Statistics like books by Devore.

Teaching and learning activities:
Lectures, projects and problem solving classes.

Assessment methods:

<table>
<thead>
<tr>
<th>Components</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home assignments</td>
<td>30%</td>
</tr>
<tr>
<td>Mid-term exam</td>
<td>15%</td>
</tr>
<tr>
<td>Project</td>
<td>25%</td>
</tr>
<tr>
<td>Final exam</td>
<td>30%</td>
</tr>
</tbody>
</table>

Language of instruction: Icelandic.
CLINICAL ENGINEERING 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Prerequisites: Calculus III (T-301-MATH), Physics II (T-202-EDL2), Analog Circuit Analysis (T-306-RAS1), Physiology II (T-306-LIFE), Physics III (T-307-HEIL).
Schedule: Runs for 12 weeks - 6 lectures per week.
Supervising teacher: Paolo Gargiulo.
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.
Taught in English.

Reading material:
Teaching and learning activities: Lectures, projects, visits and exercises.
Assessment methods: Projects, lectures and intra class examinations.
Language of instruction: English.
T-561-LIFF  BIOMECHANICS  6 ECTS

Year of study:  Third year.
Semester:  Fall.
Level of course:  First cycle, advanced.
Type of course:  Elective.
Prerequisites:  Statics and Mechanics of Materials (T-106-BURD), Physics I (T-102-EDL1).
Schedule:  Runs for 12 weeks – 4 lectures, 2 problem solving sessions each week, also lab sessions.
Supervising teacher:  Magnús Kjartan Gíslason.
Lecturer:  Magnús Kjartan Gíslason.

Learning outcome:
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 behaves under loading.

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 determinate 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 structural 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 diseases will affect the biomechanics and how mechanical stability can be achieved using total joint arthroplasty or other surgical procedures.

Reading material:  Margareta Nordin, Victor Frankel, *Basic Biomechanics of the Musculoskeletal System.*
Teaching and learning activities:  Teaching will be delivered in lectures, problem sessions and laboratory sessions.
Assessment methods:  Coursework will account for 50% of the final mark and the final exam will account for 50%.
Language of instruction:  English.
T-411-MECH MECHATRONICS I 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core HAV.
Prerequisites: Practical Programming (AT FOR1003), Statics and Mechanics of Materials (T-106-BURD),
Calculus III (T-301-MATH), Electric Circuits (T-509-RAFT).
Schedule: Combination of lectures and practical lessons, 6 hours per week for 12 weeks.
Supervising teacher: Joseph Timothy Foley.
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
- Operate oscilloscopes and benchtop power-supplies
- Create schematics, layout PCB boards, and solder components to build working devices
- Program a microcontroller to read sensors and control actuators. For example: An Arduino with C++ or a Raspberry Pi with python
- Apply the Axiomatic Design methodology to analyze the interaction between different parts of the design.
- Understand digital and analog communication interfaces such as wireless networks
- Understand actuator and electronics specification sheets
- Record communication and data into a research notebook properly for international-quality research
- Write lab reports, device documentation, and simple conference papers
- See opportunities, not obstacles, when problems arise.

Content: This is an introduction to Mechatronics, the technique of interfacing software, electronics, and mechanical components. We will be utilizing the low-cost Arduino microcontroller platform as our method for sensing and control. Students will have pay a fee for their personal lab kit which includes some shared parts for team-based labs.

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 Altium to integrate the electronics being developed.

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.


Teaching and learning activities: 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. Non-verbal participation credit is gained through use of the course’s instant messaging client. 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 final project. The final project may be sponsored by an outside company or internal research, otherwise it will be paid for out of the student’s own funds. 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. 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 is the preferred format. Failure to include citations will result in a 0 for the assignment and considered plagiarism. 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. Assignments 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 will be applied. For LaTeX documents, the SVN/MySchool submission time of the source .tex files will be used to assess lateness. Always check the assignment for the appropriate submission procedure.

Whenever possible, the evaluation sheet for a given assignment will be provided before the start of the assignment. Reports may be resubmitted up to a week after they are returned for regrading. These grades will be averaged for the new grade (40%/60%). The previous report and grading sheet must be returned with a copy of the edited report.

**Language of instruction:** English.
Feedback Control Systems

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core HEV, HAV, VV.
Prerequisites: Practical Programming (AT FOR1003), Calculus III (T-301-MATH), Electric Circuits (T-509-RAFT).
Schedule: Runs for 12 weeks - 6 lectures each week, along with practical exercises.
Supervising teacher: Þorgeir Pálsson.
Lecturer: Rafn Camillusson.

Learning outcome: This course is designed to give the student a solid foundation in the theory and concepts of dynamic systems, the development of mathematical models for describing the workings of these systems and how these models are used for determining system behavior. The design of feed-back control systems is particularly well suited to achieving this objective as it calls for an in-depth understanding of system stability and how this is affected by the design of control signals. Having completed this course the student should have gained:

- Good understanding of the structure and characteristics of automatic control systems and how they satisfy operational requirements.
- Sound knowledge of the development of mathematical models of common control systems expressed as linear differential equations.
- Understanding of how these models are calibrated experimentally using measurements of system response.
- In-depth knowledge of system stability and the application of feed-back control to achieve satisfactory performance.
- Competence in the application of the most common methods and software (Matlab) for the design of feed-back control systems and the computation of standard system response.
- Understanding of how the representation of system characteristics in state-space provides new possibilities in the design of feed-back control systems and improved understanding of the behavior of dynamic systems.
- Understanding of how methods developed for continuous systems can be applied to digital (discrete) control systems controlled by computers.
- Capability for actively participating in the design of a control system under the supervision of an experienced control system designer.
- Solid understanding of linear feed-back systems that is necessary to undertake further studies in the analysis and design of complex dynamical systems with control systems that satisfy stated requirements.

Content: This course is a traditional first course on the subject of feed-back control systems. An introduction of the history and development of automatic control systems is given and the role of this technology in modern industry and operation of systems and processes explained. Mathematical models of systems of conventional type (single-input single-output) is given with emphasis on transfer functions and computer simulation of linear systems. Also: equations of motion in state-space formulation; characteristics of linear systems with feed-back; the transient response of systems and their response to external disturbances and internal variations of system characteristics. Performance of control systems and their evaluation by use of computer simulation with emphasis on systems of second and third degree. Stability of linear systems; application of the root-locus method to achieve desired system response and stability. PID controllers. Frequency domain methods with emphasis on the use of Bode and Nyquist graphs and their interpretation. Stability, band-width and other frequency response characteristics. Frequency design methods of feed-back control systems; lead-, lag, and lead-lag controllers and systems involving integration control. Introduction to the design of control systems in state-space, design of robust and digital control systems. Computational methods for the application of common methods for analysis and design are emphasised by use of Matlab, Simulink and toolboxes for control system design. Two laboratory projects are performed whereby mathematical models and design techniques are applied to the design of practical control systems meeting stated requirements. Also eight traditional homework assignments are completed.

Reading material: Dorf R.C & Bishop R.H, Modern Control Systems.
Teaching and learning activities: There are six classroom hours allocated to this course on a weekly basis for fourteen weeks. Normally two of these are used for lectures with one hour used for blackboard problem solving in order to demonstrate important principles. One to two classroom hours a week are set aside for solving textbook problems to augment homework assignments that are reviewed and discussed in these sessions. The number of problem solving sessions is increased towards the end of the term.
The lectures are delivered in the form of PowerPoint audio slides that are available to the students prior to the lectures allowing them to prepare for the classroom lectures that focus on the main aspects of the subject matter. The project assignments are performed by the students outside scheduled classroom hours. This also applies to the homework assignments that are turned in for grading purposes.

**Assessment methods:** Student performance in this course is evaluated as follows:
1. Final examination 60%
2. Special project 20%
3. Homework assignments 20%

There are two project assignments performed in this course as stated in the course schedule. The lab set-up is accessible through an internet connection from the student’s laptop. The first one consists of building a math model of a liquid tank with a PID controller for regulating its in-flow of water. Various trials and measurements are performed for this purpose and a suitable set of parameters is selected for the controller to maintain and change a set point. The second project consists of a speed control system for an electrical motor which will be demonstrated by the instructor in the classroom. The students turn in a comprehensive report on the first project and an summary report for the second one. The homework assignments that are turned in by the students are on the order of 8-10 during the semester including the classroom problems that are solved in special sessions 3-4 times during the semester. These assignments are evaluated by grading in a traditional manner. Additional problem solving sessions are held at the end of the semester.

**Language of instruction:** Icelandic.
Learning outcome: The students will get to know the fundamentals of fluid dynamics and its applications. At the end of the course the students have gained skills in analyzing simple fluid flows, make appropriate approximations and apply basic numerical methods to solve them. In particular, the students will:

- Be able to use and understand the fundamental conservation laws of physics in the context of fluid flows.
- Know the differences between flow of viscous and non-viscous fluids, and understand when the non-viscous approximations can be applied in real situations.
- Be able to apply the equations of fluid motions on simple flows, and make appropriate approximations, in flows such as boundary layers and pipe flows.
- Have skills in analyzing and solving engineering fluid flow problems in an organized manner, for example by presenting well rounded algebraic derivations in text, carry units systematically through analysis, and cross check consistency of solution by dimensional analysis.
- Be able to perform an experiment/measurement in an organized manner, understand the importance of holding a log book, analyze errors and uncertainties, and presenting the results in scientific form.
- Understand simple measurement systems in fluids, their limitations and errors.

Content: The course covers the fundamental concepts in fluid dynamics, properties of fluids, hydrostatics, fundamental laws of fluid dynamics in integral and differential form, Bernoulli’s equaiton, potential flow, solutions to the Navier-Stokes equation for simple viscous flows, dimensional analysis, pipe flow, boundary layer theory and compressible flows.

Reading material: F.M White, Fluid Mechanics.

Teaching and learning activities: Lectures, sections, and experiments.

Assessment methods: Grade is based on performance in homeworks (10%), labs (10%), preliminary examinations (50%), and in the final exam (30%).

Language of instruction: English/Icelandic.
T-302-TOLF  STATISTICS I  6 ECTS

Year of study: Second year/third year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core RV, FV (2nd year); Core HÁV, VV, HEV (3rd year).
Prerequisites: Calculus I (T-101-STA1).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.
Supervising teacher: Lecturer:

Learning outcome: On completion of the course students should:
Knowledge
The students will know:
• basics of probability and statistics
• samples and random variables
• joint distributions
• error propagation
• most common probability distributions and the processes they model
• Central Limit Theorem
• confidence intervals
• hypothesis testing
Skills
The students will learn to:
• put down simple statistical experiments and interpret the results
• find out whether distributions are dependent or independent
• compute error propagation
• decide which probability distribution is appropriate to describe the data at hand
• compute confidence intervals for different distributions
• use hypothesis testing to reject hypothesis in different contexts

Content: Collection, analysis and presentation of data. Population, sample and description of data. Probability and probability distributions. The central limit theorem. Confidence intervals. Hypothesis testing. Correlation and regression. Information theory. Data and projects will be selected based on the students’ field of study.

Reading material: Navidi, Statistics for Engineers and Scientists.
Teaching and learning activities: Lectures, practical sessions and projects.
Assessment methods: Homework 20% and final exam 80%. Students need a grade of at least 5 in the final to pass as well as a total grade of 5.
Language of instruction: Icelandic.
<table>
<thead>
<tr>
<th>Course Code: T-562-EMG1</th>
<th>Title: ELECTROMYOGRAPHY I</th>
<th>ECTS: 6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year of study:</strong></td>
<td>3rd year.</td>
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<tr>
<td><strong>Semester:</strong></td>
<td>Fall.</td>
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<tr>
<td><strong>Level of course:</strong></td>
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<tr>
<td><strong>Type of course:</strong></td>
<td>Elective.</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>None.</td>
<td></td>
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<tr>
<td><strong>Schedule:</strong></td>
<td>12 weeks, 6 runs for 12 weeks — 6 teaching hours a week, a combination of lectures and practical lessons.</td>
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</tr>
<tr>
<td><strong>Supervising teacher:</strong></td>
<td>Baldur Porgilsson.</td>
<td></td>
</tr>
<tr>
<td><strong>Lecturer:</strong></td>
<td>Baldur Porgilsson, Magnús Kjartan Gíslason.</td>
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</table>

**Learning outcome:** on completion of the course the student should  
- Know about and recognise the EMG signal  
- Be able to record EMG signal  
- Know most common methods for analysing EMG  
- Have basic understanding of human motion

**Content:**  
This is a basic interdisciplinary EMG course where students of sports science and engineering with different background work together to solve real problems. Mixed groups of complementary knowledge have broader background to solve more complex tasks. Topics covered: origin of EMG signal, recording of EMG, processing and interpretation of EMG. Specialists in human motion and experienced users of EMG explain human motion, application in practical situation. Each group selects a project theme and works on it the whole semester. Theoretical and practical sessions add background to complete the task. Examples of projects are: analysis of handball throw, analysis of running, controlling of prosthetic devices. The groups have a goal, they analyze, plan and execute measurements, deliver data, interpret the data and derive theories.

**Reading material:** Various articles from teachers.

**Teaching and learning activities:** Lectures, practical exercises, group project.

**Assessment methods:** Report 40%, presentation 20%, lab book 15%, video 20%, practical exercises 5%.

**Language of instruction:** Icelandic/English.
Courses taught in 3rd year, 6th semester - Spring semester

T-503-AFLE DERIVATIVES 6 ECTS

Year of study: Third year.
Level of course: First cycle, advanced.
Type of course: Core FV.
Prerequisites: Securities (T-303-VERD).
Schedule: Runs for 12 weeks - 6 teaching hours each week.
Supervising teacher: Sverrir Ólafsson.
Lecturer: Ottó Stefán Michelsen.

Learning outcome: At the end of this course the student will be able to price the main derivative products as well as how to use these products for speculation or hedging. This main goal can be broken down into the following sub goals:
• Know the main derivative products and their mechanics
• Understand the difference between spot price and future price and be able to calculate future price. Be able to calculate the value of forward/futures contracts through time and at closing date.
• Be able to calculate a zero coupon yield curve from the prices of traded government bonds. The Nelson-Siegel Model will be introduced.
• Set up interest rate swaps and calculate their value. Understand when using such a contract is appropriate and how they are used for hedging in companies and financial institutions.
• Use the binomial model to price options (european, american, asian)
• Know the main risk factors (greeks) of options, be able to calculate them and use for hedging a option portfolio
• Be able to draw up a payoff profile for a portfolio of options
• Use the Black-Scholes model to price options and calculate their risk factors
• Understand the theoretical underpinnings of the Black-Scholes model (Ito-calculus)
• A special emphasis will be placed on the students ability to gather necessary financial data independently from reliable sources on the internet. Be able to assess the appropriate volatility, interest rate level and other important factors.
• Can use Monte Carlo simulation to price exotic derivatives

Content: The course starts with a brief introduction to derivatives and interest rates. The students will learn to construct the term structure of interest rates and study the models used to explain its shape. Then, forward contracts on interest rates and market assets will be introduced. Swap contracts will be discussed with focus on their cash flows and pricing techniques. Finally, derivative contracts on equity, bonds and interest rates will be discussed in some detail. During the course various cases will be studied where students can apply the acquired knowledge to practical situations.

Reading material: John C Hull, Futures, Options & Other Derivatives.
Teaching and learning activities: Lectures and problem solving classes.
Assessment methods: Assignments: 30%, Mid-term exam: 10%, Final exam: 60%.
Language of instruction: Icelandic/English.
### T-602-RISK  RISK MANAGEMENT  6 ECTS

<table>
<thead>
<tr>
<th><strong>Year of study:</strong></th>
<th>Third year.</th>
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</thead>
<tbody>
<tr>
<td><strong>Semester:</strong></td>
<td>Spring.</td>
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<tr>
<td><strong>Level of course:</strong></td>
<td>First cycle, advanced.</td>
</tr>
<tr>
<td><strong>Type of course:</strong></td>
<td>Core FV.</td>
</tr>
<tr>
<td><strong>Prerequisites:</strong></td>
<td>Calculus (T-101-STA1), Securities (T-303-VERD).</td>
</tr>
<tr>
<td><strong>Schedule:</strong></td>
<td>Runs for 12 weeks – taught in intensive sessions, an average of 6 teaching hours each week.</td>
</tr>
<tr>
<td><strong>Supervising teacher:</strong></td>
<td>Sverrir Ólafsson.</td>
</tr>
<tr>
<td><strong>Lecturer:</strong></td>
<td>Sigurður Pétur Magnússon.</td>
</tr>
</tbody>
</table>

**Learning outcome:** At the end of the course the student will have an appreciation of the role of risk management in corporate finance and in financial markets and be able to apply risk management techniques to a whole range of practical problems. This learning outcome can be broken down into the following sub-outcomes:

- Understand how financial risks are identified, quantified and then managed
- Know how to evaluate risks in different contexts
- Appreciate different types of risks – such as market risk, credit risk, liquidity risk and operational risk
- Understand and be able to quantify different types of market risk such as, interest rate risk, foreign exchange risk, commodity and equity risk
- Use the Value of Risk methodology to estimate risk in different market or corporate scenarios
- Use constrained optimisation methods to construct minimum risk portfolios
- Know how to estimate the risk contribution of different assets to a portfolio
- Understand the fundamental difference between systematic and non-systematic risk
- Understand how to estimate risk capital
- Use different hedging strategies to manage different types of risk
- Understand the cost and the potential benefits of risk management
- Understand the role of risk management for the matching of assets to liabilities

**Content:** The course starts by introducing basic concepts assessing and managing risk. The discussion will then focus on how risk arises, both in corporate and financial environment and on ways to manage it, either by means of active hedging or diversification. Classification of risk will be explained with specific focus on equity-, interest rate – and credit risk. Value-at-risk (VaR) will be introduced as one way of quantifying risk and the KMV model, popular with rating agencies such as Moody’s, will be discussed for quantifying credit risk. For both models we will emphasize their strengths and limitations.

The course will also cover risks associated with positions in a range of different derivative contracts and how they can be hedged.

**Reading material:** To be decided

**Teaching and learning activities:** Lectures and problem solving classes.

**Assessment methods:**

**Language of instruction:** English/Icelandic.
Year of study: Second/third year.
Semester: Spring.
Level of course: First cycle. (Introductory)
Type of course: Mandatory for HÁV.
Prerequisites: Chemistry (T-204-EFNA).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem-solving classes each week. Weekly homework.
Supervising teacher: Halldór G. Svakarsson.
Teacher: Þröstur Guðmundsson.

Learning outcome: On completion of this course, the student should:

- know the main crystal lattice systems and their relations to the electrical and mechanical properties of solids
  - Miller indices system
- be able to describe the main characteristics and materials properties of polymers, ceramics, metals and composites
- know the basic production steps of iron, steel and aluminum, polymers and ceramics
- know the basic forming and casting methods of metals, polymers and ceramics
- know the main methods use for measuring mechanical properties
- be familiar with solid state diffusion
- be able to analyze and identify corrosion of metals and alloys
- be able to identify phases and phase compositions from binary phase diagram
- know the main concepts of nanotechnology
  - nanolithography
- be familiar with the electrical and electronic properties of semiconductors.
  - carrier concentration
  - carrier’s mobility
  - electrical conductivity/resistance
  - activation energy
- understand the principles of electronic microscope (SEM), atomic force microscope (AFM) and X-ray diffraction (XRD)

Chemistry T-204 EFNA is a recommended prerequisite.

Content: The fundamentals of the properties and structure of materials utilized in the practice of engineering are presented. The groups of materials studied include metals and alloys, ceramics, polymers and multiphase systems. Theoretical basis is given for the understanding of the behavior of materials where their electrical, mechanical, thermal and chemical properties are related to their molecular and crystalline structure. A brief introduction to biomedical applications is given. Methods for analyzing and testing of materials’ properties are studied as well as the methods used for controlling them, e.g. heat treatment, grain refinement and alloying. Corrosion and its prevention are studied and an introduction to binary and ternary phase diagrams is given. An insight into Micro-Electro-Mechanical Systems (MEMS) and nano-systems is also provided.


Assessment methods: 3 hours written final exam (weights 60% in the final grade), one laboratory training (weighs 20% in the final grade), weekly homework (weights 10% in the final grade) and two pop quiz (the higher of the two grades weights 10% in the final grade). A minimum grade of 5.0 is required in the final exam.

Language of instruction: Icelandic.
<table>
<thead>
<tr>
<th><strong>T-620-FJAX</strong></th>
<th><strong>FINANCE X</strong></th>
<th><strong>12 ECTS</strong></th>
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<tbody>
<tr>
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<td>Third year.</td>
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<tr>
<td><strong>Semester:</strong></td>
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<tr>
<td><strong>Type of course:</strong></td>
<td>Elective.</td>
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<tr>
<td><strong>Prerequisites:</strong></td>
<td>Teachers approval. Admission is restricted to students who are studying in their final year of the BSc program in Financial Engineering.</td>
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<tr>
<td><strong>Schedule:</strong></td>
<td>Equivalent to 3 - 4 lectures per week + project work for 12 weeks. Intensive project work for 3 weeks following the 12-week period.</td>
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<tr>
<td><strong>Supervising teacher:</strong></td>
<td>Sverrir Ólafsson.</td>
<td></td>
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<tr>
<td><strong>Lecturer:</strong></td>
<td>Sverrir Ólafsson and Eyjólfur Ingi Ásgeirsson.</td>
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</table>

**Learning outcome:** The course will help students to make the vital step from solid understanding of the fundamentals of financial engineering to the application of theory to practical scenarios, as they arise in the real financial world, both the corporate and the financial sector.

The problems and the projects addressed will be very similar to what the recently qualified financial engineer can expect to face in an investment bank environment, in fund management, with an insurance company, a hedge fund or a medium sized to large corporation.

In as much as possible we will strike the balance between short problems that simply “pop up” in everyday work and need to be solved and longer, project type of tasks, that need proper planning including allocation of subtasks to members of a team.

Some problems can be solved by mathematical or probabilistic methods, often involving the application of stochastic and optimisation models, others require simulations or even qualitative modelling of some sort.

On completion of the course the students will have extensively applied their knowledge of financial engineering to a range of practical and relevant problems. The problems will require knowledge from courses such as operational research, programming, securities, probability and stochastic processes, derivatives, risk management and corporate finance. The focus of the course will vary from year to year.

**Content for T-620 FJAX Finance X Spring 2017: Managing a Portfolio of Bonds**

In this task students will take on the role of a bond portfolio manager. Initially they will familiarize themselves with the Icelandic bond market and in that process appreciate the following important points:

- Market conditions that impact on the value of their investments.
- How do the specifics of a bond impact on its risk-return profile?
- Work out the correlation between the performances of individual bonds.

The next step is to move on to a portfolio of several bonds, which will be analysed and optimised from a defined risk-return perspective. It is important to analyse in particular the following aspects,

- Price, risk and portfolio returns.
- Quantification of risk for bond portfolios
- The role of different interest rate models
- The impact of inflation on portfolios’ risk and return characteristics
- The role of inflation – and interest rate contracts

The students will put in place a “life system” that takes in real-time data from the market and updates the value and the risk position of the portfolio. Adjustments will be made to the portfolio as required and an investment policy will be determined and used to rebalance the portfolio. Some attention will be paid to the possible use of interest rate and/or inflation indexed derivatives.
The results will be presented in the form of a report and a demonstrator.

**Reading material:** Will be introduced in the first lectures.

**Teaching and learning activities:** Short lectures, discussion classes and project work

**Assessment methods:**

12 week term:
- Lectures, ideas and precise formulation of tasks
- Documentation of work plan
- Progress report for each group
- Draft for one final report
- Workbooks assessed

3 week time period:
- Demonstration
- Final report
- Final showing of demonstrator

**Language of instruction:** Icelandic/English.
**T-420-HONX**  
**DESIGN X**  
**12 ECTS**

**Year of study:** Third year.  
**Semester:** Spring.  
**Level of course:** First cycle, advanced.  
**Type of course:** Elective.  
**Prerequisites:** Teacher approval. Admission into the course is limited and efforts are made to ensure that students with various talents and backgrounds are admitted, in order to create an integral group.  
**Schedule:** 3 -4 lectures per week + project work for 12 weeks. Project work for 3 weeks following the 12-week period.  
**Supervising teacher:** Indriði S. Ríkharðsson.  
**Lecturer:** Indriði S. Ríkharðsson, Ágúst Valfells

**Learning outcome:** A student who has met the objectives of the course will be able to:

- Analyze an open-ended problem and establish requirement specifications
- Assess the merits of, and choose between, competing design alternatives
- Productively operate in an inter-disciplinary project team environment
- Work disciplined on a sub-task of a larger project.
- Demonstrate project management skills, including meeting important deadlines and operating within budgetary limits.
- Execute a design, build, test, and refine process of machines that are combined of hardware, electronics and software.

**Content:**  
**Objective:** Students in Design X works in (possible big) group on a project that is defined each year. The students goal is to design, build, test, and refine subsystems enabling the participation of a RU student team in the 2017 Formula Student competition or similar open ended inter-disciplinary projects. (see http://events.imeche.org/formula-student and http://www.auvsifoundation.org/2014-robossub-teams)  
Example projects:

- Rocket.  
- "Mars" rowers.  
- Autonomous submarine.  
- Robot for temperature inspection in aluminum smelter.  
- Walking robot for Össur.  
- Sound probe for recording whale sounds in sea.  
- Formula Student race car.

**Challenges:**  
Working in an inter-disciplinary team environment. Project management. Applying principles of engineering design.  
**Prerequisites:** Teacher approval. Admission into the course is limited and efforts are made to ensure that students with various talents and backgrounds are admitted, in order to create an integral group. This course is aimed to students on 3rd year in engineering, applied engineering and computer science but 2nd year students can also apply. Those students who are interested in the course should register and send a short resume to honnunx@ru.is. This resume should include which courses the student has completed in addition to any special competencies.

**Reading material:**

**Teaching and learning activities:** Project supervision, including regular discussions with project team leaders.  
**Assessment methods:** Group work assessment 60% (design report, meeting goal criteria), Individual assessment 40 % (notebooks, peer review)  
**Language of instruction:** Icelandic/English
Year of study: Third year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core HEV.
Prerequisites: Physiology I (T-206-LIFE).
Schedule: Runs for 12 weeks - 6 lectures each week along with practical experiments.
Supervising teacher: Þórður Helgason
Lecturer: Marta Guðjónsdóttir, Logi Jónssóttir and others.

Learning outcome: The primary goal of the course is to prepare the student for further studies and eventually a career in medical engineering. By the end of the course the student should have acquired competence and skills in the following areas:

- Ability to recognize and to describe basic concepts in physiology, the structure and function of organs and organ systems, and research methods and techniques.
- Ability to explain physiologic processes and what consequences a dysfunction in these processes would have.
- Ability to measure physiologic factors and analyze the results. Ability to explain physiologic processes by reference to (actual) examples/cases.
- Ability to interpret the results obtained by oneself and others in a critical manner.
- Ability to apply knowledge of physiology in formulating hypotheses that can be tested experimentally.
- Ability to discuss and present one’s point of view with references to published results, and to be able to distinguish between facts and conclusions.
- Ability to participate actively in working groups engaged in solving practical physiological problems.


Reading material: Dee Unglaub Silverthorn, *Human Physiology. 7th edition.*

Teaching and learning activities: Review of a scientific paper. Project: Students work on selected topics in biomedical engineering, present the project verbally and write a report. Lectures, seminars and laboratory hours are held according to a time table presented at the beginning of each term. All laboratory exercises and projects are compulsory.

Assessment methods: The grade for the course is combined marks from the final exam (45%), laboratories/reports (25%), project (15%), review of scientific paper (5%) and average grade from the best two of three tests during the course (10%).

Language of instruction: Icelandic.
Year of study: 3. year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: Teachers approval. Admission is restricted to students who are studying in their final year of the BSc program in Engineering Management.
Schedule: Equivalent to 3-4 lectures per week + project work for 12 weeks. Intensive project work for 3 weeks following the 12-week period.
Supervising teacher: Eyjólfur Ingi Ásgeirsson.
Lecturer: Eyjólfur Ingi Ásgeirsson and Páll Jensson.

Learning outcome: The course will help students to make the vital step from solid understanding of the fundamentals of engineering management and operations research to the application of theory to practical scenarios, as they arise in the real world.

On completion of the course the students will have extensively applied their knowledge of engineering management to a range of practical and relevant problems. The problems will require knowledge from course such as operations research, programming, data processing, simulation, and production and inventory management.

Description: A student in Model X works in a group on a project that is defined every year. For engineering management the project can focus on optimization, simulation, forecasting, inventory management or production scheduling. The focus of the course will vary from year to year. Description of the project will be announced late October for each year.

Reading material: Will be introduced in the first lectures.
Teaching and learning activities: Lectures, discussion classes and project work.
Assessment methods:

12 week term:
- Workbooks
- Introductions/demonstrations
- Final report

3 week period:
- Workbooks
- Introductions/demonstrations
- Showcase + final report.

Language of instruction: Icelandic/English.
**T-535-MECH**  
**MECHATRONICS II**  
6 ECTS

**Year of study:** Third year.  
**Semester:** Spring.  
**Level of course:** First cycle, advanced.  
**Type of course:** Elective.  
**Prerequisites:** Mechatronics I (T-411-MECH).  
**Schedule:** Runs for 12 weeks – 6 teaching hours a week, a combination of lectures and practical lessons.  
**Supervising teacher:** Baldur Porgilsson.  
**Lecturer:** Baldur Porgilsson.

**Learning outcome** On completion of the course the student  
- Should be able to understand in details how a microcontroller work  
- Should be able to optimize the choice of a microcontroller for a mechatronic task  
- Should be able to interface various sensors to various controllers in various ways  
- Should be able to optimize code on a given hardware platform  
- Should be able to complete a defined personal project in a systematic and predictable way  
- Should be able to take decisions in a mechatronic design and argument for them

**Content:** Mechatronics-2 extends Mechatronics-1 by going into more details. While Mechatronics 1 is broader and more about getting results fast (what is possible), Mechatronics 2 is more about accuracy and how to match a design to a task with economy, accuracy and robustness in mind (what is the limit).  
The course includes sensors, signal conditioning, interfacing, analog-digital conversion, digital input/outputs, timers, low level embedded firmware programming, actuators, UARTs and serial communication. It is expected that the student is familiar with the programming language C.  
Along with the lectures, each student has his/her own private project based on the fundamental elements of mechatronics: sense-think-act. For this project the student holds a lab notebook. At the end of the course the student delivers a report about the project.


**Teaching and learning activities:** Lectures, practical sessions and personal project  
**Assessment methods:**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
</tr>
<tr>
<td>Midterm evaluation, draft of report</td>
<td>15%</td>
</tr>
<tr>
<td>Final project presentation</td>
<td>15%</td>
</tr>
<tr>
<td>Lab notebook</td>
<td>10%</td>
</tr>
<tr>
<td>Report</td>
<td>30%</td>
</tr>
</tbody>
</table>

**Language of instruction:** English/Icelandic.
**T-510-MALI**  
**INSTRUMENTS AND VITAL SIGNS**  
**6 ECTS**

**Year of study:** Third year.  
**Semester:** Spring.  
**Level of course:** First cycle, advanced.  
**Type of course:** Core HEV.  
**Prerequisites:**  
- Calculus II (T-201-STA2), Physics II (T-202-EDL2), Analogue Circuit Analysis (T-306-RAS1),  
- Calculus III (T-301-MATH), Physiology I (T-206-LIFE), Electronics (T-509-RAFT), Signal Processing (T-306-MERK), Statistics (T-302-TOLF).

**Schedule:** Runs for 12 weeks - 6 teaching hours per week and practical exercises.  
**Supervising teacher:** Þórður Helgason.  
**Lecturer:** Örn Orrason, Helga Jóna Harðardóttir, Páll Ingvarsson, a.o.

**Learning outcome:** By the end of the course student should:  
- know well use of Laplace transformation to describe sensors, amplifiers and measurement systems  
- know well main error types and their treatment  
- know well the origin of electrical signals from the human body and the physiological basis for other life signs  
- realize the properties of electrodes for registration of electrical life signs  
- know common sensors used to monitor signals from the human body  
- have trained calculation of transfer properties of sensors, amplifiers and measurement systems  
- know main life signs  
- have a overview of CE and FDA requirements  
- know electrical safety requirements for medical devices  
- have training in building a medical life signs amplifier  
- have training in measuring some typical electrical signals from the human body

**Content:** The course covers the measurement of some common parameters for diagnostics and monitoring of patients. Origin of the signals, electrodes for registration, technical construction of sensors and amplifiers as well as registration methods. Measurements of electrocardiograph ECG, electroencephalograph EEG, electromyography EMG and others. Also measurements of blood pressure, blood flow in vessels, use of ultrasound for measurements and measurements of ventilation. Vital signs are considered and assessed. Requirements for CE marking and FDA approval are treated. Use of Laplace transform for describing sensors, amplifiers and their transfer functions. Error estimation and treatment is covered. In the course an amplifier for measurement and registration of different signals is a central theme. Students build an amplifier and calculate his main properties. They learn to connect sensors to the amplifier and realise how the complete system works. Practical exercises are done for practising. Main theme of the course is how knowledge in physiology, physics, mathematics and electronics is used to define a measurement system and design it. Prerequisites for the course are these fundamental courses of biomedical engineering.

**Reading material:** John G. Webster, *Medical Instrumentation*.

**Teaching and learning activities:** Lectures are two days a week. Calculating hours are once a week or as needed. Calculation hours are attached to the lectures or built into them. Students deliver solutions of the exercises one a week. The exercises cover sensors, amplifiers and their transfer functions. Two type of projects are done: 1. Practical exercises. For each of them students deliver a small report. 2. Building an amplifier. Students in group of two build each one amplifier. The amplifier is demonstrated, measured and a small report on that work delivered. A written exam is at the end of the semester. It contains both multiple choice and calculation examples.

**Assessment methods:** 1. Weekly exercises 10%, 2. Building of an amplifier 25%, 3. Three practical exercises 15%, 4. Exam in the end of the semester 50%

**Language of instruction:** Icelandic except there is a foreign student in the group then the language is English.
T-629-URO1  UNDERGRADUATE RESEARCH OPPORTUNITIES I  6 ECTS

Year of study:  Third year.
Semester:  Fall/Spring/Summer.
Level of course:  First cycle, advanced.
Type of course:  Elective.
Prerequisites:  No prerequisites.
Schedule:  As decided by supervising teacher.
Supervising teacher:  Eyjólfur Ingi Ásgeirsson.
Lecturer:  Eyjólfur Ingi Ásgeirsson, Magnús Gíslason, Sigurður Ingi Erlingsson.

Learning outcome: The main objectives are to introduce research within RU to students, deepen their understanding of a particular research area and give opportunities to students to start their research career.

Content: Projects are usually 6 ETCS units per semester. T-629-URO1 is available only for outstanding students that are interested in academic research. Students can apply for undergraduate research positions advertised by faculty, or suggest research projects to the appropriate advisor. Once advisors and students agree on a project, the student must prepare a 1-3 page project proposal, which is submitted to the School of Science and Engineering curriculum council. Students are not allowed to receive any monetary payments for their work, and the project must be within RU. The research project can either be a single independent project or a part of a larger research project.

Reading material:
Teaching and learning activities: Independent work, under the supervision of an advisor.
Assessment methods:
Language of instruction: Icelandic/English.
**T-629- URO2**  
**UNDERGRADUATE RESEARCH OPPORTUNITIES II**  
**6 ECTS**

**Year of study:** Third year  
**Semester:** Fall/Spring/Summer  
**Level of course:** First cycle, advanced  
**Type of course:** Elective  
**Prerequisites:** No prerequisites.  
**Schedule:** As decided by supervising teacher.  
**Supervising teacher:** Eyjólfur Ingi Ásgeirsson  
**Lecturer:** Eyjólfur Ingi Ásgeirsson, Magnús Gíslason, Eyþór R Þórhallsson, Sigurður Ingi Erlingsson.

**Learning outcome:** The main objectives are to introduce research within RU to students, deepen their understanding of a particular research area and give opportunities to students to start their research career.

**Content:** Projects are usually 6 ETCS units per semester. T-629-URO2 is available only for outstanding students that are interested in academic research. T-629-URO2 is used for larger projects, i.e. only in the exceptional cases where projects cover more than 6 ETCS units in a single semester. Students can apply for undergraduate research positions advertised by faculty, or suggest research projects to the appropriate advisor. Once advisors and students agree on a project, the student must prepare a 1-3 page project proposal, which is submitted to the School of Science and Engineering curriculum council. Students are not allowed to receive any monetary payments for their work, and the project must be within RU. The research project can either be a single independent project or a part of a larger research project.

**Reading material:**

**Teaching and learning activities:** Independent work, under the supervision of an advisor.

**Assessment methods:**

**Language of instruction:** Icelandic/English.
Learning outcome:
The objective is for students to be able to analyse the work of undertakings and institutions toward sustainability, work on strategic planning in the spirit of sustainability, establish goals and define indicators and prepare a project plan on the implementation of sustainability. Also, to link the principal issues relating to sustainable development to engineering and develop the skills to seek sustainable solutions. Finally, to understand the ethical obligations that come with working as an expert in the interests of the public.

Content: The course discussion will centre on how the rapid growth of the world population, and the human activity that goes with it, has in recent decades had a constantly increasing impact on natural resources and the environment. This poses a challenge for engineers to make use of their knowledge and seek solutions, so that people can meet their present needs without compromising the possibilities of the coming generations to meet their needs. The history of the general debate on sustainability will be covered, as well as international policymaking. The development of the concept of sustainability will be examined and the ideology underlying its definition, that is to say the interaction of economy, environment and society. The way in which the world economy meets sustainable development will be discussed, and how sustainability can be combined with economic growth. Is consumption by humans in line with the capacity of the Earth, and what impact do things like lifestyle and fashion have on the balance? It will also be examined what the principal causes of environmental problems are and their significance, both in an Icelandic and global context. An analysis will be conducted of what incentives are available in society for companies to take up environmental management and what the advantages of doing so are. The various available tools will be presented, such as the ISO 14000 standard, eco-labels, environmental impact assessment and ecological footprints. Attention will also be focused on the social factors that affect sustainability, such as human rights and equal rights. What does corporate social responsibility involve, and how can corporations assess their respective situations?

Reading material:
T-629-INDE  INDEPENDENT PROJECT  6 ECTS

Year of study:  3rd year.
Semester:  Fall / Spring.
Level of course:  First cycle, advanced.
Type of course:  Elective.
Prerequisites:  Approval of department head.
Schedule:  Independent work, undir advisor`s supervision.
Supervising teacher:  Haraldur Auðunsson.
Lecturer:  Árman Gylfason, Haraldur Auðunsson and Páll Jensson.

Learning outcome:
Upon completion of the course the student should:  1) have actively participated in planning a clearly defined project.  2) have experienced working independently, under the supervision of an advisor.  3) have gained experience in presenting findings in a clear and concise way.  4) have gained experience in working on and finishing a clearly defined project.

Content:
A clearly defined project based on students independent work, under the supervision of a faculty supervisor. The project could be within the field of research, development, building or design, and should be carried out parallel to an organized plan of study within a BSc program in engineering. Prerequisites: Before a student can enroll in this course, the department head must approve both the project plan and student’s choice of faculty supervisor.

Reading material:
Teaching and learning activities: The student works independently on a project under the guidance of a faculty supervisor. The student will deliver a report and introductory material (i.e. poster, website material) upon conclusion of the project.
Assessment methods: The student delivers a report, or alternatively the manuscript of a paper, which will be evaluated by two teachers within the School of Science and Engineering and the project supervisor. These individuals will evaluate whether the project meets the set criteria, the grade is either "Passed" or "Failed".

Language of instruction:
T-600-STAR  INTERNSHIP  6 ECTS

Year of study:  Third year.
Semester:  Spring.
Level of course:  First cycle, advanced.
Type of course:  Elective.
Prerequisites:  This course is only open to students in their final year of BSc engineering. Exchange students cannot enroll in this course.
Schedule:  Taught for 10 - 12 weeks, according to a schedule which the student makes in cooperation with his/her supervisors.
Supervising teacher:  Ingunn Sæmundsdóttir.
Lecturer:  Ása Guðný Ásgeirsdóttir and Ingunn Sæmundsdóttir.

Learning outcome:  The main objectives of internship are:
- to enhance the students’ knowledge and understanding of their chosen field of study and their future profession.
- to give students the opportunity of solving real life problems under the supervision of experienced professionals.
- to prepare students for their future careers.
- to pave the students’ way into the job market.
- to strengthen mutually beneficial ties between RU and industry.

Content:  An elective course in the 3rd year of the BSc engineering programmes. Supervisors select candidates from the group of applicants, a.o. grades and progression are considered. The student works under the supervision of a faculty member and a professional from the relevant firm/institution. The internship includes a minimum of 120 working hours in the firm/institution, in addition to the student’s preparatory work and work on the final report and presentation (a total of approx. 30 hours). The internship spans a period of 10-12 weeks and must be scheduled in such a way that it does not overlap with classes in other courses.

Reading material:  As recommended by supervisor.
Teaching and learning activities:  The student works under the supervision of a faculty member and a professional from the relevant firm/institution. The internship includes a minimum of 120 working hours in the firm/institution, as well as a total of approx. 30 hours in preparatory work, work on a final report and a final presentation.
Assessment methods:  The student’s performance in the workplace is evaluated, as well as his/her final report and presentation. The grading is Passed/Failed.
Language of instruction:  Icelandic/English.
T-424-SLEE  SLEEP  6 ECTS

Year of study: Third year.
Semester: Spring. Taught every other year.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: Taught every day for three weeks.
Supervising teacher: Karl Ægir Karlsson.
Lecturer: Karl Ægir Karlsson.

Learning outcome: Upon completion the student should:
- Be knowledgeable on the current understanding of sleep
- Understand the bottlenecks that preclude full understanding of sleep
- Know the most active fields within sleep research
- Understand the most common research methods employed by sleep researchers

Content: In the course the following topics will be addressed: early sleep research, the neural underpinnings of sleep and wakefulness, comparative sleep research, the role of sleep in learning and memory, sleep deprivation and the function of sleep active compounds. A special emphasis will be placed on understanding the application of information accumulated by sleep researchers.

The course is intended for MSc and upper level BSc students (teacher approval needed).
The course is taught in Icelandic but assignments can be turned in in Icelandic, English or Scandinavian languages.

Reading material:
Teaching and learning activities: The course consists of: lectures, in-class discussions, and tutorials.
Assessment methods: Class participation: 20%
Weekly e-mails to teacher with summary of reading material
Lab reports: 30%
Final exam, essay: 50%

Language of instruction: English.
Year of study: Third year.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: Taught every day for three weeks.
Supervising teacher: Karl Ægir Karlsson.
Lecturer: Karl Ægir Karlsson.

Learning outcome: Following a successful completion of the course the student should be able to:
- Describe the basic electrical properties of neurons and the ionic basis of membrane potentials
- Describe the basic elements of an electrophysiology recording system
- Describe and critically compare the different electrophysiological recording preparations (e.g. extracellular, intracellular and patch-clamp recordings) and be able to express which questions each method is best suited to address
- Describe and compare different types of tissue preparations
- Describe the most common ways of manipulating neural activity in during electrophysiological recordings
- Understand and be able to carry out standard electrophysiological data analysis (e.g. ionic current calculations, current-voltage curves and spike sorting).

Content: The course is designed for MSc and upper level BSc students in engineering. The course is centered on a set of hands-on exercises: A) preparation of tissue slices (using Danio rerio) for recording; B) set of recordings and manipulations; C) data will be analyzed and D) turned in in poster format. Formal lectures will be kept to a minimum. Necessary prerequisites include: molecular biology, physiology and chemistry. Maximum attendance is only 12 students. The course language is English (lectures, materials, exams and poster are all English only).

Reading material: Original papers, book chapters and other hand-outs will be delivered by the teacher.
Teaching and learning activities: The course is first and foremost hands-on in a laboratory setting. Under instructor guidance the students set-up recording apparatus, prepares tissue samples for recording, records neural activity, and analysis data. The lectures are few and seminar style.
Assessment methods: Students will be rated on participation in hands on practicums (good attendance is critical), three take home exams and a poster format presentation of data. No final exam.
Language of instruction: English.
T-606-LABB THERMO AND HYDRAULICS LAB 6 ECTS

Year of study: Third year.
Semester: Spring - Last offered Spring 2015.
Level of course: First cycle, advanced.
Type of course: Core VV.
Prerequisites: Fluid Mechanics (T-536-RENN).
Schedule: Runs for 12 weeks - 6 teaching hours each week.
Supervising teacher: Ármann Gylfason.
Lecturer: NN.

**Learning outcome:** The students will acquire knowledge of the physics of common instruments to measure temperature, pressure and velocity in fluid flows and gain skills in applying these instruments. They will acquire skills in processing numerical data, both in terms of analysing time series as well as image processing. Particular attention is on the presentation of results according to the traditions in the field of fluid mechanics, heat transfer and thermodynamics. The students will get to know analysis of turbulent free shear flows. The students gain skills in the design and implementation of simple experimental facilities aimed at confirming well known results.

**Content:** In the course we introduce experimental methods and measurement systems applied in fluid mechanics, thermodynamics and heat transfer. The focus is on sensors and technologies applied in scientific research and in product development in industry. The students will gain deep understanding of the principles of the measurement systems, they will acquire proficiency in image and time series processing and analysis, as well as being trained in presenting scientific results in writing and in presentations.
Projects include prescribed experiments, where various detection systems are applied to study complex physical phenomena, such as turbulence and turbulent heat transfer. Furthermore, students will design and construct an experiment in thermodynamics/heat transfer/fluid mechanics aimed at confirming a well known results.

**Reading material:**

**Teaching and learning activities:**

**Assessment methods:**
- Design projects (40%): Design, implementation and testing of experiments in fluid mechanics and heat transfer, design reports.
- Reports (40%): Two advanced experiments are performed during the course.
- Programming projects (20%): Related to experiments.
- The students must pass an oral exam at the end of the course.

**Language of instruction:** English/Icelandic.
T-606-NUFF NUMERICAL FLUID FLOW AND HEAT TRANSFER 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: Undergraduate course, specialized course.
Type of course: Elective, students in ME can choose between T-606-Labb or T-606-NUFF.
Prerequisites: Fluid Dynamics (T-536-RENN) or Fluids and Heat transfer (VT STV 1003).
Schedule: 12 Weeks, 6 hours pr. week.
Supervising teacher: Ármann Gylfason.
Lecturer: Yonatan Afework Tesfahunegn.

Learning outcome: Upon completion of the course students will have a good understanding of the basic theory of CFD, including discretization, accuracy and stability. They will be capable of writing a simple solver and using commercial and open source CFD codes.

Knowledge: After completing this course the students will have knowledge on:

- Mathematical modeling
- Classification of basic equations of fluid dynamics
- Discretization methods
- Stability and accuracy analysis
- Solution methods

Skills: After completion of this course the students will have skills on:

- Practical use and programming of numerical methods in fluid dynamics
- Setting up a given problem using commercial and open source CFD codes
- Generating computation grids
- Choosing appropriate boundary conditions for model problems
- Interpreting the results critically

Competence: After completion of this course, the students will have competence on:

- Numerical solution of model problems in fluid dynamics and heat transfer
- Checking and assessing basic numerical methods for fluid flow and heat transfer problems

Content: The main purpose of this course is to introduce the basic principles of computational fluid dynamics (CFD) for analyzing fluid flows and heat transfer. Hands on exercises are used to study the basic theory of CFD through programming and using existing commercial and open source CFD codes. Finite difference and finite volume techniques are emphasized.

Reading material: Essential computational fluid dynamics (Zikanov Oleg, 2010)

Teaching and learning activities: Lectures, tutorials, hands-on exercises, assignments and projects. The course is organized into two parts. The first part (about 60 % of the total course time) is reserved for lectures of the basic methods of CFD. It includes a programming project using Matlab. The remainder of the course includes hands-on exercises and projects with CFD commercial grid generator (ICEM-CFD), commercial CFD software (Fluent) and open source CFD code (SU2)

Assessment methods: Programming assignments and homework 10%; Programming project 25%; Grid generation assignments 10%; CFD code assignments 15%; CFD code projects 30%; Quiz 10%; Total 100%.

Language of instruction: English
HEAT TRANSFER

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Core VV.
Prerequisites: Calculus III (T-301-MATH), Thermodynamics (T-507-VARM), Fluid Mechanics (T-536-RENN).
Schedule: Runs for 12 weeks - 6 teaching hours each week.
Supervising teacher: Ármann Gylfason.
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, and
- Be able to perform simple laboratory experiments in heat transfer.

Content: In this course the concepts of heat transfer are introduced:
- 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.

Problem sessions, homework, laboratory experiments, and a programming project.

Reading material: Incropera Dewitt, Bergmenn and Lavine, Introduction to Heat Transfer.
Teaching and learning activities: Lectures, problem sessions, and laboratory experiments.
Assessment methods: Homework (10%): Students hand in solutions to homework problems each week. Solutions handed in after the deadline are not accepted.
Laboratory experiments (20%): Students work in groups and perform two laboratory experiments. Each group hands in a joint report for each experiment. 100% lab attendance is required.
Design project (20%): Each student writes a program for the numerical analysis of a heat transfer problem. The student hands in a report describing the project.
Final exam (50%): A four hour written exam. Closed book and close notes. Students can only bring a calculator of the type Casio FX350. Formula sheets are provided.
Language of instruction: English.
T-507-VARM  THERMODYNAMICS  6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core VV, recommended elective HÁV.
Prerequisites: Calculus I (T-101-STA1), Physics I (T-102-EDL1).
Schedule: Runs for 12 weeks - 4 lectures and 2 problem solving classes each week.
Supervising teacher: Ágúst Valfells.
Lecturer: Ágúst Valfells.

Learning outcome: Upon completion of the course students should have:
• a good understanding of the fundamental concepts of thermodynamics.
• the ability to apply the laws of thermodynamics to practical problems.

Content: Introduction to the fundamental concepts of engineering thermodynamics: State, temperature, etc. The first law of thermodynamics, work, heat, efficiency. Properties of pure substances, phase change, ideal gas, real gas, equations of state. Thermodynamic analysis of open and closed systems e.g. turbines and heat exchangers. Second law and its applications. Reversible and irreversible processes, Carnot cycle etc. Entropy, the Clausius inequality and the third law. Exergy and its applications for analysis.

Reading material: Yunus A. Cengel, Michael A. Boles, Thermodynamics: An engineering approach.

Teaching and learning activities: Lectures, and practical sessions.
Assessment methods:
Projects 20%. Two 4-in-a-group will be handed in. In addition students shall solve and explain one homework problem to fellow students.
Mid-term exams 2x15%. Three exams will be given, only two will count towards final grade. Make up exams will not be offered. Details given later.
Final Exam 50%. Three hours. Students must pass final exam (4.75/10) to receive a passing grade for the course. Note, students may pass final, but still fail the course (4.75/10) due to mid-term exams and projects.
The plan is to allow only the text book and a calculator in all exams.

Language of instruction: Icelandic.
Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: Basic knowledge of Matlab programming; Calculus (elementary linear algebra, in particular, vector/matrix operations and linear systems; Basic knowledge of derivatives, including Taylor expansion).
Schedule: Taught every day for three weeks.
Supervising teacher: Slawomir Marcin Koziel.
Lecturer: Slawomir Marcin 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.
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).

Reading material:
Teaching and learning activities: Lectures and practical sessions.
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.
Year of study: Second/third year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core VV (2nd year); Core HÁV (3rd year).
Prerequisites: Introduction to Engineering Design (T-116-VERK (or AI TEI1001 and VI HON1001)), T-106-BURD, Classical Dynamics (T-534-AFLF).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. Laboratory experiments.
Supervising teacher: María S. Guðjónsdóttir.
Lecturer: María S. Guðjónsdóttir.

Learning outcome: A student who has met the objectives of the course will be able to:

- show skills in the design of machine components, and their analysis with respect to fixed and varied loads, as well as their performance, by applying the methods of mechanical engineering design as well as applying CAD analysis.
- perform lifetime and load analysis of bearings; force and power analysis of breaks and joints as well as selection criteria for contact materials.
- design belts and chain drives by from force and power requirements and selection from manufacturer specification.
- design systems of gears by load and gear ratio requirements; analysis of loads on shafts and bearings in gear systems based on power transfer.
- design coiled and leaf springs from constraints in deformation and strength;
- design welded joints and bolted joints under steady and variable load.

Content: Course contents include load- and stress analysis of beams, shafts, and plates; Common fracture and fatigue theories for mechanical components under steady and varying loads; Mechanical design of bolts, welds and springs; Analysis, design and life time of journal bearings and ball bearings; Mechanical components such as gears, chain and belt drives, breaks and couplings.

Teaching and learning activities: Lectures, problem solving sessions and laboratories.
Assessment methods: Home assignments 10%, design project 20%, final exam 70%.
Language of instruction: Icelandic.