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

Course Catalogue 2014-2016
Revised, October 24th 2014
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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 2014-2015. 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/

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 Telma Hronn Numadottir, program administrator for undergraduate studies in engineering, tvd@ru.is
**BSc in Engineering - 180 ECTS programs – emphasis on preparation for further studies at MSc/PhD level**

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

Course descriptions

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

T-100-HUGM BRAIN STORMING 1 ECTS

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.
Lecturer: Haraldur Auðunsson a.o.

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 s.a. 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 ideas at the end of the course with posters, photos, models, videos and/or other audio-visual solutions, and answer questions as appropriate.

Students must have completed the course before entering the third year of study.

Reading material

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: Assessment of participation and activity in group work and presentation of solutions. The grade is Pass / Fail.

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.
Lecturer: Ingunn Gunnarsdóttir

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 there 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 seperable differential equations.
Know second order differential equations with constant coefficients and their solution.
Be acquainted with mathematical reasoning and proofs.

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.
Be able to use mathematical symbols to show a solution in a clear and precise manner.

Content: Complex numbers, roots and polar coordinates. Induction proofs.
Calculus of real-valued functions of one variable. Real numbers, functions and their graphs. Discussion of the most important functions and their properties. Limits, continuous functions, differentation, anti-derivatives and integration, Taylor-polynomials and simple differential equations.

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

Teaching and learning activities: Lectures and problem solving sessions.

Assessment methods: Written examination counts 80%. Homework counts 10%. Tests over the semester counts 10% (no retake tests). It is necessary to pass the written exam.
It is necessary to pass a algebra test with the minimum grade of 7 before taking the final exam.
The tests and the final exam are NOT open book. The student will get a sheet of formulas with the exam.
The students are only allowed to bring a calculator to the tests/exam. TI-nspire CAS calculators must be in press-to-test mode during exams.
Language of instruction: Icelandic.

T-204-EFNA CHEMISTRY 6 ECTS

Year of study: First 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. Three lab work sessions during the semester.
Lecturer: Halldór G Svavarsson.

Learning outcome:
On completion of the course students should:

- have achieved knowledge of the main areas of applied chemistry. These include fundamental aspects of metallurgy, nuclear- organic- and bio-chemistry and processing of chemicals.

Content: An introductory chemistry course 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-, bio- and organic chemistry will be given.

Reading material: Raymond Chang and William College, Chemistry.

Teaching and learning activities: Lectures, practical sessions and laboratory work.

Assessment methods: 3 hour 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 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.

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.
Lecturer: Haraldur Auðunsson, Halldór G Svavarsson, a.o.

Learning outcome: After completing the course the student should:

- be able to use design software, AutoCAD and Inventor, to draw and design simple structural objects.
- be able to describe the engineering methods of work an and project management.
- be able to keep a workbook.
- 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 reports, oral presentation, poster, a short film and a structural model.

Content: The course is based on group work, where students in the first year of BSc engineering work on solving a practical assignment for full three weeks. Students learn basic computer-aided drawing and design and use CAD/CAM software. In addition to computer-aided design, the focus of the course is on
engineering methods, construction of a simple model and presentation of the results. At the end of the course, each group will submit a model along with a short video presentation of the work.

**Reading material**

**Teaching and learning activities:**

**Assessment methods:** Projects in AutoCAD and Inventor, participation and contribution in group work, evaluation of workbooks, modeling and models, and presentation of the results, including a short video.

**Language of instruction:** Icelandic.

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**T-102-EDL1 PHYSICS I**

**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. Weekly support classes are also offered as part of this course.

**Lecturer:** Sigurður Ingi Erlingsson

**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
- Kinematics 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 is methodology extends much further into e.g. biology, economics and finance. In the course students will be trained in describing 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 and practical sessions, including problem solving and experiments.

**Assessment methods:**

**Language of instruction:** Icelandic.

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**AT FOR 1003 PRACTICAL COMPUTER SCIENCE**

**Year of study:** First year.
**Semester:** Fall.
**Level of course:** First cycle, introductory.
**Type of course:** Core.
**Prerequisites:** None.
**Schedule:** 6 teaching hours per week for 12 weeks.

**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: Stephen J Chapman, Essentials of Matlab programming.

Teaching and learning activities: Lectures and exercise classes.

Assessment methods: 20%: 3 or 4 semester exams, the lowest grade is not counted. 20%: 2 larger programming assignments. 60%: Final exam. Students are required to pass the final exam.

Language of instruction: Icelandic.

Courses taught in 1st year, 2nd semester - Spring semester

T-201-STA2  CALCULUS II  6 ECTS

Year of study: First year.
Semester: Spring/Summer.
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.
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.
• Be familiar with mathematical reasoning and proofs.
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 chain 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.

**Content:** Sequences and series: Limits, partial sums, absolute and conditional convergence.
Convergence tests. Power series and Taylor series.

**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. No retake exams will be held for tests.
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.

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**VI HON 1001 COMPUTER- AIDED DESIGN 3 ECTS**

**Year of study:** First year.

**Semester:** Spring

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

**Type of course:** Core/Elective. This is a core course for students who commence their studies in the spring semester, they take this course instead of T-116-VERK Introduction to Engineering Design.

**Prerequisites:** Computer-Aided Drawing (AI TEI 1001).

**Schedule:** Taught for 7.5 weeks, distance learning with in-class sessions and tutorials.

**Lecturer:** Gunnar Kjartansson.

**Learning outcome:** N/A


**Reading material:**

**Teaching and learning activities:**

**Assessment methods:**

**Language of instruction:** Icelandic.
AI TEI 101
COMPUTER-AIDED DRAWING
3 ECTS

Year of study: First year.
Semester: Spring
Level of course: First cycle, introductory
Type of course: Core/Elective. This is a core course for students who commence their studies in the spring semester, they take this course instead of T-116-VERK Introduction to Engineering Design.
Prerequisites: No prerequisites.
Schedule: Taught for 7.5 weeks, distance learning with in-class sessions and tutorials.
Lecturer: Íngridín Birna Kjartansdóttir.

Learning outcome: Upon completing this course the student should:
• Understand the concepts and terms used in technical drawing
• Be able to apply accepted standard practices to graphically represent technical design.
• Be able to represent a 3-D object effectively on a 2-D drawing surface
• Recognize and know how to use symbols and standards as applied to engineering
• Be able to create multiview and auxiliary view drawings
• Be able to apply the concept of cutting planes to create section views.
• Be able to apply the standard dimensioning practice for technical drawings.
• Understand the meaning of different linetypes in a technical drawing.
• Be able to use software like AutoCAD to create a simple technical drawing.
• Be able to use the drawing tools and drafting settings in AutoCAD.
• Be able to control the work environment in AutoCAD such as the drawing display.
• Be able to create templates, blocks and use different text and dimension styles.
• Know basic commands in Autocad.
• Be able to use Xref.
• Be able to set up layout and plot a drawing.

Content: This course introduces basic concepts of technical drawing through the use of the licensed software program AutoCad. Students apply accepted standard practices to graphically represent technical design. Furthermore, produce 2-D wireframe drawings to represent a 3-D object by creating multiview drawings and section views. Lectures are in Icelandic. The course starts with an intensive 2-3 all-day session introducing the course material and the use of AutoCad. It is important to attend this session to be able to work on course assignments. Other lectures on AutoCad will be provided on-line through MyShcool as videolectures. Additionally about 6 hours of class room lectures will be dedicated to the concepts of technical drawings and basic theory.

Reading material:

Teaching and learning activities: On-line course.
Assessment methods: Evaluation, total 100%: 3 homework assingments (45%), 1 mid term assessment (10%), Final assessment (45%).
Language of instruction: Icelandic.

T-106-REVE
ENGINEERING MANAGEMENT
6 ECTS

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.
Lecturer: Páll Kristján Pálsson.

Learning outcome:
At the end of the course the students should have reliable knowledge of the methods used when operating a company from a 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 the 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: Purchaseing, 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 themselves 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 the 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.

**Reading material:** N/A

**Teaching and learning activities:** N/A

**Assessment methods:** 3 hrs written exam (50%) and project work (50%).

**Language of instruction:** Icelandic.

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**X-204-STOF ENTREPRENEURSHIP AND STARTING NEW VENTURES 6 ECTS**

**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.

**Lecturer:** Hrefna Sigriður Briem.

**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
T-101-INNF  INTRODUCTION TO FINANCIAL ENGINEERING  6 ECTS

**Year of study:** First year.
**Semester:** Spring.
**Level of course:** First cycle, introductory.
**Type of course:** Core FV.
**Prerequisites:** No prerequisites.

**Schedule:** Runs for 12 weeks – taught in intensive sessions, an average of 6 teaching hours per week.

**Lecturer:** Sverrir Ólafsson and Guðmundur Magnússon.

**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.

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.
Lecturer: NN.

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, eigenvalues and eigenvectors.
• have learnt methods for the diagonalization of matrices.
• know fundamental concepts for linear transformations.
• be acquainted with the use of matrix transformations in computer graphics.
• have learnt methods for proving various theorems in linear algebra.

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 vector 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 use the Cauchy-Schwarz inequality to prove theorems.
• 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 construct proofs for unseen theorems related to the topics in the course.

Content: There is a basic treatment of matrix algebra and its utilization, e.g. in solving systems of linear equations. Also vectors are covered and their use in geometry. Further the course deals with determinants, eigenvalues and eigenvectors. Additionally the course covers matrix transformations with references to computer graphics.

Reading material: David Poole, Linear Algebra: A Modern Introduction.

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

Assessment methods: Final examination 80%. Written assignments 20%.

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.
Lecturer: Karl Ægir Karlsson and Ólafur Eysteinn Sigurjónsson

Learning outcome: N/A
Content: N/A
Teaching and learning activities: Lectures, discussions and tutorials.
Assessment methods:
Language of instruction: Icelandic.

T-202-EDL2  PHYSICS II  6 ECTS

Year of study: First year.
Semester: Spring/Summer.
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.
Lecturer: Sigurður Ingi Erlingsson.

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 Ohm's law
- Using Kirchoff'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 antennas.

Reading material: H.D Young and R.A Freedman, *University Physics with Modern Physics.*
Teaching and learning activities: Lectures and practical sessions, including problem solving and experiments.
Assessment methods: three hour final exam accounts for 70% of the final grade and the final exam must be passed. All exams are without books etc (few pages with basic formulas is supplied) and only Casio- FX-350 calculators are allowed in the exam. Best grade from 3 "midterms" exams accounts for 10%, weekly homeworks 10%, and lab report 10% of the final grade. All reports must be handed in (three labs and one home experiment) to be able to take the final exam.
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 (1\textsuperscript{st} year); Core HEV (2\textsuperscript{nd} year).
Prerequisites: Calculus I (T-101-STA1), Physics I (T-102-EDL1).
Schedule: Runs for 12 weeks – 6 lectures per week.
Lecturer: Ármann Gyðason

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.


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 (31. Jan, 21. Feb, 18. March). 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

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, HÁV, VV.
Prerequisites: Calculus I (T-101-STA1), Physics II (T-202-EDL2).
Schedule: Runs for 12 weeks- 6 teaching hours per week.
Lecturer: Ágúst Valfells.

Learning outcome: Upon completion of this course students should be capable of:

- Defining current, potential and power in a circuit, and to know about current and voltage sources and their properties.
- Presenting and using Kirchoff’s law’s and using node- and mesh methods for circuit analysis.
- Analyzing simple circuits with resistors in series and parallel, and using current and voltage division.
- Understanding ideal ideal op-amps and analyzing circuits with op-amps.
- Using standard op-amp circuits, understanding and explaining the general op-amp model and amplifier concepts.
• Understanding and using circuit analysis methods for capacitors and inductors, and constructing appropriate differential equations with initial values.
• Solving and understanding the properties of 1. and 2. order RL, RC and RLC circuits, damping, time constants, natural frequency, dynamic response and steady state.
• Analyzing steady-state AC circuits with phasors, impedances and circuit theorems.
• Understanding and using the concepts of complex power, rms, instantaneous power, average power.
• Understanding mutual inductance, transformers and how to analyze circuits including such components.
• Making and using simple computer models of circuits in simulation software (e.g. SPICE).
• Building and testing simple circuits. Measuring time constants, frequency, voltage and current with an oscilloscope. Understanding the sources and nature of uncertainty in measurements.

Content: Electric circuits and circuit components: e.g. independent and dependent current and voltage sources; resistors; capacitors; inductors; switches and transformers. Analysis of simple circuits; Kirchhoff’s law’s and Ohm’s law; mesh and node analysis; voltage and current division. Circuit theorems: source transformations; Thévenin and Norton equivalent circuits; superposition; maximum power transfer. Operational amplifiers: ideal op-amps; standard op-amp circuits (e.g. amplifiers, integrators and differentiators); real op-amps. Conservation of energy in electric and magnetic fields capacitance and induction; RC and RL circuits; energy content of capacitors and inductors; initial conditions; time constants and dynamic response; serial and parallel capacitors and inductors. RLC circuits: Transient response, damping; steady state response; forced response. AC circuits: Alternating current; phasors; impedance; circuit theorems for phasors; electric power and energy; complex power; average power and reactive power; rms and immediate power; power factor; mutual inductance; transformers.

Reading material: Richard C Dorf and James A Svoboda, Introduction to Electric Circuits.

Teaching and learning activities:

Assessment methods: N/A

Language of instruction: Icelandic.

T-316-RAS2 ANALOG CIRCUIT DESIGN 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core HÁV.
Prerequisites: Analog Circuit Analysis (T-306-RAS1).
Schedule: Taught every day for three weeks.
Lecturer: NN.

Learning outcome: Upon completion of this course the students shall be familiar with the frequency response and transfer functions for circuits; first and second degree filters; dB, logarithmic scales and Bode plots; use of Laplace transforms for electrical circuits, zeros and poles; two-port networks.

The student should be able to use simulation software, such as PSpice, to design and analyze simple amplifier circuits, passive filter circuits and active filter circuits (op-amps).

The students should also be able to carry out measurements and experiments to verify and understand circuit behavior. The students should also be able to report on their design and experiments in a clear and concise manner, both in written reports and orally.

Content: Frequency response of circuits (including op-amps): Gain, phase shift and network functions; Bode plots; resonance. The Laplace transform and Fourier series: Application of the Laplace transform to circuit analysis; transfer functions; impedance; convolution; stability; circuits and Fourier series; Fourier transform; Fourier spectrum.

Filter circuits: Ideal filter, low-pass; high-pass; band-pass; notch; filter order; second order filters; high-order filters; simulation.

Two-port and three-port networks: T-to-P transformation and two-port three-terminal networks; equations of two-port networks; Z and Y parameters for circuits with dependent sources; hybrid and transmission parameters; relationship between two-port parameters; interconnection of two-port networks.

Reading material:
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.
Lecturer: Eyjólfr Ingí Asgeirsson.

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: 3 x Projects (small groups) (30%, 30% and 40%).
Language of instruction: Icelandic.

T-316-STAF  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.
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-534-AFLF CLASSICAL DYNAMICS 6 ECTS**

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core HÅV, VV.
Prerequisites: Physics I (T-102-EDL1), Calculus II (T-201-STA2).
Schedule: Runs for 12 weeks – 6 lectures/problem solving classes per week.
Lecturer: Andrei Manolescu.

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

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.

Teaching and learning activities: Lectures and problem solving classes. The lectures will be often based on examples.
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.
Language of instruction: English.

**T-301-MATH MATHEMATICS III 6 ECTS**

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: Calculus I (T-101-STA1), Calculus II (T-201-STA2).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.
Lecturer: Ingunn Gunnarsdóttir.

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.


Teaching and learning activities: Lectures and problem solving sessions.

Assessment methods: Written examination counts 80%. Homework counts 20%. It is necessary to pass the written exam.

Language of instruction: Icelandic.

T-316-LABB MECHANICS LAB 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core VV.
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.
Lecturer: Ármann Gylfason.

Learning outcome:
Content:
Reading material:
Teaching and learning activities:
Assessment methods:
Language of instruction: Icelandic.

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.
Lecturer: Logi Jónsson, Jón Ólafur Skarphéðinsson.

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.

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**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.
- **Lecturer:** Guðmundur Eliás 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:** N/A

**Assessment methods:** N/A

**Language of instruction:** Icelandic.

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**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.
- **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.

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, stings 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: 50-80%
Mid-term exams: 2x10% (only considered if the grade from these exams pulls up the student’s average grade for the course)
Milestone projects: 20%
Weekly 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, milestone projects and weekly assignments to be considered.

Language of instruction: Icelandic.

T-303-VERD SEQUENCES 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core FV.
Prerequisites: Calculus I (T-101-STA1), Engineering Management (T-106-REVE).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.
Lecturer: Bjarki Andrew Brynjarsson, Guðmundur Magnússon.

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. Taught in English (unless all enrolled students are Icelandic speaking).

Reading material: David Luenberger, *Investment Science.*

Teaching and learning activities: Lectures and problem solving sessions.

Assessment methods:

Language of instruction: Icelandic.

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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 (2\textsuperscript{nd} year); Core HÁV, VV, HEV (3\textsuperscript{rd} year).

Prerequisites: Calculus I (T-101-STA1).

Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.

Lecturer: Sigurður Freyr Hafstein.

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

Knowledge

- 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

- 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.

Courses taught in 2\textsuperscript{nd} year, 4\textsuperscript{th} semester - Spring semester
T-509-RAFT  ELECTRONICS  6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core HEV, HAV.
Prerequisites: Analog Circuit Analysis (T-306-RAS1).
Schedule: Runs for 12 weeks – 4 lectures and 2 practical classes each week.
Lecturer: Richard Már Jónsson.

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.

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).
Schedule: Runs for 12 weeks - 4 lectures and 2 problem solving classes each week.
Lecturer: Gunnar Porgilsson.

Learning outcome:
Knowledge and understanding
The aim is that students 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
The aim is that students:
• can make algorithms that approximate solutions for simple mathematical problems,
can program and implement algorithms on computers,
• can estimate the error of the approximations made with numerical methods,
• can estimate the amount of time needed to complete numerical algorithms.

**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.

**Language of instruction:** Icelandic.

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**T-403-ADGE**

**OPERATION RESEARCH**

6 ECTS

**Year of study:** Second year.

**Semester:** Spring.

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

**Type of course:** Core FV, RV.

**Prerequisites:** Calculus I (T-101-STA1), Statistics I (T-302-TOLF).

**Schedule:** Runs for 12 weeks – 4 lectures and 2 practical classes each week.

**Lecturer:** Hlynur Stefánsson.

**Learning outcome:** After the completion of this course students will be capable of using basic methods of Operations Research for analysing and solving complex decision problems. More specificly 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, *Introduction to Operation Research.*

**Teaching and learning activities:** Lectures and problem solving classes.
Assessment methods: 
Language of instruction: Icelandic.

**T-305-PRMA**  
**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.  
**Lecturer:** Viðar Helgason and Hera Grímsdóttir.

**Learning outcome:** On completion of the course students should be able to:  
• manage projects and use different tools of project management.  
**Content:** The aim of the course is to introduce the methods of project management and it’s employment. Definition of projects, project lifetime, project schedule and progress as well as reporting will be taught. Project management, Gantt, CPM, PERT will be introduced. Tender offers, contracts, supervision.  
Excercises with Microsoft Project.  
**Reading material:** Gray & Larson, *Project Management: The managerial process*.  
**Teaching and learning activities:** Lectures and practical sessions.  
**Assessment methods:**  
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.  
**Lecturer:** Jón Guðnason.

**Learning outcome:** On completion of the course students should:  
• understand and be able to apply the basic theory of signal processing.  
**Reading material:** Oppenheim, Willsky og Nawab, *Signals and Systems*.  
**Teaching and learning activities:**  
**Assessment methods:** Problem sheets 10%, matlab exercises 20%, final exam 70%.  
**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 HÅV, 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
Lecturer: Ármann Gyitfason

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 (31. Jan, 21. Feb, 18. March) . 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.

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T-402-TOLF STATISTICS II 6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core FV, RV.
Prerequisites: Calculus I (T-101-STA1), Statictics I (T-302-TOLF), Linear Algebra (T-211-LINA).
Schedule: Runs for 12 weeks – 4 lectures and 2 practical classes each week.
Lecturer: Sigurður Freyr Hafstein.

Learning outcome:
Knowledge
After the course students will know:
• several methods of simulation in statistics
• correlation
• linear regression
• models and model selection
• factorial experiments and design of experiments
• statistical quality control
Skills
After the course students can:
• use statistics to interpret data
• use simulation in statistics
• can design statistically significant experiments
• can apply the methods of statistical quality control

**Content:** Námskeiðið er beint framhald af Tölfræði 1. Farið er m.a. í hermun, tölfræðilega vinnslu á gögnum, aðhvarfsgreiningu, líkanagerð, hönnun tilrauna og tölfræðilega gæðastjórnun.

**Reading material:** Navidi, *Statistics for Engeneers and Scientists.*

**Teaching and learning activities:** Lectures, projects and homework.

**Assessment methods:** Homework (15%), group project (10%), final exam (75%)

**Language of instruction:** Icelandic.

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**T-507-VARM**  
**THERMODYNAMICS**  
6 ECTS

**Year of study:** Second year.

**Semester:** Spring.

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

**Type of course:** Core VV.

**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.

**Lecturer:** Gylfi Árnason.

**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. Exams will be held in week 3, 6 and 9. Details given later.
Final Exam 50%. Three hours. Students must pass final exam (4.75/10) to receive a pass in grade for the course. Note, students may pass final, but still fail the course 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.

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Courses taught in 3rd year, 5th semester - Fall semester

**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.
Lecturer: Magnús Kjartan Gíslason

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

Reading material: 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 30% of the final mark and the final exam will account for 70%.

Language of instruction: English.

T-621-CLIN CLINICAL ENGINEERING 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Elective.
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.
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 practice at Landspitali: medical device park, acquisition and maintenance Part-II, CE Electronic.
• Electrical safety in clinical environments.
• Leaks 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.
• Practical measurements 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-104-FJAR CORPORATE FINANCE 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core FV, RV.
Prerequisites: No prerequisites.
Schedule: Runs for 12 weeks – 6 lectures per week.

Lecturer: Ottó Stefán Michelsen.

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: Adequate delivery of 10 exercises counts 10% of the final grade, large project (1-2) counts 30%, final exam counts 60%, a grade minimum of 5,0 for the final exam is required as well as an overall average of 5,0 or better.
Language of instruction: Icelandic

T-603-AKVA  DECISION ANALYSIS FOR MANAGEMENT  6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: Statistics I (T-302-TOLF).
Schedule: Runs for 12 weeks - 4 lectures and 2 problem solving classes each week.
Lecturer: Þórður Vikingur Friðgeirsson.

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 and negation skills.

Reading material: Goodwin & Wright, Decision Analysis for Management Judgment.

Teaching and learning activities:
The course is structured in lectures and exercise classes intended for academic exercises, 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%.

Language of instruction: English.

T-503-AFLE  DERIVATIVES  6 ECTS

Year of study: Third year.
Semester: Fall.
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.
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 an 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:
Reading material: John C Hull, *Futures, Options & Other Derivatives.*
Teaching and learning activities:
Assessment methods: Assignments: 30%, Mid-term exam: 10%, Final exam: 60%.
Language of instruction: Icelandic.

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**T-105-HAGF**  
**ECONOMICS**  
6 ECTS

**Year of study:** Third year.  
**Semester:** Fall.  
**Level of course:** First cycle, introductory.  
**Type of course:** Core FV, RV.  
**Prerequisites:** No prerequisites.  
**Schedule:** Runs for 12 weeks – 6 lectures per week.  
**Lecturer:** Bolli Héðinsson.

**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 elasticities 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:** N/A

**Language of instruction:** Icelandic.

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**T-501-REGL  FEEDBACK CONTROL SYSTEMS  6 ECTS**

**Year of study:** Third year.

**Semester:** Fall.

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

**Type of course:** Core HEV, HÅV, 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.

**Lecturer:** Þorgeir Pálsson.

**Learning outcome:** This course is designed to give the student a solid foundation in the characteristics 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 feedback 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 feedback control to achieve satisfactory performance.
- Competence in the application of the most common methods and software (Matlab) for the design of feedback control systems and the computation of standard system response.
- Understanding of how expression of system characteristics in state-space form provides new possibilities in the design of feedback 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 designer.
- Solid basic understanding of linear feedback systems that is necessary to undertake further studies in the analysis and design of complex control systems.

**Content:** This course is a traditional first course on the subject of feedback 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 feedback; 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 feedback 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 five classroom hours allocated to this course on a weekly basis for fourteen weeks. Normally three of these are used for lectures with interspersed blackboard problem solving for demonstrating important principles. Two classroom hours a week are set aside for solving textbook problems to augment homework assignments. Also questions on homework assignments are addressed 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 presentations that are available to the students at the time of the lectures allowing them to take notes that can be attached to the slides. 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 the course as stated in the course schedule. These are submitted in two parts where the first part consists of developing appropriate models without consideration of the controller design. The second part which is performed during the latter part of the course focuses on the design of the controller and evaluation of the various system configurations. The work is carried out by teams of two students that each submits a report on the results. The homework assignments are evaluated by grading in a traditional manner.

**Language of instruction:** Icelandic.

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**T-536-RENN FLUID MECHANICS**

**Year of study:** Third year.
**Semester:** Fall.
**Level of course:** First cycle, advanced.
**Type of course:** Core VV.
**Prerequisites:** Calculus II (T-201-STA2), Physics II (T-202-EDL2), Thermodynamics (T-507-VARM).
**Schedule:** Runs for 12 weeks - 6 teaching hours each week.
**Lecturer:** Ármann Gylfason.

**Learning outcome:**

**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 equation, potential flow, solutions to the Navier-Stokes equation for simple viscous flows, dimensional analysis, pipe flow, boundary layer theory and compressible flows. Taught in English (unless all enrolled students are Icelandic speaking).

**Reading material:** F.M White, *Fluid Mechanics.*

**Teaching and learning activities:**

**Assessment methods:**

**Language of instruction:** English/Icelandic

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**T-411-MECH MECHATRONICS I**

**Year of study:** Third year.
**Semester:** Fall.
**Level of course:** First cycle, advanced.
**Type of course:** Core HÁV.
**Prerequisites:** Practical Programming (AT FOR1003), Calculus III (T-301-MATH), Electric Circuits (T-509-RAFT).
**Schedule:** Combination of lectures and practical lessons, 6 hours per week for 12 weeks.
**Lecturer:** Joseph Timothy Foley.

**Learning outcome:**
Prerequisites:
- C/C++ (can be taken at the same time)
- Basic electronics (resistors, inductors, capacitors, current, voltage)
- Physics 1 (mechanics)

On completion of the course students should:
- Be able to design, build, and test advanced circuits with active elements
- Fix and improve simple broken mechatronic devices
- Build motor and heater control systems with feedback
- Program a microcontroller using an appropriate language to read sensors and control actuators. For example: An Arduino with C++ or a Raspberry Pi with python
- Understand digital and analog communication interfaces such as wireless networks
- Create schematics, layout PCB boards, and solder components to build working devices
- Be able to understand actuator and electronics specification sheets
- Use a research notebook properly for international-quality research
- Write lab reports for experiments performed
- See opportunities, not obstacles, when problems arise.

**Content:** This is an introduction to Mechatronics, the technique of interfacing software, electronics, and mechanical components.

Past courses have focused on LabView. This time we will be focusing on the low-cost Arduino microcontroller platform as our method for sensing and control. Students will have pay a small deposit for their personal lab kit that can be returned at the end of the semester if the student does not wish to keep it.

We will begin with an introduction to microcontroller programming and software engineering. This includes C++ and Subversion (for collaboration). We will then shift to electronics design, implementation, and testing. We will cover both analog and digital electronics with a focus on interfacing to sensors, DC motors, and stepper motors. Students will be designing and building PCB boards using EAGLE to connect to sensors and interface with the motors using H-bridges. We will complete the academic side of the course with closed loop control of these actuators.

Students will choose a final mechatronics group project to be presented at the end of the semester. This project should involve manufacturing mechanical elements and interfacing them with the microcontrollers to demonstrate their mastery of the subject.

Students will be spending a good deal of time in the Electronics Lab and Machine Shop building projects. This means that each student will be going through safety training in the labs as part of the course.

The content (assignments and syllabus) of this course may change during the semester based upon student input.


**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. Some assignments will be individual, some as groupwork. Collaboration on individual assignments is expected, but each student must do their own writeup (no copying). There will be a mid-term examination and final project. The final project may be sponsored by an outside company or internal research.

At the end of each project, students will be presenting their design and results along with a short written report. Lab assignments only require a report based upon a standard template.
Students are expected to make use of the Machine shop and Electronics lab, taking appropriate International safety precautions where applicable. The instructor will give guidelines on these procedures and assist in execution.

**Assessment methods:** No final exam, instead a final project presentation and report. There will be a written midterm exam. Students must be able to effectively communicate their ideas through written and oral methods. Students will each have a research notebook which must be used on a regular basis on topics relating to the class and will be checked periodically for grading purposes. In-class participation is part of the student’s grade.

Each assignment will be evaluated considering these three aspects:

- process
- documentation quality/rigor
- product/result

Proper citation is a requirement in this class, without exemptions. All material from an outside source (ideas, text, pictures) must include a proper citation. IEEE bibtex is the preferred format. Failure to include citations will result in a 0 for the assignment and considered 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 kicks in. For LaTeX documents, the SVN/MySchool submission time of the source .tex files will be used to assess lateness. Unless specified, assignments should be submitted to MySchool.

Notebooks will be graded with a grading sheet that will be provided. Reports may be resubmitted up to a week after they are returned for regrading. These grades will be averaged for the new grade. The previous report and grading sheet must be returned with a copy of the edited report.

**Breakdown**

- 5% class participation (in zulip, class, etc)
- 15% problem sets
- 20% labs, reports, and small projects
- 20% notebook evaluations
- 10% written midterm
- 5% Final project milestone presentation
- 10% Final project presentation
- 15% Final report

**Language of instruction:** English.

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**T-307-HEIL PHYSICS III**

**6 ECTS**

**Year of study:** 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.

**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.

Teaching and learning activities: Lectures and practice sessions, experiments and projects.

Assessment methods: Final written exam accounts for 60% of the final grade (each student is allowed to bring with him 4 pages of his own notes in the final exam) and work during the semester, i.e. due problems and lab reports, accounts for 40%. 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.
• design and optimize intelligent machines that are combined of hardware, electronics and software.
• be able to describe characteristics of human gait.
• communicate in a group through digital media (svn).
• work disciplined on a sub-task of a larger project (lab book).

Content: Aim: to make a machine that can replace a human in testing prosthetics. Make a complete foot with interfaces for trans-tibial and trans-femoral prostheses. Challenges:
• Project planning, overall design, requirement specifications.
• Construct a frame that can apply human weight forces.
• Add human like motion (various types).
• Various terrain (staircase).
• Attachment of predefined artificial limbs.

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. Those students that 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 (for example in programming, machine construction, electronics etc.)

Reading material:
Teaching and learning activities: Lectures and practical sessions.
Assessment methods:
12 week period (100%)
Concept Presentation (20%, all C)
End of week 3. One presentation per group.
Design Report (20%, all D.)
End of week 6. One report per group.
Final Report (40%, D =10, I = 20, O = 10)
End of week 12. Joint report.
Laboratory notebook (20%, all O)
Lab notebooks are assessed at the end of the 12 week period.
3 week period (100%)
Oral exam (35%, D=5, I=10, O=20)
Takes place in week 3. Individual examination.
Demonstration and final report (45%, D=5, I=30, O=10)
Demonstration takes place in week 3. Joint report.
Laboratory notebook (20%, all O)
Lab notebooks are assessed at the end of the 3 week period.

Language of instruction: Icelandic/English.

T-423-ENOP ENGINEERING OPTIMIZATION 6 ECTS

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.
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.

T-863-HEAT  HEAT TRANSFER  6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced / second cycle, introductory.
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.
Lecturer: Lahcen Bouhlali.

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:
• Heat conduction: One dimensional steady state heat conduction, solution of the Fourier equation
  for steady state and transient problems. Lumped analysis using thermal resistance. Application of
  numerical techniques.
• Convective heat transfer: Natural convection, empirical relations in free convection. Forced
  convection, laminar and turbulent convective heat transfer analysis in external and internal flows,
  such as flows between parallel plates, over a flat plate and in a circular pipe. Condensation and
  boiling heat transfer. Empirical relations, application of numerical techniques in problem solving.
• Radiative heat transfer: Introduction to the physical mechanism, radiation properties, radiation
  shape factors black body radiation, and deviation from black body radiation, radiation from gases.
• Heat exchangers: Classification of heat exchangers, temperature distribution, overall heat
  transfer coefficient, and fouling. Heat exchanger analysis using LMTD method and NTU method.
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.
1. Assessment methods: Homework (10%): Students hand in solutions to homework problems
each week. Solutions handed in after the deadline are not accepted.
2. 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.
3. 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.
4. 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-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), Analog 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.
Lecturer: Brynjar Vatnsdal and Björn Ómarsson.

Learning outcome:
Content:
Reading material: John G. Webster, Medical Instrumentation.
Teaching and learning activities:
Assessment methods:
Language of instruction: Icelandic.

T-600-STAR  INTERNSHIP  6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: 10 - 15 weeks, according to a schedule which the students make in cooperation with his supervisors.
Lecturer: Ingunn Sæmundsdóttir and Erna Karen Óskarsdóttir.

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 (6 ECTS). The student works under the supervision of a faculty member and a professional from the relevant firm. The internship includes 120-150 working hours in the firm, in addition to the student`s work on the final report. The internship spans a period of 8-12 weeks and must be scheduled in such a way that it does not overlap classes in other courses. See also “Guidelines for internship”. Generally taught in Icelandic.
Reading material:
Teaching and learning activities: The student works under the supervision of a faculty member and a professional from the relevant firm. The internship includes 120-150 working hours in the firm, as well as work on the final report.
Assessment methods: The student`s performance in the workplace is evaluated, as well as his/her final report. The grading is Passed/Failed.
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.
Lecturer: NN

Learning outcome: The students have 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. The students will know and be capable of using common machining tools, such as lathe, and a mill, and have a firm knowledge of safety requirements while applying such equipment, the student will be trained in constructing simple mechanical components after performing the design. The emphasis in on knowledge of various mechanical components and ability to perform; lifetime and load analysis of bearings; force and power analysis of breaks and joints as well as selection criteria for contact materials; design of belts and chain drives by from force and power requirements and selection from manufacturer specification; design of systems of gears by load and gear ratio requirements; analysis of loads on shafts and bearings in gear systems based on power transfer; design of coiled and leaf springs from constraints in deformation and strength; design of 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 joints. Hands on project introduce students to machining of metals and plastic in lathe and mill as well as welding.

Reading material: Shigley, Mischk, Budynas, *Mechanical Engineering Design*.

Teaching and learning activities: Lectures, problem solving sessions and laboratories.
Assessment methods: N/A
Language of instruction: Icelandic.

T-407-EFNI MATERIALS SCIENCE 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: Chemistry (T-204-EFNA).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week.
Lecturer: Halldór G Svavarsson

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 and steel, 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)

**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 behaviour 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 material:** William F. Smith and Javad Hashemi, *Foundation of Materials Science and Engineering.*

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

**Assessment methods:** 3 hour written exam accounts for 70% of the final grade. Work during the semester accounts for 30%. The work consists of assignment and weekly homework. A minimum grade of 5.0 is required in the written exam.

**Language of instruction:** Icelandic.
Year of study: Third year
Semester: Spring
Level of course: First cycle, advanced
Type of course: Elective
Prerequisites: Practical Programming (AT FOR1003), Calculus III (T-301-MATH), Signal Processing (T-306-MERK), Physics III (T-307-HEIL).
Schedule: Runs for 12 weeks - 6 teaching hours each week.
Lecturer: Haraldur Auðunsson, Brynjar Karlsson, Valdís Guðmundsdóttir.

Learning outcome: At the end of the course students should:
• know the physics used in medical imaging
• know the most common imaging modalities used in medical imaging and their properties.

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.

It is expected that students have completed the courses Physics 3 and Signal analysis.

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, design project and homework. There will be no final exam.

More detailed description will be given when the class starts.

Language of instruction: Icelandic.

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T-306-LIFE  PHYSIOLOGY II  6 ECTS

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.
Lecturer: Logi Jónsson, Marta Guðjónsdóttir.

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.

laboratory hours are held according to a time table presented at the beginning of each term. All laboratory exercises and projects are compulsory. The grade for the course is combined marks from the final exam (45%), laboratories/reports (30%), project (15%) and average grade from the best two of three tests during the course (10%).

**Reading material:** Dee Unglaub Silverthorn, *Human Physiology.*

**Teaching and learning activities:**

**Assessment methods:**

**Language of instruction:** Icelandic.

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**T-606-PROB**  
**PROBABILITY AND STOCHASTIC PROCESSES**  
6 ECTS

**Year of study:** Third year.

**Semester:** Spring.

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

**Type of course:** Core FV.

**Prerequisites:** Mathematics III (T-301-MATH), Statistics I (T-302-TOLF)

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

**Lecturer:** Sverrir Ólafsson

**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:** Several processes in modern engineering have uncertain outcomes and are therefore probabilistic (random) by nature. Examples include, electrical signals in communication engineering; user and consumer purchasing behaviour; clients entering and waiting for service; fracture dynamics of many materials is essentially probabilistic in nature; price processes in financial engineering are generally random. Material and chemical engineering, road traffic engineering, structural and civil engineering, as well as of course operational and financial engineering all need models and methods from probability theory and stochastic processes.

To be able to model engineering processes accurately the use of probability theory and stochastic models is required. When dealing with time-dependent uncertainties the probabilities need to be modelled in terms of stochastic processes, i.e. processes with time-dependent probability distributions.
The goal of this course is to introduce students to various important concepts in probability and stochastic processes. Initially these concepts will be introduced in the abstract but in parallel a range of different engineering and commercial applications will be considered.

We will emphasize multidisciplinary approach and point out cross disciplinary applications of various important concepts from probability and stochastic models. This includes Brownian motion and diffusion processes, which play an important role both in material science and chemical engineering in relation to transfer of heat and kinetic energy, as well as in financial engineering for pricing various financial contracts. We will analyse some of the stochastic processes used for these scenario and derive the corresponding differential equations, the diffusion equation for heat transport and the Black-Scholes equation for the price - evolution of contingent contracts. We will also study the fundamental solutions of these equations and their application and interpretation in various engineering contexts.

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.

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**T-610-STOD  PROSTHETICS AND ARTIFICIAL ORGANS  6 ECTS**

Year of study: Third year.

Semester: Spring.

Level of course: First cycle, advanced.

Type of course: Elective.

Prerequisites: Calculus III (T-301-MATH), Physics II (T-202-EDL2), Physiology II (T-306-LIFE), Electric Circuits (T-509-RAFT), Signal Processing (T-306-MERK).

Schedule: Runs for 12 weeks – 4 lectures, 2 problem solving sessions each week, also lab sessions.

Lecturer: Brynjar Vatnsdal, Björn Ómarsson.

Learning outcome:

Content:

Reading material:

Teaching and learning activities:

Assessment methods:

Language of instruction: Icelandic.

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**T-602-RISK  RISK MANAGEMENT  6 ECTS**

Year of study: Third year.

Semester: Spring.

Level of course: First cycle, advanced.

Type of course: Core FV.

Prerequisites: Calculus (T-101-STA1), Securities (T-303-VERD).

Schedule: Runs for 12 weeks – taught in intensive sessions, an average of 6 teaching hours each week.

Lecturer: Guðmundur Magnússon.

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:
Teaching and learning activities: Lectures and problem solving classes.
Assessment methods: Written final exam of 3 hours and weekly assignments.
Language of instruction: English/Icelandic.

T-502-HERM SIMULATION 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Core RV.
Prerequisites: Calculus I (T-101-STA1), Statistics I (T-302-TOLF), Statistics II (T-402-TOLF).
Schedule: Intensive course. Taught every day for 3 weeks.
Lecturer: Ágúst Þorbjörn Þorbjörnsson.

Learning outcome: The initial focus of the course is Monte-Carlo simulation in Excel to develop understanding of simulation concepts, and to clarify the advantages and limitations of simulation in a spreadsheet. We then look at discrete-event simulation using Simul8, a widely used simulation modeling language for a variety of application areas. 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 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 initial focus of the course is to develop an 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:
Teaching and learning activities: Lectures and problem solving classes.
Assessment methods:
Language of instruction: Icelandic

T-424-SLEE SLEEP 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: No prerequisites.
**Schedule:** Taught every day for three weeks.
**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. 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:** Students will be evaluated on: class participation (30%), reports on tutorials (30%), and written exam (40%).

**Language of instruction:** English.

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**T-650-SUST  SUSTAINABILITY** 6 ECTS

**Year of study:** Third year.
**Semester:** Spring.
**Level of course:** First cycle, advanced.
**Type of course:** Core RV.
**Prerequisites:** None.
**Schedule:** Runs for 12 weeks - 6 teaching hours each week.
**Lecturer:** Jóhanna Harpa Árnadóttir.

**Learning outcome:**

**Content:**

**Reading material:**

**Teaching and learning activities:**

**Assessment methods:**

**Language of instruction:** Icelandic.

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**T-606-LABB  THERMO AND HYDRAULICS LAB** 6 ECTS

**Year of study:** Third year.
**Semester:** Spring.
**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.
**Lecturer:** Ármann Gylfason.

**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.

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**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:**

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-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.

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**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: 
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.

T-420-PROX WORKSHOP IN PRODUCT DESIGN 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: No prerequisites.
Schedule: Project work for 3 weeks.
Lecturer: Páll Kr Pálsson and Pórdís Jóhannsdóttir Wathne.

Learning outcome:
Content:
Teaching and learning activities:
Assessment methods:
Language of instruction: Icelandic.