TÆKNI- OG VERKFRÆÐIDEILD
SCHOOL OF SCIENCE AND ENGINEERING

Applied Electrical Engineering BSc

A BSc program of 210 ECTS credits

Course catalogue
2017-2019

Updated February 15th 2018

Contents may be subject to change, for newest updates see www.ru.is

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

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BSc in APPLIED ENGINEERING - 210 ECTS

The School of Science and Engineering offers programs in applied engineering of 210 ECTS credits in three disciplines rooted in traditional trades: Civil Engineering, Mechanical and Energy Engineering, and Electrical Engineering. Students take a final examination after 3,5 years. The goal is to provide specialized and practical knowledge so that graduates are well prepared for employment in industry upon graduation. A major emphasis is placed on practical, realistic projects that are based on the teachers´ knowledge from industry. The majority of the teachers have considerable experience of design, production or construction. The students enrolled are in many instances qualified tradesmen or have work experience in their field and the program enhances that background. Although preparation for further studies is not the major goal of these programs, there are numerous opportunities and the path towards an MSc degree in engineering is easily accessible.

The admittance criteria is a matriculation examination with emphasis on mathematics and physics, or a comparable examination. Students who do not have practical experience from the workplace at the start of their studies are encouraged to obtain experience by working in the summer breaks. Applicants not having the adequate theoretical basis are offered supplementary courses at RU´s preliminary studies program.

The final examination in BSc Applied Engineering BSc 210 ECTS credits is completed in 3,5 years.
Gives very considerable professional competences seen in relation to the duration. Those graduating from this study program receive accreditation from the Icelandic Ministry of Industry to practice as fully qualified engineers, with the professional title of engineer (Icelandic: Tæknifræðingur) which is protected by law. At the same time it is easy to base studies for an MSc degree on the final examination, either in Iceland or at universities abroad. In the study programs, an emphasis is placed on the students´ work on practical projects in cooperation with engineering firms and research institutes, and students have the option of taking up to 18 ECTS credits as internship with an industrial firm. The students´ final project of 24 ECTS is a design and/or research project with emphasis on independent work and goal oriented methods in practical project work in the industry.

As a member of the CDIO network www.cdio.org 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.

This course catalogue contains descriptions of courses offered fall semester 2016 to spring semester 2018. Course descriptions may be subject to change without notice. **For further information see** www.ru.is **or contact RU School of Science and Engineering´s programme administrator for applied engineering Hjördís Lára Hreinsdóttir** tvd@ru.is

BSc in Applied Electrical Engineering - 210 ECTS

Electrical engineers work in various fields such as electric power distribution, electronics design, industrial robots, embedded systems, telecommunications, and management. They are employed at electric power companies, consulting engineering firms, in production enterprises, telecommunication companies, to name just a few. Their responsibilities include the design and analysis of power distribution equipment, the design of electronic devices, the design and installation of automation equipment for manufacturing, the design of lighting, and security equipment for buildings. The study program covers the basic theory of mathematics, physics, computer science, electric circuit theory, and electronics, and provides students with knowledge and skills in selected areas of electrical power systems theory, electronics and computer systems.

The students are encouraged to develop an investigative approach to problem solving and to develop independent study skills, good writing skills and oral communications skills. Develop management, teamwork, problem-solving, and design skills through a combination of directed practical projects, and independent projects. The goal is to produce graduates with the theoretical and practical knowledge and skills that enables them to make an immediate contribution in the electrical and electronic industries.

In the first 6 semesters, students generally take five courses per semester (6 ECTS each). Four courses are taught during the first 12 weeks of the semester (6 ECTS each), ending with a written or an oral examinations. After the examination period comes a three-week intensive, project-oriented course (6 ECTS). In the 7th semester students work on a specialized final project (24 ECTS) and one elective course (6 ECTS). During the 5th, 6th and 7th semesters students take elective subjects that offer a degree of specialization. Instead of elective courses, they gave the option of taking up to 18 ECTS credits as internship with an engineering firm. Two fields of specialization are offered: Electric Power Systems, and Electronics and Computers.
For further information see www.ru.is

STUDY PLAN IN APPLIED ELECTRICAL ENGINEERING

Plan for students who commence their studies in FALL 2017 or FALL 2018

	Fall	Spring	Fall	Spring
	RT1 1. önn	**RT2** 2. önn	**RT3** 3. önn	**RT4** 4. önn
Brain Storming (1 ECTS)	T-100-HUGM			
Physics	AT EÐL 1003	RT EÐL 2003		
Mathamatics	AT STÆ 1003	AT STÆ 2003	AT STÆ 3003	
Digital Electronics	RT STA 1003			
Programming in C++	T-111-PROG			
Intro to Engineering Design/CAD	AT TÆK 1002			
Electric Circuit Analysis		RT RAS 1003		
Statistics and Methodology		AT AÐF 1013		
Data Structures**				T-201-GSKI**
Electric Installations Design**				RI RLH 1003**
Electromagnetic Theory			RT EXH 1013	
Electric Circuit Design			RT RAS 2003	
Electronics I				RT RAT 1003
Electrical Power Systems I				RT RAK 1003
Robots – Practical Project I		RT HVR 1013		
Measurement Techniques			RT MAL 1003	
Project Management			AT VST 1003	
Signals and Systems				T-306-MERK
Practical Project II				RT HVR 2003

	RT5 5. önn	**RT6** 6. önn	**RT7** 7. önn
Core courses:			
Feedback Control Systems	VT REG 1003		
Power Electronics	RT PWR 1003		
Communication Systems I	RT FSK 1003		
Industrial Controllers and Robots		RT IDN 1003	
Final Project			RT LOK 1012
Management and Innovation			AT RSN 1003
Practical Project in electric power or electronics/computers	RT HVR 3003	RT HVR 4003	
Specialization: Electric Power			
Internship I, II, III	AT INT 1003*	AT INT 1003*, AT INT 2003*, AT INT 3003*	
Lighting and Regulations	RI LYR 1003*		
Electrical Machines		RT RVE 1003*	
Electrical Power Systems II		RT RAK 2003*	
Energy in Industrial Processes	T-863-EIIP*		
Specialization: Electronics			
Internship I, II, III	AT INT 1003*	AT INT 1003*, AT INT 2003*, AT INT 3003*	
Design X		T-420-HONX*	
Mechatronics	T-411-MECH*	T-535-MECH*	
Communication Systems II		RT FSK 2003*	
Electronics II		RT RAT 2003*	
Reiknirit	T-301-REIR*		
Various electives in computer science, subject to program director´s approval			

*Recommended electives, other elective courses are also available. Instead of RT HVR 3003 in the 5th semester and/or RT HVR 4003 in 6th semester, it is optional to take Internship II and/or III.

**Mandatory to take either Electric Installations Design (RI RLH 1003) or Data Structures (T-201-GSKI). The other course may be taken as an elective in the 6th semester.

Taught as an intensive 3-week course at the end of the semester

Course descriptions in BSc in Applied Electrical Engineering

First year courses – Fall semester

AT EÐL1003 PHYSICS 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Taught for 12 weeks – 4 lectures and 2 problem-solving classes a week, with additional weekly tutorial sessions and 3 lab sessions.
Supervising teacher: Sigurður Ingi Erlingsson.
Lecturer: Vilhelm Sigfús Sigmundsson. Andrei Manolescu (labs).

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 desribe motion in 2 and 3 dimensions
- Newtons 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 decribing simple collisions
- Kinematic of rotation, angular momentum and moment of inertia
- Statics and properties of static fluids and fluid motion
- Free, damped and driven oscillations
- Heat, temperature and simple heat flow
- Performing measurements, quantitative error analysis and report writing

Content: Physics is a cornerstone to the traditional engineering desciplines. In the course students will be trained in describing simple motion using Newtonian mechanics and the basics of thermodynamics. Special emphasis will be placed on understanding the various concepts in preparation for further studies in applied engineering.

Reading material: H.D Young and R.A Freedman, *University Physics with Modern Physics*.
Teaching and learning activities:. Lectures and practical sessions. Laboratory work (3 experiments with reports) and weekly due exercises.
Assessment methods: 3 hour written exam counts for 80% of the final grade. Laboratory work and due exercises count for 20%.
Language of instruction: Icelandic.

T-111-PROG PROGRAMMING IN C++ 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core. ***This course is taught in the School of Computer Science***.
Prerequisites: No prerequisites.
Schedule: ***See the School of Computer Science´s course catalogue***.
Supervising teacher: See the School of Computer Science´s course catalogue.
Lecturer: See the School of Computer Science´s course catalogue.

Learning outcome:

Knowledge. The student can:

- Describe the meaning of the following concepts: encapsulation, information hiding and abstract data type.
- Describe how the concept of a class supports the above concepts.
- Understand the difference between an interface and an implementation.

Skills. The student can:

- Use an integrated development environment (IDE) for developing and compiling a program.
- Implement, test, debug, change and explain a program that uses each of the following basic programming constructs: variables, types, expressions and assignments, simple I/O, conditional and iterative statements, arrays and functions.
- Coose appropriate conditional and iterative constructs for a given programming task
- Apply top-down design to break a program into smaller pieces.
- Apply different methods of parmeter passing.
- Write programs that uses pointers and dynamic arrays.
- Apply overloading with regard to operations.
- Design, implement, test, debug and explain a program that uses classes.

Competence. The student can:

- Design and implement a program for a problem that is described in a general manner.

Content: This is an introductory course in computer programming using the C++ language. Fundamental programming constructs are covered, e.g. variables, types, control structures, functions and pointers, as well as built-in data structures like arrays, strings and vectors. The concept of a class is introduced and how it supports encapsulation and information hiding in the context of object-oriented programming. Students learn to use both an Integrated Development Environment (IDE) and command prompt mechanisms for development and compilation.

Reading material: See the School of Computer Science´s course catalogue.
Teaching and learning activities: See the School of Computer Science´s course catalogue.
Assessment methods: See the School of Computer Science´s course catalogue.
Language of instruction: Icelandic.

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: An intensive project course taught for 3 days in September; Wednesday afternoon, and all day Thursday and Friday.
Supervising teacher: Haraldur Auðunsson.
Lecturer: Haraldur Auðunsson, and others.

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 situations where decisions and planning are based on uncertain information.
- have been introduced to diverse ways of presenting 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 probelm proposed to them. Students must have completed the course before entering the third year of study.

Reading material: Handout from teachers.
Teaching and learning activities: Teachers give short presentations on teamwork, brainstorming and various methods of presenting ideas. Students work in groups of 5-6 under the guidance of teachers.
Assessment methods: The final grade is either “Pass” or “Failed” and is based on active participation in the course.
Language of instruction: Icelandic.

AT TÆK1002 INTRODUCTION TO ENGINEERING DESIGN 5 ECTS

Year of study: First year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: None.
Schedule: An intensive course taught every weekday for 3 weeks.
Supervising teacher: Haraldur Auðunsson.
Lecturer: Haraldur Auðunsson, and others.

Learning outcome: After completing the course the student should:

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

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

Reading material: Material will be provided by teachers.
Teaching and learning activities: Lectures, assignments to be solved either by each student or by a group, and teamwork.

Assessment methods: The following will be evaluated: Projects using computer-aided design and drawing, participation and contribution in group work, workbooks, and presentation of the project results including presentations, posters and a short video.
Language of instruction: Icelandic.

RT STA1003 DIGITAL ELECTRONICS 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Taught for 12 weeks - 6 teaching hours a week. In the 10th – 12th week of teaching, students work on a project designing and constructing a digital system.
Supervising teacher: Baldur Þorgilsson.
Lecturer: Baldur Þorgilsson.

Learning outcome: On completion of the course the student should
- have a good understanding of digital circuits and their components
- be able to analyse, design, simulate and simplify simple digital circuits
- be able to implement simple digital circuits and confirm their function with measurements
- be able to write simple programs for microcontrollers

Content:
- Numbering systems and codes and arithmetic operations.
- Logic gates and logic families in TTL and CMOS
- combinational and sequential logic circuits.
- Interaction of logic circuit and Boolean algebra. Karnaugh Map.
- Encoders, decoders, multiplexers, de-multiplexers
- Latches, flip-flops, timers, counters, shift-registers
- Programmable logic
- Data acquisition, analog/digital and analog-digital converters
- Microcontrollers for simple embedded systems
- Practical sessions with microcontrollers

Reading material: Thomas L. Floyd, *Digital Fundamentals*, 11th edition, global edition, 2015.
Teaching and learning activities: Lectures, home assignments, assignments in class, labwork, and final exam.
Assessment methods: A 3 hour written exam counts 50%. Gaded home assignments, labwork and reports count 50%.
Language of instruction: Icelandic.

AT STÆ1003 MATHEMATICS I 6 ECTS

Year of study: First year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Taught for 12 weeks – 4 lectures and 2 problem-solving classes a week, with additional weekly tutorial sessions.

Supervising teacher: Hlynur Arnórsson.
Lecturer: Hlynur Arnórsson.
Learning outcome: On completion of the course students should:

Knowledge:

- Know complex numbers and basic operations with complex numbers.
- Know polar representation and roots of complex numbers
- Know basic functions and their characteristics.
- Know limits and be familiar with continuity and differentiability.
- Know the Intermediate-value theorem.
- Know the Mean Value theorem.
- Know integrals and their 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.
- Know the fundamental theorem of Calculus.
- Know how to find extreme-values of functions.
- Know linear approximation.
- Know Taylor Polynomials.
- Know initial value problems.
- Know second order differential equations with constant coefficients and their solution.
- Be acquainted with mathematical reasoning.

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 on the form $z^n = w$.
- Be able to determine basic properties of functions.
- Be able to find the limit of a function.
- Be able to use the Intermediate-value theorem.
- 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 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 find the solution of a second order differential equation with constant coefficients.
- Be able to use mathematical symbols and reasoning to show a solution in a clear and precise manner.

Competence:

- Be able to use mathematics to solve technical problems.

Content: In Calculus I we learn about functions of one variable. Complex numbers, roots and polar coordinates. 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, differentiation, anti-derivatives and integration, Taylor-polynomials and second order differential equations with constant coefficients.

Reading material: Adams, *Calculus, A complete course*. Teacher´s lecture notes.

Teaching and learning activities: Lectures and practical sessions, and problem-solving sessions with tutorial assistance.
Assessment methods: Written examination counts 80%, home projects 20%.
Language of instruction: Icelandic.

First year courses – Spring semester

RT EÐL2003 PHYSICS II 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: Physics I (AT EÐL1003), Mathematics I (AT STÆ1003).
Schedule: Taught for 12 weeks – 6 teaching hours a week, with additional lax exercises.
Supervising teacher: Sigurður Ingi Erlingsson.
Lecturer: NN. Andrei Manolescu (labs).

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

- Properties of electric charge and Coulombs law
- Electric flux and using Gauss law to calculate electric fields
- Electrostatic potentials, capacitance, capacitors and the properties of dielectrics
- Electric current, resistance, EMF, internal resistance and Ohms law
- Charging and discharging of capacitors
- Magnetic field, magnetic force and sources of magnetic field
- Faraday´s law, mutual inductance, self-inductance, and inductors
- Transmission lines and waves
- 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 electical systems from simple circuits to antenna.

Reading material: H.D. Young and R.A: Freedman, *Univerisity Physics with Modern Physics.*
Teaching and learning activities: Lectures, problem-solving sessions, and lab exercises. Participation in all lab exercises is mandatory and all 4 lab reports must be turned in.
Assessment methods: A 3 hour written examination 70%; best grade out of 3 midterm exams 10%; due exercises 10%, mandatory lab exercises and written lab reports 10%.
Language of instruction: Icelandic.

RT RAS 1003 ELECTRIC CIRCUIT ANALYSIS 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core.

Prerequisites: No prerequisites.
Schedule: Taught for 12 weeks – 4 lectures and 2 problem-solving sessions a week, with additional lab exercises.
Supervising Teacher: Ragnar Kristjánsson.
Lecturer: Jón Bjarnason.

Learning outcome: This course presents the fundamentals of electric circuits. After successful completion of the course, students should understand the basic concepts of voltage, current, power and energy and circuit elements, including different types of sources. They should:

- be familiar with the basic variables of linear circuits
- know the basic methods of linear circuit analysis
- be exposed to experiments and computer-aided circuit analysis
- have gained competence in disciplined and accurate procedures in presenting homework assignments and reports.

Content: Electric circuit diagrams and their elements. Circuits in equilibrium: Kirchoffs current and voltage laws. Definition of ideal voltage and current sources. Circuit analysis based on mesh analysis and nodal analysis. Superposition, Thévenin and Norton equivalent circuit theorems. Energy storage in electric and magnetic fields, capacitors and inductors. Response of RL, RC, and RLC circuits. AC-circuits, phasors, power in AC circuits. + more e.g three-phase circuits, Y-to-D circuit transforms or filter basics.

Reading material: Richard C. Dorf & James A. Svoboda, *Introduction to Electric Circuits*.
Teaching and learning activities: Lectures, problem solving sessions and practical lab exercises.
Assessment methods: Homework assignments 30%. Lab exercises and reports 30%. Final exam 40%.
Language of instruction: Icelandic.

RT HVR1013 ROBOTS – PRACTICAL PROJECT I 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: First year, intermediate.
Type of course: Core.
Prerequisites: Stafræn tækni (RT STA1003).
Schedule: An intensive course, taught all weekdays for 3 weeks.
Supervising teacher: Baldur Þorgilsson.
Lecturer: Davíð Freyr Jónsson.

Learning outcome: On completion of the course students should:
• know how to obtain and utilize technical information from the internet, about electronic components.
• be familiar with using measuring equipment and construction of electronic devices.
• be able to draw electronic circuit diagrams with a computer program and use a specialized equipment for making printed circuit prototypes.
• be able to write a clear and concise report on their work.

Content: Construction project: Designing, building and programming an autonomous robot, controlled by a microcontroller. The robot senses its enviroment with SONAR and avoids any contact with obstacles, using regulation to stear clear of any hinderance. The robot can transmit various sound signals including a pre-recorded human voice.

Reading material: As recommended by teacher.

Teaching and learning activities: Short lectures and consultations in the lab. Students complete a design project.
Assessment methods: Assessment of project report and an oral presentation counts 100%.
Language of instruction: Icelandic.

AT STÆ2003 MATHEMATICS II 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: Mathematics I (AT STÆ1003).
Schedule: Taught for 12 weeks – 4 lectures and 2 problem-solving classes a week, with additional weekly tutorial sessions.
Supervising teacher: Hlynur Arnórsson.
Lecturer: Hlynur Arnórsson.

Learning outcome: On completion of the course students should:

Knowledge:

- Know basic matrix operations.
- Know how to solve a linear system of equations.
- Be familiar with vector operations and their utilization in geometry.
- Know methods for computing determinants, eigenvalues and eigenvectors.
- Know linear dependent and linear independent vectors.
- Know linear combination and be familiar with rank, basis and dimensions in R^n.
- Know matrixes and systems of linear equations.
- Know the reduced row echelon form.
- Know the parametric representation of basic curves, e.g. a line and a circle.
- Know how to describe a particle in 3 space by a parametric curve and find its speed, velocity and acceleration.
- Know how to find curve length and line integral.
- Know partial derivatives and directional derivatives and know how to interpret them graphically.
- Know the Jacobian matrix and the chain rule for functions of several variables.
- Know extreme values of functions of several variables.
- Know how to evaluate double integrals in Cartesian and polar coordinates.
- Know Cartesian, spherical and cylindrical coordinates.
- Know conservative vector fields and their potential.
- Be familiar with iteration.

Skills:

- Be able to solve a linear system of equations.
- Be able to find dot product, cross product and write the equations for lines and planes.
- Be able to find the determinant of a matrix.
- Be able to find eigenvalues and eigenvectors for a matrix.
- Be able to determine if vectors are linear dependent or independent.
- Be able to write a linear combination of vectors.
- Be able to write a matrix in a reduced row echelon form.
- Be able to find the parametric representation of basic curves.

- 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 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 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 give the Cartesian, spherical and cylindrical coordinates for a point in 3-space.
- Be able to determine if vector fields are conservative and if so find a potential.

Competence:

- Be able to use linear algebra and multivariate calculus to solve technical problems.

Content: Vectors and matrices. Dot product, cross product, eigenvalues and eigenvectors. Systems of linear equations. Parametrization of curves. Position vector of a particle in space, velocity, speed and acceleration. Arc length and line integrals. Functions of several variables; limits, continuity, differentiability, partial derivative, directional derivative, Jacobi matrix, the chain rule, linear approximation and extreme values. Double integrals in cartesian and polar coordinates. Conservative vector fields, potential function.

Reading material: R.A.Adams, *Calculus, A complete course*, 7th or 8th edition. P.V. O'Neil, *Advanced Engineering Mathematics*, 6th or 7th edition**.** Lecture notes from teacher.
Teaching and learning activities: Lectures and practical sessions, and problem-solving sessions with tutorial assistance.
Assessment methods: Written examination counts 70%, home projects 10% and short exams 10%.
Language of instruction: Icelandic.

AT AÐF1013 STATISTICS AND METHODS 6 ECTS

Year of study: First year.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: Mathematics I (AT STÆ1003).
Schedule: Taught for 12 weeks – 6 hours a week: 4 hours statistics and 2 hours research methodology.
Supervising teacher: Hera Grímsdóttir.
Lecturer: Hera Grímsdóttir.

Learning outcome: The course is divided into two parts; statistics and research methodology.

After completion of the statistical part of the course the student should be able to:

- describe the extent to which a sample can describe the sampled population
- calculate descriptive statistics, i.e. average and standard deviation, median, quartiles and interpret the results
- evaluate measurement uncertainties and explain what it means for both single and repeated measurements
- calculate the uncertainty of a function of several random variables
- briefly describe the normal, lognormal, binomial and Poisson probability distributions

- calculate confidence intervals for the averages of large and small samples, and interpret the results
- set up a statistical test for the difference of two averages and interpretation of the results
- set up a statistical test for the difference between paired measurements, and interpret the results
- calculate the "best fit" for linearly correlated measurements, and explain what "best fit" means
- interpret the uncertainties of the coefficients of the “best fit” line, and evaluate the correlation coefficient
- use software, such as Excel, to compute descriptive statistics and the “best line”.

After completion of the research methodology part of the course the student should be able to:

- describe and follow the classical structure of research papers (IMRaD)
- prepare a list of references according to standards, focusing on the IEEE standard
- write a short essay, evaluate the quality of references and use databases
- give a short lecture.
- design a simple research project, carry it out, and present the results according IMRaD and with a poster.

Content: The aim of the course is to prepare students such that they can:

- apply statistical methods to organize a research project, perform statistical analysis of data, interpret and present the results, as well as evaluate statistical results from others.
- organize and manage a design or research project, and present the results in a report, in a lecture and by a poster.

Reading material: William Navidi, *Statistics for Engineers and Scientists*. Material from teacher.
Teaching and learning activities: Lectures, projects, exercises and presentations.
Assessment methods: There will be no final exam. The final grade is based on six exams during the semester in statistics (every other week), homework in statistics (to be turned in every other week), and several projects in research methodology. The statistics part counts for 2/3 of the final grade and the methodology part counts for 1/3.
Language of instruction: Icelandic.

Second year courses – Fall semester

RT RAS2003 ELECTRIC CIRCUIT DESIGN 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: Electric Circuit Analysis (RT RAS 1003).
Schedule: Taught for 12 weeks – 4 lectures and 2 problem-solving sessions a week. Three laboratory exercises.
Supervising teacher: Slawomir Koziel.
Lecturer: Slawomir Koziel.

Learning outcome:

Upon completing the course, the students should be able to:

- Understand and utilize the concept of phasors and impedances
- Carry out steady-state analysis of linear circuits
- Understand and apply the concept of frequency responses and Bode plots
- Design elementary passive and continous-time op-amp-RC active filters
- Use simulation software for circuit analysis (here, MultiSim)
- Apply the Laplace and Fourier transform for circuit analysis and design
- Describe systems as two-port networks

Content: Analysis of circuits in frequency domain, frequency response, bode plots, filter circuits, Laplace and Fourier transforms and their applications, two-port networks.
Topics covered: 1. Sinusoids and phasors (Chapter 9); 2. Sinusoidal steady-state analysis (Chapter 10); 3. Frequency response (Chapter 14); 4. Introduction to the Laplace transform (Chapter 15); 5. Applications of the Laplace transform (Chapter 16); 6. Fourier transform (Chapter 18); 7. Two-port networks (Chapter 19).

Reading material: C.K. Alexander, M.N.O. Sadiku, *Fundamentals of Electric Circuits*, McGraw Hill, 5th edition preferred.
Teaching and learning activities: The course consists of: 1. Lectures (4 hours a week); 2. Problem solving sessions (2 hours a week); 3. Experimental work in the lab (3 labs × 2 hours in the semester). The actual amount of lectures/problem-solving sessions/labs may differ slightly from the listed above.
Assessment methods: Assignments 10%. Laboratory exercises 15%. Homework 10%. Quizzes 10%. Midterm exam 15%. Final exam 40%. See course website for further details.
Language of instruction: English.

RT MAL1003 MEASUREMENT TECHNIQUES 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Taught for 12 weeks – 6 teaching hours a week.
Supervising teacher: Baldur Þorgilsson.
Lecturer: Guðjón Hugberg Björnsson.

Learning outcome: On completion of the course students should:
- have an understanding of the fundamentals of instruments and measuring techniques
- be able to select a suitable instrument and measurement technique for each measuring task.
- be able to analyse the measurement records and write a through report on the results

Content: Measurements in DC and AC systems, on analog- and digital circuits and communications circuits. Handling of measuring instruments and their use in the lab, laboratory exercises.

Reading material: Material from teacher.
Teaching and learning activities: Lectures, problem-solving classes and laboratory exercises.
Assessment methods: Laboratory exercises 30%. Final project 30%. A 3 hour final exam 40%.
Language of instruction: Icelandic.

RT EXH1013 ELECTROMAGNETICS AND SEMI-CONDUCTORS 6 ECTS

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

Type of course: Core.
Prerequisites: Physics II (RT EÐL2003).
Schedule: Taught for 12 weeks – 6 teaching hours a week.
Supervising teacher: Andrei Manolescu.
Lecturer: NN. Andrei Manolescu (labs).

Learning outcome: On completion of the course students should:

- become familiar with the fundamental ideas of electromagnetics / semiconductors and their applications.
- be able to formulate and solve basic electromagnetic and semiconductor problems, and have a sound basis for more specialized courses.

Content:

- Electromagnetic theory calls for a good understanding of mathamatics, especially vector analysis. The basics of vector analysis will be reviewed in this course.
- Applied electromagnetics: Electric and magnetic fields; electro- and magnetostatics; Maxwells equations; induction; transmission lines, Smith chart, matching in high frequency transmission line circuits; electromagnetic waves and their propagation.
- Semiconductors: fundamentals of semiconductors, pn junction, pn junction operation, current-voltage relationship of the junction, diodes.

Reading material: Ulaby F.T. et al, *Fundamentals of Applied Electrmagnetics*.
Teaching and learning activities: Lectures, problem solving, laboratory experiments and a project.
Assessment methods: Final exam 55%; Tests 4 x 4% = 16%; Labs 4 x 3% = 12%; Work-book 5%; Home project 12%.
Language of instruction: English.

AT STÆ3003 MATHEMATICS III 6 ECTS

Year of study: Second year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: Mathematics I (AT STÆ1003), Mathematics II (AT STÆ2003).
Schedule: Taught for 12 weeks - 6 hours a week.
Supervising teacher: Hlynur Arnórsson.
Lecturer: Hlynur Arnórsson.

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 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 Fourer series, Fourier Sine Series and Fourier Cosine Series.
- Know 1. order system of linear 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 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 functions Fourer Series, Fourier Cosine Series and Fourier Sine Series.
- Be able to find 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.

Competence:

- Be able to solve differential equations for simple dynamical systems.

Content: First order linear differential equations and differential equations with separable variables. Second order differential equations with constant coefficients. Method of variation of parameters and method of and the Method of undetermined coefficients. The Laplace transform, the Heaviside function and Diracs delta function. Fourier- Cosine- and Sine-series. Systems of first order linear differential equations. Partial differential equations.

Reading material: P.V. O'Neil, *Advanced Engineering Mathematics*, 6th or 7th edition**.** Lecture notes from teacher.
Teaching and learning activities: Lectures and practical sessions.
Assessment methods: Written examination counts 60%, home projects 30%, short exams 10%.
Language of instruction: Icelandic.

AT VST1003 PROJECT MANAGMENT 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: An intensive course, taught every weekday for 3 weeks.
Supervising teacher: Hera Grímsdóttir.
Lecturer: Hektor Már Jóhannsson, Kristinn Alexandersson, Ólafur Hermannsson.

Learning outcome: On completion of the course students should:

- Have a good understanding of the methodology of project management, the basic theories and methods that have been developed in the field of project management.

- Have a good understanding of the importance and different aspects of project work and project management in business operations.
- Be familiar with available software and technology that can be used in project management.
- Know how project management is practiced in local companies.
- Have obtained skills sufficient to apply project management methods within his field of discipline.
- Know how tender documents are structured and learn about the different forms of the bidding process.
- Be able to prepare tender documents, offers, work schedules and cost estimates for common and traditional projects and evaluate plans made by others.
- Be familiar with the basic principles and procedures in supervision of construction projects and the use of quality systems in construction.
- Attain a good understanding of the implementation of construction management methods in an actual construction project.
- Be able to apply the knowledge gain to administrate and oversee a construction project and on-site inspection.

Content: The course is on project- and construction management.

Project management:

Overview of project management methodology. Coordination of projects to attain direction and organizational management. Selecting and defining projects. Life cycle and characteristics of projects. Goals, work analysis, breakdown of work into components and creation of a flowchart. Planning, resource management, schedule, execution, progress and performance, report and sharing information. MS Project program - basis.

Optimization of the project time schedule, risk management. MS Project - inputs. Procurement, project management, project team, stakeholders. Prince2 and other methods, Gantt, CPM, PERT etc. How to choose between viable projects. MS Project - continuation.

Construction Management:

Contracting documents, design at various levels, project descriptions, specifying and registering material quantity. The bidding process and different bidding practices. Cost planning and estimating, assumptions, uncertainties, presentation. Making bids and contracts, advertising, bidding time, opening of tenders. Bidding, cost factors, data collection, structuring unit prices, estimating volume, risk, uncertainty, profits.

Contracting, evaluation of tenders, accepting a bid, rejecting a bid, negotiations. Project surveillance and control, project organization, project meetings, communication protocols, information sharing etc. Basic quality control, Project quality manual, examples of the use and benefits of the quality system. Legal concerns regarding implementation of projects, settlement and disagreement.

Reading material:
Teaching and learning activities: Lectures and practical sessions. A main construction project entails scrutinizing tender documents, making offers and organizing the project. Students deliver their offer and schedule and defend their work orally, working in groups of 3-4, teachers select students into groups.
Assessment methods: Small projects and quizzes counts 30%, grade for project work and oral examination counts 70% of final grade.
Language of instruction: Icelandic.

Second year courses – Spring semester

T-201-GSKI DATA STRUCTURES 6 ECTS

Year of study: First year/ Second year. ***This course is taught in the School of Computer Science***.
Semester: Spring.
Level of course: First cycle, introductory.
Type of course: Core. ***This course is taught in the School of Computer Science***. *A student of Applied Electrical Engineering must take either RI RLH 1003 Electrical Installations Design, or T-201-GSKI Data Structures.*
Prerequisites: Programming (T-111-PROG).
Schedule: ***See the School of Computer Science´s course catalogue***.
Supervising Teacher: See the School of Computer Science´s course catalogue.
Lecturer: See the School of Computer Science´s course catalogue.

Learning outcome: On completing the course, students should be able to:

- Write programs that use each of the following data structures: multi-dimensional arrays, linked lists, stacks, queues, trees, and hash tables.
- Choose the appropriate data structure for modeling a given problem.
- Identify the base case and the general case of a recursively defined problem.
- Implement, test, and debug simple recursive functions.
- Compare iterative and recursive solutions for elementary problems such as factorial.
- Apply sequential search, binary search and sorting algorithms in a creative manner or in new circumstances.
- Describe the ideas underlying the notion of abstract data types and the differences between their specification and implementation.
- Be able to use abstract data types by only having access to their specification.
- Justify and describe the philosophy of object-oriented design and the concepts of encapsulation, inheritance and polymorphism.
- Design, implement, test, and debug programs in an object-oriented programming language.
- Develop code that responds to exception conditions raised during execution.

Content: This course discusses various data structures, like linked lists, stacks, queues, trees and hash tables. Recursive programming and sorting algorithms are also discussed. At the same time, emphasis is on abstract data types, object-oriented programming and exception handling. The programming language C++ is used in the course.

Reading material: See the School of Computer Science´s course catalogue.
Teaching and learning activities: See the School of Computer Science´s course catalogue.
Assessment methods: See the School of Computer Science´s course catalogue.
Language of instruction: Icelandic.

RT HVR2003 PRACTICAL PROJECT II 6 ECTS

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

Type of course: Core.
Prerequisites: The course is taught at the end of the 4th semester in applied electrical engineering, and is based on the course content of all previously completed mandatory courses.
Schedule: An intensive course, taught all weekdays for 3 weeks.
Supervising teacher: Ragnar Kristjánsson.
Lecturer: Ragnar Kristjánsson and/or Baldur Þorgilsson.

Learning outcome: On completion of the course students should:

- have used electrical engineering methods to solve practical projects
- have learned to use independent and goal oriented methods in practical project work and/or research work in the industry.
- have obtained a broader overview through the interaction of courses where he applies knowledge from many subjects previously studied in the Electrical Engineering programme.

Content: A practical design and/or research project normally connected with subjects from the last semester courses, selected by the student and approved by the teacher. The student is required to show his capability to work independently. Projects are often in cooperation with firms and companies in the industry. The main emphasis is on an organized technical approach to the problem and it´s definition, notebook writing, gathering of information, synthesis, analysis and optimisation, evaluation, report writing and presentation. The project is presented orally.

Reading material: As recommended by teacher.
Teaching and learning activities: Lectures and practical work on a project.
Assessment methods: Assessment of student´s logbook 20%, written project report 60%, oral presentation 20%.
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 RT, HEV, HÁV.
Prerequisites: Practical programming (AT FOR 1003), Analog Circuit Analysis (T-306-RAS1), Calculus III (T-301-MATH).
Schedule: Runs for 12 weeks – 4 lectures and 2 problem solving classes each week. 5-6 practical lab sessions during the semester.
Supervising teacher: Jón Guðnason.
Lecturer: Jón Guðnason.

Learning outcome:
Knowledge:

After the course the students should be able to recall, describe and define the following terms: Contionous-time and discrete-time signals. Unit impulse and unit step signal. Contionous-time and discrete-time systems. Causality, stability, linearity, time invariance and systems with memory. Linear time invariant systems. Unit impulse and unit step response. Convolution. Fourier series. Continous Fourier transform. Discrete-Time Fourier transform. Convolution property of the Fourier transform. Sampling. Laplace Transform. Z-transform. Amplitude and phase response. Two-dimensional signal processing. Filters.

Skills:

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

Compentence:

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

Content:

Contionous-time and discrete-time signals. Unit impulse and unit step signal. Contionous-time and discrete-time systems. Causality, stability, linearity, time invariance and systems with memory. Linear time invariant systems. Unit impulse and unit step response. Convolution. Fourier series. Continous Fourier transform. Discrete-Time Fourier transform. Convolution property of the Fourier transform. Sampling. Laplace Transform. Z-transform. Amplitude and phase response. Two-dimensional signal processing. Filters.

Reading material: Oppenheim, Willsky og Nawab, *Signals and Systems.*
Teaching and learning activities:
Assessment methods:
Language of instruction: Icelandic.

RT RAT1003 ELECTRONICS I 6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: Electric Circuit Analysis (RT RAS1003), Electric Circuit Design (RT RAS2003).
Schedule: Taught for 12 weeks – 6 teaching hours a week.
Supervising teacher: Baldur Þorgilsson.
Lecturer: Jón Ingi Einarsson.

Learning outcome:
- be familiar with basic semi-conductor theory.
- be able to analyze, troubleshoot and design the the most common types of amplifiers.
- be able to analyze and design simple power supply circuits.
- be able to analyze and design frequency dependent circuits.

Content: Semiconductor theory. Design of simple electronic circuits using diodes, transistors (MOSFET and BJT) and Op-Amps. Biasing, efficiency, amplification, input and output impedances, common sub-circuits and configurations. Design techniques of small-signal amplifiers (CS, CE and difference amps) and their uses in multistage amplifiers. Effect of frequency dependent components.

Reading material: Sedra/Smith, *Microelectric Circuits*, International 6th edition, 2011.
Teaching and learning activities: Lectures and problem solving sessions. Four lab experiments. Active students participation in classes is required i.e. students regularly present their solved problems to the class.
Assessment methods: Homework 25% (10 assignments). Laboratory exercises 25% (4 exercises). Final exam 50% (a 3 hour written exam).
Language of instruction: Icelandic.

RI RLH1003 ELECTRICAL INSTALLATIONS DESIGN 6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle - Intermediate.
Type of course: Core. *A student of Applied Electrical Engineering must take either RI RLH 1003 Electrical Installations Design, or T-201-GSKI Data Structures.*
Prerequisites: Lighting and regulations (RI LÝR 1003).
Schedule: Distance learning for 15 weeks, two weekend sessions on campus.
Supervising teacher: Kristinn Sigurjónsson.
Teacher: Svanbjörn Einarsson.

Learning outcome: On completion of the course students should:

- Become proficient in the design of the most common electrical and special systems and can use the appropriate software.

Content: Design of electrical linstallation, smaller and larger, signal systems, choice of materials, price calculation, specifications and bill of quantities. Drawing, using computers, design of switchboards with traditional lighting controls, Dali and KNX and the layout of lighting control in drawings of electrical installations.

Reading material: Material from teacher.
Teaching and learning activities: Distance learning for 15 weeks, two weekend sessions on campus. Lectures, sample problems, assignments and projects during on-campus sessions, and through the electronic teaching system. Material on the web is followed up by regular assignments during the term. Instructions from the teacher on the web, audiovisual aids.
Assessment methods: Due assignments and a final project count 100% of the grade.
Language of instruction: Icelandic.

RT RAK1003 ELECTRICAL POWER SYSTEMS I 6 ECTS

Year of study: Second year.
Semester: Spring.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: Electric Circuit Design (RT RAS 1003).
Schedule: Taught for 12 weeks – 6 teaching hours a week. Laboratory exercises.
Supervising teacher: Mohamed Abdel-Fattah.
Lecturer: Mohamed Abdel-Fattah. *Teacher in spring semester 2018 is Kristinn Sigurjónsson*.

Lærdómsviðmið:
• The main object of the course is to present the fundamentals of power engineering. After successful completion of this course, students should know the basic components of the modern power systems. They should gain some idea about the energy resources and power plants and understand how electrical energy is generated, transmitted, distributes and consumed.
• Students should understand the fundamentals of electric power and the three-phase systems, and gain a broad knowledge of the main components of the electric power systems and electric machines, including generators, transformers, transmission lines and cables, distribution systems. They should also gain a broad knowledge of the different types of electric machines and its applications, including synchronous, induction and DC machines.
• Students should be able to analyze and solve simple tasks/problems in electric power systems and electric machines. They should also gain adequate experimental experience and skills by doing some experiments at the lab (not confirmed yet).
• Students' individual skills are expected to be improved by using individual assignments and projects, related to the power system in Iceland. On the other hand, their group work experience is expected to be developed by using group discussions and tasks and presenting their work.

Lýsing:
• Basic components of the modern power systems; generators, transformers, transmission and distribution line, and electric machines.
• Energy resources and power plants.
• Three-phase systems and power factor improvement.
• Magnetic circuits, transformers and per-unit analysis.
• Function and performance of transmission lines, underground cables and electrical distribution systems.
• Electric machines; synchronous generators, induction motors and DC machines (separately excited, series, shunt and compound machines).

Lesefni: Mohamed A. El-Sharkawi, *Electric Energy, an Introduction*, 3rd edition, 2012 (aðalbók). P.C. Sen, *Principles of Electric Machines and Power Electronics*, 3rd edition, 2013 (ítarefni).
Kennsluaðferðir:
• Lectures; for the presentation of the fundamentals and theory.
• Exercises/problem solving; for the development of the analytical engineering skills.
• Group discussions; for thinking, brainstorming and understanding.
• Experiments in the lab (not confirmed yet), for the development of the experimental skills.
• Group work presentations; for supporting the knowledge exchange and team work skills.
• Individual tasks/assignments; for the development of the self-learning and individual skills.
Námsmat:
Presentation (Group-Work, Grade: 20%). Homework/Assignments (Grade 3x10%). Experiment Report or Individual Task (Grade 10%). Examination (written or on-line examination, Grade: 2x20%).
Tungumál: Enska.

Third year courses – Fall semester

RT FSK1003 COMMUNICATION SYSTEMS I 6 ECTS

Year: Third year.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Core.
Prerequisites: No prerequisites.
Schedule: Taught for 12 weeks – 6 teaching hours a week.
Supervising teacher: Baldur Þorgilsson.
Lecturer: Ingvar Bjarnason.

Learning outcome: Upon completion of the course the student should:
• know the most common types of modern communication systems
• have the necessary knowledge of communication technology and systems to work with the following:

- Telecom firms
- Companys and institutions that are large users of telecom
- Companys that import-/export telecom equipment

Content: Modern communication systems, radio, television, moblie phones, satellite communication, fiber optics, SDH, xDSL, IP, Ethernet, MPLS, modulation methods, coding, bandwidth, analog and digital techniques, propagation of signals in wireless systems, virtualization in communication. Field trips to relevant firms in the communication sector.

Reading material: Andrew S. Tanenbaum, *Computer Networks*, 5. útgáfa.
Teaching and learning activities: Lectures. Students write reports and give oral presentations. Field trips to relevant firms in the communication sector.
Assessment methods: An oral examination. Assessment of reports and presentations.
Language of instruction: Icelandic.

RT HVR3003 PRACTICAL PROJECT III 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core.
Prerequisites: The course is taught at the end of the 5^{th} semester in applied electrical engineering, and is based on the course content of all previously completed mandatory courses.
Schedule: An intensive course, taught all weekdays for 3 weeks.
Supervising teacher: Ragnar Kristjánsson.
Lecturer: Ragnar Kristjánsson, Baldur Þorgilsson.

Learning outcome: On completion of the course students should:

- have used electrical engineering methods to solve practical projects
- have learned to use independent and goal oriented methods in practical project work and/or research work
- have obtained a broader overview through the interaction of courses where he applies knowledge from many subjects previously studied in the Electrical Engineering programme.

Content: A practical design and/or research project normally connected with subjects from the last semester courses, selected by the student and approved by the teacher. The student is required to show his capability to work independently. The main emphasis is on an organized technical approach to the problem and it´s definition, notebook writing, gathering of information, synthesis, analysis and optimisation, evaluation, report writing and presentation. The project is presented orally.

Reading material: As recommended by teacher.
Teaching and learning activities: Lectures and practical work on a project.
Assessment methods: Assessment of student´s logbook 20%, written project report 60%, oral presentation 20%.
Language of instruction: Icelandic.

RT PWR1003 POWER ELECTRONICS 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core.
Prerequisites: Electronics I (RT RAT1003).
Schedule: Taught for 12 weeks – 4 lectures and 2 problem solving classes a week.
Supervising teacher: Kristinn Sigurjónsson.
Lecturer: Kristinn Sigurjónsson.

Learning outcome: On completion of the course students should:

- have a good grasp of the methods used to control large amounts of electric power.
- have a good overview of various kinds of semiconductor devices used in the power electronics.
- know methods for control of converters and inverters.

Content: The course is intended to give overview of devices broadly used in power electronics. The course will cover electronic devices such as diodes, thyristors, triacs a.o. Special attention will be drawn to the use of power electronic in motor control, in the heavy industry and in the electrical transmission system (HVDC, FACTS). The conversion between AC and DC will be covered. The teaching will be based on lectures, examples, question and problems. A project in building a power electronic device will be part of the course.

Reading material: Theodore Wildi, *Electrical Machines, Drives, and Power Systems*, 6th edition.
Teaching and learning activities: Lectures and practical sessions.
Assessment methods: A 3 hour written examination counts 100%.
Language of instruction: Icelandic.

RI LÝR1003 LIGHTING AND REGULATIONS 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle - Introductory.
Type of course: Elective.
Prerequisites: None.
Schedule: Distance learning for 15 weeks, two weekend sessions on campus.
Supervising teacher: Kristinn Sigurjónsson.
Teacher: Rósa Dögg Þorsteinsdóttir.

Learning outcome: The main objective is that the student gain insight into lighting technology and lighting design, as well as an understanding of the most important lighting terms. A student who has completed the course should:

- know the basic methods used in lighting standards and the sustainability certification of buildings.
- have gained experience in using lighting software.
- be able to identify key concepts in lighting technology and their context, as well as the main effects of lighting on visual perception.
- know the main types of light sources and their properties.
- be able to identify key solutions in light controls.
- know the key strategies to take advantage of day lighting.
- be able to use software such as Dialux / Relux and DayViz.
- have learned to use the European standard EN12464-1 Light and lighting of indoor workplaces.

Content
Basic concepts of lighting technology and the standard EN12464-1 are discussed and explained. The students are expected to use the concepts in their project work. Projects are based on mastering the basic concepts and using them in lighting software. The final project must comply with the standard EN12464-1, and is based on having mastered the basic concepts as well as understanding the terminology on which the standard is based.

Reading material: Handbook: *Lýsingartækni, tæknilegir tengiskilmálar og orðsendingar.* Other material upon teachers recommendations.
Teaching and learning activities: Distance learning for 15 weeks, two weekend sessions on campus. Lectures, sample problems, assignments and projects during on-campus sessions, and through the electronic teaching system. Material on the web is followed up by regular assignments during the term. Instructions from the teacher on the web, audiovisual aids.
Assessment methods: Two assignments and a final project. Assignment 1 counts 25%, assignment 2 counts 35%; the final project in lighting design counts 40% of the final grade. To pass the course, students must obtain a passing grade for the final project.
Language of instruction: Icelandic.

T-411-MECH MECHATRONICS I 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core HÁV, elective for other programs.
Prerequisites: Practical Programming (AT FOR1003), Statics and Mechanics of Materials (T-106-BURD), Calculus III (T-301-MATH), Electric Circuits (T-509-RAFT).
Schedule: Combination of lectures and practical lessons, 6 hours per week for 12 weeks.
Supervising teacher: Joseph Timothy Foley.
Lecturer: Joseph Timothy Foley.

Learning outcome:
On completion of the course students should:

- Be able to design, build, and test advanced circuits with active elements
- Operate oscilloscopes and benchtop power-supplies
- Create schematics, layout PCB boards, and solder components to build working devices
- Program a microcontroller to read sensors and control actuators. For example: An Arduino with C++ or a Raspberry Pi with python
- Apply the Axiomatic Design methodology to analyze the interaction between different parts of the design.
- Understand digital and analog communication interfaces such as wireless networks
- Understand actuator and electronics specification sheets
- Record communication and data into a research notebook properly for international-quality research
- Write lab reports, device documentation, and simple conference papers
- See opportunities, not obstacles, when problems arise.

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

We will begin with an introduction to microcontroller programming and software engineering. This includes C++ and Subversion (for collaboration). We will then shift to electronics design, implementation, and testing. We will cover both analog and digital electronics with a focus on interfacing to sensors, DC motors, and stepper motors. Students will be designing and building PCB boards using Altium to integrate the electronics being developed.

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

Reading material: J. Edward Carryer, R. Matthew Ohline and Thomas W. Kenny, *Introduction to Mechatronic Design.*

Teaching and learning activities: Communication and rigor are critical to proper mechatronic design. Students will be shown how to use a research notebook and expected to keep it up to date as part of their grade. Peer-review of designs will be required. Proper citation of included internet and written material must be performed.
Each subject will consist of lectures and related labs or projects. Student participation and interaction in lecture discussions is mandatory. Non-verbal participation credit is gained through use of the course's instant messaging client. Some assignments will be individual, some as groupwork. Collaboration on individual assignments is expected, but each student must do their own writeup (no copying). There will be final project. The final project may be sponsored by an outside company or internal research, otherwise it will be paid for out of the student's own funds. At the end of each project, students will be presenting their design and results along with a short written report. Lab assignments only require a report based upon a standard template.

Students are expected to make use of the Machine shop and Electronics lab, taking appropriate International safety precautions where applicable. The instructor will give guidelines on these procedures and assist in execution.

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

- process
- documentation quality/rigor
- product/result

Proper citation is a requirement in this class, without exemptions. All material from an outside source (ideas, text, pictures) must include a proper citation. IEEE is the preferred format. Failure to include citations will result in a 0 for the assignment and considered plagarism. You are explicitly given permission to use the RU logo on your reports and presentations without citation because you are enrolled at our university.

Late work will be penalized according to the degree of lateness: You lose 1 point per day that work is late to a maximum of 5 points (for 5+ days late). Lateness begins at 00:00, regardless of the time specified in MySchool. Assigments may only be submitted up to two weeks late. Software with code that was checked in to SVN or MySchool at the due date/time can be checked off at the next lecture at full credit. If any changes are made after that time, the late work penalty will be applied. For LaTeX documents, the SVN/MySchool submission time of the source .tex files will be used to assess lateness. Always check the assignment for the appropriate submission procedure.

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

Language of instruction: English.

T-863-EIIP ENERGY IN INDUSTRIAL PROCESSES 8 ECTS

Year of study: First or second year MSc engineering. Also offered for final year BSc students (VT/RT).
Semester: Fall.
Level of course: Second cycle, introductory.
Type of course: Elective.
Prerequisites: BSc in mechanical, electrical or energy engineering.
Schedule: Taught for 12 vikur - 6 teaching hours a week.
Supervising teacher: Einar Jón Ásbjörnsson.
Lecturer: Einar Jón Ásbjörnsson.

Learning outcome:
Upon completion of the course students should have the ability to:

- Understand how electricity is turned into products.
- Explain the main principles in energy intensive processes.
- Promote and stimulate innovation in energy utilization.
- Have knowledge of production processes, raw materials, energy sources, energy demand, finished products and effect on environment.
- Set up process models to verify feasibility of processes.

Content: The course covers the use of energy in industrial processes and society. The principles of mass and energy balance are applied to processes taking into account thermodynamics and thermochemistry. The chemistry of metallurgical processes such as iron and steel production is covered but the main focus is on the industrial processes that are prevalent in Iceland, aluminum and silicon. Also other energy intensive processes are addressed such as cement production, mineral wool, fertilizer and synthetic fuel.

The main emphasis is on the student's ability to get an overview over various processes in terms of material and energy flow, raw materials, energy use and efficiency, environmental effects and mitigation. Also the economic background i.e. the cost, profit and market conditions are addressed. Grading is based on problem solving, individual and group projects as well as a final exam. Field trips are an integral part of the course.

Reading material: To be decided.
Teaching methods: Runs for 12 weeks – 6 teaching hours a week. Lectures, field trips and discussions. Guest lecturers from industry.
Assessment methods: Two mandatory field trips. Final grade: Five assignments 10%; Individual projects 20%; Group projects 40%, thereof 5% for milestone; Oral exam 30%.
Language of instruction: English.

VT REG1003 FEEDBACK CONTROL SYSTEMS 6 ECTS

Year of study: Third year.
Semester: Fall.
Level of course: First cycle, advanced.
Type of course: Core.
Prerequisites: Mathamatics III (AT STÆ3003).
Schedule: Taught for 12 weeks - 6 hours a week.
Supervising teacher: Indriði Sævar Ríkharðsson.
Lecturer: Indriði Sævar Ríkharðsson.

Learning outcome: On completion of the course students should:

- Be familiar with different control and regulation systems, and know the most common calculation- and design methods.
- Have a good understanding of how an automated system with feedback is structured and function to achieve desired goal.
- Have gained a basic understanding of how mathematical models of common systems are presented in the form of linear ordinary differential equations and transfer functions.
- Be able to determine the main characteristics of linear control systems from transfer functions in Laplace form.
- Understand how such models are calibrated with experiments, measurements and data processing.
- Knowledge of stability and how to influence it by applying feedback control.
- Know how to construct root locus and Bode diagrams and understand their meaning.
- Be familiar with function and characteristics of P, PD, PD and PID compensators and their impact on errors and stability.
- Be able to use Matlab and Simulink for simulation and design of control systems.
- Have practical knowledge of controllers and their application in industry.

Content: Emphasis is placed on fundamental feedback control technology, its use and design of control systems. Traditional control methods and properties of controllers, especially PID control. Design methods and tools that can be used in the development of compensators in control systems. Development of transfer functions. Laplace transform. Basic principles of feedback control systems. Block diagrams and block diagram algebra. Time and frequency response. Stability. Simulation of control systems with Matlab and Simulink. Different kind of control and regulator systems. P , PD, PI and PID compensators. Design methods for compensators. Root locus. The Bode diagram.

Reading material: Richard C. Dorf, Robert H. Bishop, *Modern Control Systems*, 12th edition.
Teaching and learning activities: Lectures and practical sessions.
Assessment methods: A 3 hour written examination counts 60% and exercises 40% of final grade.
Language of instruction: Icelandic.

T-301-REIR ALGORITHMS 6 ECTS

Year of study: Third year. ***This course is taught in the School of Computer Science***.
Semester: Fall.
Level of course: First cycle, intermediate.
Type of course: Elective. ***This course is taught in the School of Computer Science***.
Prerequisites: Programming (T-111-PROG), Data Structures (T-201-GSKI).
Schedule: ***See the School of Computer Science´s course catalogue***.
Supervising teacher: See the School of Computer Science´s course catalogue.
Lecturer: See the School of Computer Science´s course catalogue.

Learning outcome: On completing the course, students should be able to:

<u>Knowledge</u>

Be able to describe the efficiency of major algorithms for searching, sorting and hashing
Be able to describe the problem with exponential growth of brute-force solutions and its consequences
Be able to give examples of the use of graphs, trees, and symbol tables
Be able to explain the main features of the major methods
Be able to describe major versions of the symbol table

<u>Skills</u>

Be able to specify computational problems from general textual description
Be able to apply different search methods on trees and graphs
Be able to trace the execution of operations on classic data structures: heaps, binary search trees, red-black trees and union-find
Be able to solve tasks with the fundamental algorithms for graphs, such as depth-first and breadth-first search, transitive closure, topological sort, and algorithms for shortest paths and minimum spanning trees
Be able to assess the impact of different implementation of abstract data types on the time complexity of algorithms
Be able to use "big-O", omega and theta notations to give the asymptotic upper, lower and tight limits on the time and space complexity of algorithms.
Be able to apply the scientific method in the timing of algorithms
Be able to implement generic data structures and apply them to different data

<u>Competence</u>

Be able to assess algorithms, choose between possible solutions, justify the choice of method and implement in programs

Content: This course introduces the most important types of algorithms and data structures in use today. Emphasis is placed on algorithms for sorting, searching and graphs. The focus is on developing implementations, analyze them or evaluate empirically, and assess how useful they can be in actual situations.

Reading material: See the School of Computer Science´s course catalogue.
Teaching and learning activities: See the School of Computer Science´s course catalogue.
Assessment methods: See the School of Computer Science´s course catalogue.
Language of instruction: Icelandic.

AT INT1003 INTERNSHIP IN APPLIED ENGINEERING I 6 ECTS

Year of study: Third year.
Semester: Fall/Spring.
Level of course: First cycle, advanced.
Type of course: Mandatory for students in the applied civil engineering program. Elective for students in the applied electrical engineering and applied mechanical and energy engineering programs.
Prerequisites: Two years of study in applied civil, electrical or mechanical and energy engineering.
Schedule: Runs for up to 12 weeks, according to a fixed schedule.
Supervising teacher: Ingunn Sæmundsdóttir.
Lecturer: Hera Grímsdóttir (civil), Indriði Sævar Ríkharðsson (mechanical and energy), Ragnar Kristjánsson (electrical), Ása Guðný Ásgeirsdóttir (administrative).

Learning outcomes: Learning outcomes should reflect what the student learns and the experience he/she gains during the internship period. Specific learning outcomes, points of emphasis, deliverables and other requirements will be defined by the supervisors for each individual project, with the following objectives in mind.

- Strengthen students´ ties to the relevant industry.
- Enhance students´ knowledge and understanding of their chosen field of study and their future profession.
- Enhance students´ understanding of processes and the importance of planning their tasks.
- Enhance students´ competence in working with given criteria and fulfilling set requirements.
- Strengthen students´ communication skills, both external and internal within a company.
- Give students the opportunity of solving real life problems under the supervision of experienced professionals.
- Prepare students for their future careers.
- Pave students´ way into the job market.

Content: The course *Internship in Engineering I (AT INT 1003)* is mandatory in the third year of the BSc in Applied Civil Engineering program. It is also offered as an elective in the third year of the BSc programs in Applied Electrical Engineering and Applied Mechanical and Energy Engineering. Students work on a designated project under the guidance of a supervisor in a company/institution and a supervisor in HR. The student´s contribution in the company/institution shall be a minimum of 120 working hours over a period of 10-12 weeks during the semester, as well as preparatory work, work on the final report and an oral presentation. The internship must be organized in such a way that working hours do not overlap with classes in other courses. For information see: *Guidelines on Internships in Applied Engineering*.

The project must be defined and delineated in consultation with the supervisors. Typically, the intern will work on a practical project in which he/she utilizes knowledge and skills from the curriculum of previous semesters. Before the start of the internship period, the student delivers a project description which must be approved by the supervisors.

Emphasis is placed on an organized, independent and technical approach. The student must initially define the project, i.e. goals and deliverables. During the internship the student will keep a journal so that progress can be monitored. At the end of the internship period, the student writes a project report which he/she presents orally.

If a student takes the course *AT INT 1003 Internship in Engineering I* as an elective (i.e. a student of Applied Electrical Engineering or Applied Mechanical and Energy Engineering) he/she may, subject to the supervisors permission, work on a number of smaller tasks during the internship period rather than one specific project for the whole period. The primary objective of such an internship is that the student become acquainted with the diverse activities of the workplace.

Reading material: As advised by supervisors.
Teaching and learning activities: Runs for up to 12 weeks according to a previously defined schedule. Students work on a designated project under the guidance of a supervisor in a company/institution, and a supervisor in RU. The student must initially define the project, i.e. goals and deliverables. The student´s contribution in the company/institution shall be a minimum of 120 working hours. In addition, there is work on preparation, the final report and the presentation.
Assessment methods: The grade is Pass / Fail. The student´s performance in the workplace will be evaluated, as well as his/her project logbook, and the final report and presentation. The evaluation will take into account whether the student has fulfilled the learning outcomes which the supervisors defined at the beginning of the internship period.
Language of instruction: Icelandic.

Third year courses – Spring semester

RT FSK2003 COMMUNICATION SYSTEMS II 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: Communication Systems I (RT FSK1003).
Schedule: Taught for 12 weeks – 6 teaching hours a week.
Supervising teacher: Baldur Þorgilsson.
Lecturer: NN.

Learning outcome: On completion of the course students should
- Understand theoretical background for telecommunications
- Have adequate knowledge to study and work with different types of communication systems
- Realize opportunities and limits of telecommunication systems

Content: Introduction to the world of telecommunications, history of telecommunication, mathematical background, description of signals in time and frequency space, Fourier series, Fourier transform, FFT, amplitude-, phase- and frequency modulations, correlation in time-, frequency- and code-space, receivers, transmitters, noise, random processes, digital signals, the sampling theorem, digital modulation, PCM, FSK, PSK, QPSK, QAM, Shannon's rule for channel capacity, transmission of signals through linear systems, eye-diagrams, OFDM., Introduction to specific communication systems, radio, television, mobile phones, fibre optic- and DSL systems. Emphasis on calculations with Matlab. Field trips to relevant firms in the communication sector.

Reading material: Simon Haykin and Michael Moher, *Communication Systems*.
Teaching and learning activities: To be decided.
Assessment methods: To be decided.
Language of instruction: Icelandic / English.

RT HVR4003 PRACTICAL PROJECT IV 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Core.
Prerequisites: The course is taught at the end of the 6th semester in applied electrical engineering, and is based on the course content of all previously completed mandatory courses as well as 2-3 specialized elective courses.
Schedule: An intensive course, taught all weekdays for 3 weeks.
Supervising teacher: Ragnar Kristjánsson.
Lecturer: Ragnar Kristjánsson, Baldur Þorgilsson.

Learning outcome: On completion of the course students should:

- have used electrical engineering methods to solve practical projects
- have learned to use independent and goal oriented methods in practical project work and/or research work
- have obtained a broader overview through the interaction of courses where he applies knowledge from many subjects previously studied in the Electrical Engineering programme.

Content: A practical design and/or research project normally connected with subjects from the last semester courses, selected by the student and approved by the teacher. The student is required to show his capability to work independently. The main emphasis is on an organized technical approach to the problem and it´s definition, notebook writing, gathering of information, synthesis, analysis and optimisation, evaluation, report writing and presentation. The project is presented orally.

Reading material: As recommended by teacher.
Teaching and learning activities: Lectures and practical work on a project.
Assessment methods: Assessment of student´s logbook 20%, written project report 60%, oral presentation 20%.
Language of instruction: Icelandic.

T-420-HONX DESIGN X 12 ECTS

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

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

- Analyze an open-ended problem and establish requirement specifications
- Assess the merits of, and choose between, competing design alternatives
- Productively operate in an inter-disciplinary project team environment

- Work disciplined on a sub-task of a larger project.
- Demonstrate project management skills, including meeting important deadlines and operating within budgetary limits.
- Execute a design, build, test, and refine process of machines that are combined of hardware, electronics and software.

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

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

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

Reading material:
Teaching and learning activities: Project supervision, including regular discussions with project team leaders.
Assessment methods: Group work assessment 60% (design report, meeting goal criteria), Individual assessment 40 % (notebooks, peer review).
Language of instruction: Icelandic/English.

RT IDN1003 INDUSTRIAL CONTROLLERS & ROBOTS 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Core for RT, elective for VT.
Prerequisites: Practical Programming in Matlab (AT FOR1003).
Schedule: Taught for 12 weeks – 6 project-oriented classes a week.
Supervising teacher: Indriði Sævar Ríkharðsson.
Lecturer: Indriði Sævar Ríkharðsson.

Learning outcome: On completion of the course students should:

- be able to design computer-controlled production processes and be able to apply the programming control and monitoring in the industry.
- know the function and internal construction of industrial control computers (PLC) and how they are connected to sensor and actuators.
- know the function key sensors and actuators that are used in industrial control.

- be able to program simple control of Zelio PLC with Ladder, FDB or SFC programming language.
- be able to program more complex control of Modicom M340 PLC. Using analogue output and the input signals and the setup of the PID controller. Using Ladder, FDB, SFC and ST programming languages.
- be able to set up a simple display system for industrial control.
- know the basics of using and programming of industrial robots and be familiar with different coordinate systems and industrial robots.
- be familiar with the functionality of CRS industrial robot, can manually control it through Active Robot terminal and know the basic safety rules of the use of industrial robots.
- can program CRS industrial robots in Visual Basic with the ActiveX components and know all major control and motion commands and can set up user interface.
- be able to program a simple computer vision in Visual Basic with the aid of LabVIEW Vision Assistant and use it to control the movements of the robot.
- be able to connect industrial robots, PLC and other devices through the input / output unit to form an integrated system.
-

Content: Programmable logic controllers (PLC) in industry and their programming, industrial robots, computer manufacturing, monitoring system, etc. Main programming language for Industrial Controllers, Ladder, FBD, SFC (Grafset) and structured text (ST). Students work on projects that involve control of actual equipment with PLC. Programming of industrial robots and basic safety rules of their use. Basics in computer vision. Using Visual Basic with ActiveX components to program the robot and vision. Students do projects that combine control with PLC, robots and vision.

Reading material: All material is made available on the course website.
Teaching and learning activities: Mostly practical sessions, with short lectures in between.
Assessment methods: Practical exercises 50% and a 3 hour written exam 50%.
Language of instruction: Icelandic.

T-535-MECH MECHATRONICS II 6 ECTS

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

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

Content: Mechatronics-2 extends Mechatronics-1 by going into more details. While Mechatronics 1 is broader and more about getting results fast (what is possible), Mechatronics 2 is more about accuracy and how to match a design to a task with economy, accuracy and robustness in mind (what is the limit).

The course includes sensors, signal conditioning, interfacing, analog-digital conversion, digital input/outputs, timers, low level embedded firmware programming, actuators, UARTs and serial communication. It is expected that the student is familiar with the programming language C.
Along with the lectures, each student has his/her own private project based on the fundamental elements of mechatronics: sense-think-act. For this project the student holds a lab notebook. At the end of the course the student delivers a report about the project.

Reading material: J. Edward Carryer, R Mathew Ohline, Thomas W. Kerry, *Introduction to Mechatronic design*, International edition. Pearson 2011.
Teaching and learning activities: Lectures and practical sessions. Each student completes a project.
Assessment methods: Homework 30%; Midterm evaluation of draft report 15%; Final project presentation 15%; Lab-notebook 10%; Report 30%.
Language of instruction: English / Icelandic.

RT RAT2003 ELECTRONICS II 6 ECTS

Year: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: Electronics I (RT RAT 1003).
Schedule: Taught for 12 weeks - 6 teaching hours a week, with an emphasis on practical lab experiments and projects.
Supervising teacher: Baldur Þorgilsson.
Lecturer: Jón Ingi Einarsson and Baldur Þorgilsson.

Learning outcome: On the completion of the course the student should be able to
- Analyze and design frequency amplifiers with specific frequency response
- Analyze and design oscillators
- Analyze and design switching circuits

Content: Feedback amplifiers, Filters, Oscillators, Amplifier bandwidth and distortion, high frequency transistor models. Classes of amplifiers and application and voltage regulators. Taught with an emphasis on practical lab experiments.

Reading material: To be decided.
Teaching and learning activities: Theory will be taught in classes and in lab exercices. The students will work on a project.
Assessment methods: To be decided.
Language of instruction: English / Icelandic.

RT RVE1003 ELECTRICAL MACHINES 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: Electrical Power Systems I (RT RAK1003) or Electric Circuits and Electric Power (VT RAR1003).
Schedule: Taught for 12 weeks – 6 teaching hours a week. Practical lab exercises every other week.
Supervising teacher: Kristinn Sigurjónsson.

Lecturer: Kristinn Sigurjónsson.

Learning outcome: On completion of the course students should:

- be able to understand synchronous and asynchronous generators and motors.
- know how ac electricity and power flows in impedances.
- know single phase, linear induction and stepper motors.

Content: Asynchronous motors and generators, synchronous motors and generators, linear induction motor. Single phase motors and stepper motor. Electrical power production and transmission. Practical lab exercises every other week.

Reading material: To be decided.
Teaching and learning activities: Lectures, problem-solving sessions and practical lab sessions.
Assessment methods: A 3 hour written examination 80%. Lab exercises and reports 20%.
Language of instruction: Icelandic.

RT RAK2003 ELECTRICAL POWER SYSTEMS II 6 ECTS

Year of study: Third year.
Semester: Spring.
Level of course: First cycle, advanced.
Type of course: Elective.
Prerequisites: Electrical Power Systems I (RT RAK 1003).
Schedule: Taught for 12 weeks – 4 lectures and 2 problem-solving sessions a week.
Supervising teacher: Ragnar Kristjánsson.
Lecturer: Ragnar Kristjánsson.

Learning outcome: The objective of the course is that the student is able to;

- Calculate complex -voltage, -current and -power in three phase and single phase system.
- Use network equations and phasors in power system problem solving
- Select model and parameters for Transformers and Generators and be able to select and calculate these parameters based on information from the manufacturer and/or test reports.
- Use the per unit system when representing the three phase and single phase power system and in problem solving.
- Select model for transmission lines for short, medium and long lines and calculate model parameters.
- Solve power flow problems with use of Gauss-Seidel or Newton-Raphson methods.
- Identify steady state operation of the power system.
- Select models for power network components and calculate symmetrical faults

Content: This course is divided into three sections:

- Basic principles,
- Power system components and models.
- Power systems power flow and control.

The aim of the course is to provide students with a working knowledge of power system problems and computer techniques used to solve some of these problems.

Topics include: Complex power, Phasor analysis, Instantaneous power, Active and reactive power, Three phase systems, Single phase system analysis of three phase systems, Model selection and model parameter calculations for Generators, Transformers both ideal and practical, Load models, Transmission line design and parameters and calculations of resistance, inductance and capacitance, The per Unit System, The power flow problem, Power system representation in general and power flow solutions, symmetrical faults, technical treatment of the general problem of power system control. Practical assignment solved in the numerical simulation program Power World.

Reading material: Glover, Sarma, Overbye, *Power System Analysis and Design*.
Teaching and learning activities: Lectures and problem-solving sessions.
Assessment methods: A 3 hour written examination 70%; due assignments 30%.
Language of instruction: Icelandic / English.

AT INT1003 INTERNSHIP IN APPLIED ENGINEERING I 6 ECTS

Year of study: Third year.
Semester: Fall/Spring.
Level of course: First cycle, advanced.
Type of course: Mandatory for students in the applied civil engineering program. Elective for students in the applied electrical engineering and applied mechanical and energy engineering programs.
Prerequisites: Two years of study in applied civil, electrical or mechanical and energy engineering.
Schedule: Runs for up to 12 weeks, according to a fixed schedule.
Supervising teacher: Ingunn Sæmundsdóttir.
Lecturer: Hera Grímsdóttir (civil), Indriði Sævar Ríkharðsson (mechanical and energy), Ragnar Kristjánsson (electrical), Ása Guðný Ásgeirsdóttir (administrative).

Learning outcomes: Learning outcomes should reflect what the student learns and the experience he/she gains during the internship period. Specific learning outcomes, points of emphasis, deliverables and other requirements will be defined by the supervisors for each individual project, with the following objectives in mind.

- Strengthen students´ ties to the relevant industry.
- Enhance students´ knowledge and understanding of their chosen field of study and their future profession.
- Enhance students´ understanding of processes and the importance of planning their tasks.
- Enhance students´ competence in working with given criteria and fulfilling set requirements.
- Strengthen students´ communication skills, both external and internal within a company.
- Give students the opportunity of solving real life problems under the supervision of experienced professionals.
- Prepare students for their future careers.
- Pave students´ way into the job market.

Content: The course *Internship in Engineering I (AT INT 1003)* is mandatory in the third year of the BSc in Applied Civil Engineering program. It is also offered as an elective in the third year of the BSc programs in Applied Electrical Engineering and Applied Mechanical and Energy Engineering. Students work on a designated project under the guidance of a supervisor in a company/institution and a supervisor in HR. The student´s contribution in the company/institution shall be a minimum of 120 working hours over a period of 10-12 weeks during the semester, as well as preparatory work, work on the final report and an oral presentation. The internship must be organized in such a way that working hours do not overlap with classes in other courses. For information see: *Guidelines on Internships in Applied Engineering*.

The project must be defined and delineated in consultation with the supervisors. Typically, the intern will work on a practical project in which he/she utilizes knowledge and skills from the curriculum of previous semesters. Before the start of the internship period, the student delivers a project description which must be approved by the supervisors.

Emphasis is placed on an organized, independent and technical approach. The student must initially define the project, i.e. goals and deliverables. During the internship the student will keep a journal so that progress can be monitored. At the end of the internship period, the student writes a project report which he/she presents orally.

If a student takes the course *AT INT 1003 Internship in Engineering I* as an elective (i.e. a student of Applied Electrical Engineering or Applied Mechanical and Energy Engineering) he/she may, subject to the supervisors permission, work on a number of smaller tasks during the internship period rather than one specific project for the whole period. The primary objective of such an internship is that the student become acquainted with the diverse activities of the workplace.

Reading material: As advised by supervisors.
Teaching and learning activities: Runs for up to 12 weeks according to a previously defined schedule. Students work on a designated project under the guidance of a supervisor in a company/institution, and a supervisor in RU. The student must initially define the project, i.e. goals and deliverables. The student´s contribution in the company/institution shall be a minimum of 120 working hours. In addition, there is work on preparation, the final report and the presentation.
Assessment methods: The grade is Pass / Fail. The student´s performance in the workplace will be evaluated, as well as his/her project logbook, and the final report and presentation. The evaluation will take into account whether the student has fulfilled the learning outcomes which the supervisors defined at the beginning of the internship period.
Language of instruction: Icelandic.

AT INT2003 INTERNSHIP IN APPLIED ENGINEERING II 6 ECTS

Year of study: Third year.
Semester: Fall/Spring.
Level of course: First cycle, advanced.
Type of course: Elective for students in the applied civil engineering, applied electrical engineering and applied mechanical and energy engineering programs.
Prerequisites: Internship in Applied Engineering I (AT INT 1003).
Schedule: Runs for up to 12 weeks according to a fixed schedule, or as an all-day intensive course for 3 weeks.
Supervising teacher: Ingunn Sæmundsdóttir.
Lecturer: Hera Grímsdóttir (civil), Indriði Sævar Ríkharðsson (mechanical and energy), Ragnar Kristjánsson (electrical), Ása Guðný Ásgeirsdóttir (administrative).

Learning outcomes: Learning outcomes should reflect what the student learns and the experience he/she gains during the internship period. Specific learning outcomes, points of emphasis, deliverables and other requirements will be defined by the supervisors for each individual project, with the following objectives in mind.

- Strengthen students´ ties to the relevant industry.
- Enhance students´ knowledge and understanding of their chosen field of study and their future profession.
- Give students the opportunity to solve real-life problems under the supervision of experienced professionals.
- Enhance students´ understanding of processes and the importance of planning their tasks.
- Prepare students for their future careers.
- Enhance students´ competence in working with given criteria and fulfilling set requirements.
- Train students in working independently and in taking responsibility for their search for knowledge and professional priorities.
- Teach students independent and effective methods in practical design, analysis and/or research within the profession.
- Help students gain practical experience and an overview of the engineering profession by applying their knowledge and skills to solve practical, real-life projects.

- Help students develop their knowledge of the social, economic and moral aspects of the profession.
- Increase students´ knowledge and experience in the use of safety standards, and other technical standards and codes that are important in the profession.
- Improve the students´ competence in the reporting and presentation of technical solutions, and generally of the results of their work.
- Strengthen students´ communication skills, both external and internal within a company.

Content: The course *Internship in Engineering II (AT INT 2003)* is an elective in the third year of the BSc programs in Applied Civil Engineering, Applied Electrical Engineering, and Applied Mechanical and Energy Engineering. Students work on a designated project under the guidance of a supervisor in a company/institution and a supervisor in HR. The student´s contribution in the company/institution shall be a minimum of 120 working hours which can be scheduled over a period of 10-12 weeks, or as full work-days for an intensive period of 3 weeks. In addition the student does preparatory work, works on the final report and an oral presentation. The internship must be organized in such a way that working hours do not overlap with classes in other courses. For information see: *Guidelines on Internships in Applied Engineering*.

The project must be defined and delineated in consultation with the supervisors. Typically, the intern will work on a practical design-, analysis- or research-project in which he/she utilizes knowledge and skills from the curriculum of previous semesters. Before the start of the internship period, the students delivers a project description which must be approved by the supervisors.

The student must initially define the project, i.e. goals and deliverables. The project description shall provide information on what new knowledge and/or training the student will need to complete the project, with appropriate references to textbooks, specifications and/or other sources. Emphasis is placed on an organized, independent and technical approach. During the internship the student keeps a journal so that progress can be monitored. At the end of the internship period, the student writes a project report which he/she presents orally.

Reading material: As advised by supervisors.
Teaching and learning activities: Runs for up to 12 weeks according to a previously defined schedule, or as an all-day intensive course for 3 weeks. Students work on a designated project under the guidance of a supervisor in a company/institution, and a supervisor in RU. The student must initially define the project, i.e. goals and deliverables. The student´s contribution in the company/institution shall be a minimum of 120 working hours. In addition, there is work on preparation, the final report and the presentation.
Assessment methods: The grade is Pass / Fail. The student´s performance in the workplace will be evaluated, as well as his/her project logbook, and the final report and presentation. The evaluation will take into account whether the student has fulfilled the learning outcomes which the supervisors defined at the beginning of the internship period.
Language of instruction: Icelandic.

AT INT3003 INTERNSHIP IN APPLIED ENGINEERING III 6 ECTS

Year of study: Third year.
Semester: Fall/Spring.
Level of course: First cycle, advanced.
Type of course: Elective for students in the applied civil engineering, applied electrical engineering and applied mechanical and energy engineering programs.
Prerequisites: Internship in Applied Engineering I (AT INT 1003), Internship in Applied Engineering II (AT INT 2003).
Schedule: Runs for up to 12 weeks according to a fixed schedule, or as an all-day intensive course for 3 weeks.
Supervising teacher: Ingunn Sæmundsdóttir.

Lecturer: Hera Grímsdóttir (civil), Indriði Sævar Ríkharðsson (mechanical and energy), Ragnar Kristjánsson (electrical), Ása Guðný Ásgeirsdóttir (administrative).

Learning outcomes: Learning outcomes should reflect what the student learns and the experience he/she gains during the internship period. Specific learning outcomes, points of emphasis, deliverables and other requirements will be defined by the supervisors for each individual project, with the following objectives in mind.

- Strengthen students´ ties to the relevant industry.
- Enhance students´ knowledge and understanding of their chosen field of study and their future profession.
- Give students the opportunity to solve real-life problems under the supervision of experienced professionals.
- Enhance students´ understanding of processes and the importance of planning their tasks.
- Prepare students for their future careers.
- Enhance students´ competence in working with given criteria and fulfilling set requirements.
- Train students in working independently and in taking responsibility for their search for knowledge and professional priorities.
- Teach students independent and effective methods in practical design, analysis and/or research within the profession.
- Help students gain practical experience and an overview of the engineering profession by applying their knowledge and skills to solve practical, real-life projects.
- Help students develop their knowledge of the social, economic and moral aspects of the profession.
- Increase students´ knowledge and experience in the use of safety standards, and other technical standards and codes that are important in the profession.
- Improve the students´ competence in the reporting and presentation of technical solutions, and generally of the results of their work.
- Strengthen students´ communication skills, both external and internal within a company.

Content: The course *Internship in Engineering III (AT INT 3003)* is an elective in the third year of the BSc programs in Applied Civil Engineering, Applied Electrical Engineering, and Applied Mechanical and Energy Engineering. Students work on a designated project under the guidance of a supervisor in a company/institution and a supervisor in HR. The student´s contribution in the company/institution shall be a minimum of 120 working hours which can be scheduled over a period of 10-12 weeks, or as full work-days for an intensive period of 3 weeks. In addition the student does preparatory work, works on the final report and an oral presentation. The internship must be organized in such a way that working hours do not overlap with classes in other courses. For information see: *Guidelines on Internships in Applied Engineering*.

The project must be defined and delineated in consultation with the supervisors. Typically, the intern will work on a practical design-, analysis- or research-project in which he/she utilizes knowledge and skills from the curriculum of former semesters. Before the start of the internship period, the students delivers a project description which must be approved by the supervisors.

The student must initially define the project, i.e. goals and deliverables. The project description shall provide information on what new knowledge and/or training the student will need to complete the project, with appropriate references to textbooks, specifications and/or other sources. Emphasis is placed on an organized, independent and technical approach. During the internship the student keeps a journal so that progress can be monitored. At the end of the internship period, the student writes a project report which he/she presents orally.

Reading material: As advised by supervisors.
Teaching and learning activities: Runs for up to 12 weeks according to a previously defined schedule, or as an all-day intensive course for 3 weeks. Students work on a designated project under the guidance of a supervisor in a company/institution, and a supervisor in RU. The student must initially define the project, i.e. goals and deliverables. The student´s contribution in the

company/institution shall be a minimum of 120 working hours. In addition, there is work on preparation, the final report and the presentation.
Assessment methods: The grade is Pass / Fail. The student´s performance in the workplace will be evaluated, as well as his/her project logbook, and the final report and presentation. The evaluation will take into account whether the student has fulfilled the learning outcomes which the supervisors defined at the beginning of the internship period.
Language of instruction: Icelandic.

Fourth year courses – Fall or Spring semester

RT LOK1012 FINAL PROJECT 6 ECTS

Year of study: Fourth year.
Semester: Fall / Spring.
Level of course: First cycle, advanced.
Type of course: Core.
Prerequisites: Six semesters in RT. The student must have completed at least 174 ECTS credits in the Applied Electrical Engineering program to enroll for the final project.
Schedule: Runs for 15 weeks.
Supersiving teacher: Kristinn Sigurjónsson.
Lecturer: Kristinn Sigurjónsson, Baldur Þorgilsson and Ragnar Kristjánsson. External supervisors from the industry.

Learning outcome: On completion of the course students should:

- Have used engineering methods to solve extensive projects in the field of electrical/digital design and/or power systems.
- Have learned to use independent and goal oriented methods in practical project work and/or research work in the field of electrical engineering.
- Have obtained a broad overview through the interaction of courses where he applies knowledge from many subjects previously studied in the Electrical Engineering program.
- Be able to present design and/or research results in a clear way, both in writing and orally.

Content: A practical design and/or research project selected by the student and approved by the by the department. The student is required to show his capability to work independently. Projects are often in cooperation with firms and companies in the industry. The main emphasis is on an organized technical approach to the problem and it´s definition, gathering of information, synthesis, analysis and optimisation, evaluation, report writing and presentation. The student has 15 weeks to complete the project. The project is presented orally and assessed by faculty members and an external assessor.

Reading material: As recommended by supervisors.
Teaching and learning activities: The student works independently for 15 weeks, with the guidance of a supervising teacher and an external expert from the relevant industry. Regular meetings with supervisor and other instructors, see RU´s *Rules for Final Projects in Applied Engineering*.
Assessment methods: Assessment of project thesis, presentation and oral examination count 100%.
Language of instruction: Icelandic / English.

AT RSN1003 MANAGEMENT AND INNOVATION 6 ECTS

Year of study: Third year / Fourth year.
Semester: Fall.
Level of course: First cycle, introductory.
Type of course: Core.
Prerequisites: None.
Schedule: Taught for 12 weeks – 6 hours a week.
Supervising teacher: Páll Kr Pálsson.
Lecturer: Páll Kr Pálsson.

Learning outcome:
Knowledge: On the completion af the course students should be able invent business ideas that are then fostered scrutinised and matured through brainstorming, canvas methods and the creation of a business plan. On the completion of this course the students also should:
- Possess a clear understanding of the methodology and theoretical understanding of the managerial aspect used in defining and writing complete business plans.
- Understand innovation through the search for promising, inspiring and rich ideas, idea evaluation and selection.
- Understand the basics of innovation through technical developmental processes and life-cycle of both products and businesses.
- Understand marketing through market analysis and create a marketing and sales plans that define customers and market demands.
- Understand the technical challenges in innovation and define developmental processes for solutions and plan actions accordingly.
- Understand the financial and funding aspect of innovation: Plan for capital and financing, revenue and cost estimates, cash flow plan and balance sheets. Also cost estimations, revenue, value assessment and sensitivity analysis.
- Understand innovation through the human aspect of management such as the need for direction, strategy, organisation chart, and human resource management.
- Define business opportunities and write a business plan and interpret business plans.

Also students should at the completion of the course know how to define business opportunities and make a text- and calculation models in order to evaluate the business opportunity according to demand, solution, profit and financing interest. To know how to avoid making mistakes when searching and evaluating business opportunities.
Skills: Students should be able to adapt the most important methods in optimizing business opportunities by analysing current situation and suggest methods that are likely to lead to optimal results in business planning and business plans. Also students shall be able to describe how to realize their proposals.
Competence: To possess the knowledge to present and interpret the outcome of a business plan and be able to establish and/or operate minor companies.

Content: The course will give an overview of the running and managing business entities, including planning, cost analysis, human resource management and the role of managers and directors. The importance of continuous innovation is emphasised and related to the corporate lifecycles. As a practical project the students will develop a full business plan for a start-up or mature company.

Reading material: As recommended by teacher.
Teaching and learning activities: Lectures, company visits and project work.
Assessment methods: Four interim reports count 62%, the final report 18%, and an oral examination 20%.
Language: Icelandic.