# ANNEX 6

## PROGRAM-SPECIFIC STUDY AND EXAM REGULATIONS FOR BACHELOR OF SCIENCE IN MECHATRONIC ENGINEERING,

## Incl. STUDY PLAN AND MODULE HANDBOOK

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## AIMS AND OBJECTIVES

The application-oriented bachelor's degree course in Mechatronic Engineering aims to provide knowledge, skills, and competencies in engineering, mathematics, and natural sciences. This enables graduates to design, develop, operate, maintain, and repair mechatronic systems economically, ecologically, and sustainably.

The program's objective is to qualify graduates for application-oriented employment or entrepreneurship in mechatronics engineering and promote lifelong learning. Graduates are prepared to work as engineers in design, development, production, distribution, and consulting, fostering progress in society and the mechatronics engineering field.

Principles of sustainability, safety, and environmental protection are integrated into all study projects and educational components. Throughout their studies, prospective engineers are educated with a strong sense of responsibility towards society, the economy, and the environment.

Graduates in Mechatronic Engineering will be able to:

- Comprehend the purpose and function of mechatronic systems.
- Identify and analyze problems, develop engineering solutions, and implement holistic solutions for mechatronic systems such as robotics and CNC machines.
- Assess and apply mathematical, scientific, and engineering principles to solve mechatronics engineering problems.
- Develop mechatronic systems comprising sensors, actuators, controllers, software, and mechanical structures.
- Instruct and guide others in the operation, monitoring, and maintenance of mechatronic systems.
- Collaborate in international teams to address extensive and interdisciplinary problems.
- Recognize the impact of engineering activities and act responsibly towards society, the economy, and the environment.
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## CURRICULUM STRUCTURE

To achieve the aims and objectives of mechatronic engineering, the curriculum is structured to educate students 1) first two years- to prepare the foundation knowledge for mechanical engineering. The curriculum for the first two years focuses on scientific modules such as Mathematics, Chemistry, Physics, and Basic Mechanics. Also, soft skills such as communication skills, technical English and German, and scientific writing skills are taught. The curriculum for the third year provides engineering modules to help students to build basic engineering knowledge and characters. Thus the modules for introductory of mechanical engineering and modules for

general engineering are taught. Also professional internship module provides students with opportunities to learn and practice engineering skills in real situation. Finally, the forth year is dedicated to equip students with professional knowledge and engineering skills which are to be used for their career. Bachelor thesis provides research experience to solve an engineering problem and to write a logical engineering document. Especially, the final study project offers students an opportunity to cooperate with students from other engineering fields to solve a real engineering problem.

The students who want to major in mechatronic engineering program should complete the first two years' curriculum successfully with a minimum of 100 credit points. To write a bachelor thesis, a student should earn at least 171 credit point before he or she starts the 7th semester. The total amount of CPs for graduation has to be a minimum 240 CPs.

## MODULE DESCRIPTIONS

The description of each module is provided in this document following the Study Plan.

## ELECTIVES

Students take English and German language modules as electives. Every 3rd and 4th year student can choose professional engineering modules from the other programs as electives. Presupposed for participation and recognition of the elective module is that the required prerequisites of the chosen elective module already have been passed. Furthermore, the adjustment of the lecture times for attendance in the chosen elective modules can only be made by ASA in exceptional cases. The student must choose his/her subjects in such a way that participation in his/her program-related modules is not endangered or restricted.

## STUDY PLAN

| CPs | 1st Semester | 2nd Semester | 3rd Semester | 4th Semester | 5th Semester | 6th Semester | 7th Semester | 8th Semester |
|---|---|---|---|---|---|---|---|---|
| 1 | MATH101 Mathematics I 6 CP (3 UoIL, 3 UoIR) | MATH102 Mathematics II 8 CP (4 UoIL, 4 UoIR) | ENME201 Engineering Mechanics II (Dynamics) 4 CP (2 UoIL, 2 UoIR) | MEAS201 Measurement, Instrumentation, and Control Basics 4 CP (2 UoIL, 1 UoIR, 1 UoILab) | MECH301 Engineering Mechanics III (Mechanics of Materials) 4 CP (2 UoIL, 2 UoIR) | MECH303 Engineering Mechanics IV (Machine Elements) 6 CP (2UoL, 1 UoR, 0.5 UoILab, 1 UoIFt) | MECH401 Engineering Mechanics V (Dynamics of Machinery) 6 CP (2 UoIL, 1 UoIR, 0.5 UoILab, 1 UoIFt) | MECT404 Robotics 6 CP (2 UoIL, 1 UoIR 0.5 UoILab, 1 UoIEx) |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | STAT201 Introduction to Statistics 4 CP (2 UoIL, 2 UoIR) | CAD201 Computer-Aided Design (CAD) 4 CP (1 UoIL, 3 UoILab) | MECH302 Production Process Technology 6 CP (2 UoIL, 1 UoIR, 0.5 UoILab, 1UoIFt) | | | |
| 6 | | | | | | | | |
| 7 | CHEM101 Chemistry 5 CP (3 UoIL, 2 UoIR) | | | | | EEEM309 Electric Machine and Drive 4 CP (2 UoIL, 1 UoIR, 1 UoILab) | MECT401 CNC Machines 6 CP (2 UoIL, 1 UoIR, 0.5 UoILab, 1 UoIFt) | PROJ401 Final Study Project 6 CP (3 weeks) |
| 8 | | | | | | | | |
| 9 | | MATS101 Materials Science 4 CP (2 UoIL, 2 UoIR) | THER201 Engineering Thermodynamics 4 CP (2 UoIL, 2 UoIR) | FLME201 Fluid Mechanics 4 CP (2 UoIL, 2 UoIR) | | | | |
| 10 | | | | | | | | |
| 11 | | | | | EEEN304 Electronics 6 CP (2 UoIL, 2 UoIR, 2 UoLab) | MECH304 Hydraulic and Pneumatic Drives 4 CP (2 UoIL, 1 UoIR) | | |
| 12 | GEOS101 Introduction to Geoscience 4 CP (2 UoIL, 2 UoIR) | | | | | | | |
| 13 | | EMNE101 Engineering Mechanics I (Statics) 4 CP (2 UoIL, 2 UoIR) | DESN201 Engineering Design 4 CP (1 UoIL, 3 UoIR) | RREC201 Raw Materials & Recycling 4 CP (2UoIL, 2UoIFt) | | | MECT402 Software Engineering 4 CP (2 UoIL, 1 UoIR) | THES401 Bachelor Thesis + Colloquium 12 CP |
| 14 | | | | | | | | |
| 15 | | | | | | EEEM307 Power Electronics 4 CP (1 UoIL, 1 UoIR, 2 UoILab) | | |
| 16 | PROG101 Algorithm and Programming 4 CP (1 UoIL, 3 UoILab) | | | | | | | |
| 17 | | PHYS101 Physics 6 CP (1 UoIL, 1 UoIR, 4 UoILab) | ELEC201 Introduction to Electrical Engineering 4 CP (2 UoIL, 2 UoIR) | SCIM201 Scientific Methods 2 CP (2 UoIR) | EEEM302 Mechatronics & Controllers 4 CP (2 UoIL, 2 UoILab) | | MECT403 System engineering + Network Technology 6 CP (3 UoIL, 2 UoILab | |
| 18 | | | | | | | | |
| 19 | | | | HSE201 Health-Safety-Environment 4 CP (2 UoIL, 1 UoIR, 1 UoIIFt) | | EEEM308 Control Systems 4 CP (2 UoIL, 2 UoIR) | | |
| 20 | ENSO101 Engineer in Society, 2CP (1 UoIL, 1UoIR) | | | | | | | |
| 21 | | | MINE201 Introduction to Mining 4 CP (4 UoIL) | | EEEM310 Energy Storage 4CP (2 UoIL, 2 UoIR) | | | |
| 22 | PROJ101 Engineering Project 2 CP (2 UoIR) | | | | | | | |
| 23 | | CHEM102 Chemistry Lab 3 CP (3UoILab) | | LAW201 Law 2 CP (2UoIL) | | | STWR401 Scientific Writing 4 CP (2 UoIR) | |
| 24 | ENGL101 Technical English 4 CP (4 UoIR) | | | | | | | |
| 25 | | | ECON201 Introduction to Economics 4 CP (2 UoIL, 2 UoIR) | INTR201 Basic Internship 2 CP 6 weeks | RMPE301 Heat and Mass Transfer, 4CP (2 UoIL, 2 UoIR) | INTR301 Industrial Internship + Reflection 10 CP 14 weeks | | MECT405 Digital Signal Processing, 4CP, (2 UoIL, 2UoIR) |
| 26 | | BAEM101 Introduction to BA & Engineering Management 4 CP (2 UoIL, 2 UoIR) | | | | | | |
| 27 | | | | | | | MECH402 Finite Element Method 4 CP (2 UoIL, 1 UoILab) | |
| 28 | INCC101 Intercultural Comm. & Competence 2 CP (2 UoIR) | | | | | | | |
| 29 | | | | | | | | |
| 30 | TIME101 Time Management 2 CP (2 UoIR) | Electives no less than 6 CP | | | | | | |
| 31 | | | | | | | | |
| 32 | | | | | | | | |
| **Total CP** | **31** | **29** | **30** | **30** | **28** | **32** | **30** | **28** |

Legend: CP = Credit Points | Fundamentals | Specialization | General | Foreign Languages | Internship / Thesis

UoI =Unit of Instruction (45 min. per unit) UoIL = Unit of Instruction Lecture UoIR = Unit of Instruction Recitation UoILab = Unit of Instruction Laboratory
UoIFt = Unit of Instruction Field trip

***Electives: Every 3rd and 4th year student can choose professional engineering modules from the other programs as electives. Presupposed for participation and recognition of the elective module is that the required prerequisites of the chosen elective module already have been passed. Furthermore, the adjustment of the lecture times for attendance in the chosen elective modules can only be made by ASA in exceptional cases. The student must choose his/her subjects in such a way that participation in his/her program-related modules is not endangered or restricted.**

*** The total amount of CP's for Graduation has to be minimum 240.**

# GENERAL ENGINEERING MODULE (1ST – 4TH SEMESTERS)

## MATH101 – MATHEMATICS I

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Mathematics I | | | **Module code** | MATH101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 72 h |
| | | | | **Individual study** | 108 h |
| **Module coordinator** | Prof. L. Altangerel | | | **Language** | English |
| **Contents** | • Basics: logic, sets, functions and number sets (real and complex numbers)<br>• Basic linear algebra: matrices, determinants, systems of linear equations, eigenvalue problems, vector spaces, linear maps<br>• Analysis of functions of a single variable: series and functions, limits and continuity, differentiation and integration | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Describe and explain basic mathematical topics and methods.<br>2. Demonstrate and apply the basic principles of linear algebra.<br>3. Demonstrate and apply the basic concepts of analysis of a single variable.<br>4. Examine mathematical models to represent and solve simple scientific and engineering problems**.** | | | | |
| **Literature** | 1. Stewart J, Clegg D, Watson S. Calculus Early Transcendentals. 9th ed. Boston: Cengage Learning; 2019.<br>2. Thomas GB, Hass JR, Heil C, Weir MD. Thomas' CALCULUS Early Transcendentals. 14th ed. Boston: Pearson; 2018..<br>3. Anton H, Rorres C. Elementary Linear Algebra: Applications Version. 11th ed.: Viley; 2013<br>4. Rosen KH. Discrete Mathematics and Its Applications. 7th ed. New York: McGraw-Hill; 2012. | | | | |
| **Form of teaching** | Lecture (3 UoI)<br>Recitation (3 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 70% and the module examination accounting for 30%. |

## CHEM101 – CHEMISTRY

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Chemistry | | | **Module code** | CHEM101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 5 CP | **Workload** | 150 h | **Contact hours** | 60 h |
| | | | | **Individual study** | 90 h |
| **Module coordinator** | J. Bayardulam | | | **Language** | English |
| **Contents** | The students will be introduced chemistry and familiarized with the basic principles and concepts of organic, inorganic and physical chemistry<br>• Introduction of chemistry<br>• The components of Matter; Atomic theory,<br>• Compounds, Formulas, Names & Mass of compounds<br>• The mole, Determining the formula of unknown compound, Writing and balancing chemical equation<br>• Calculating quantities of reactant & products, Fundamentals of solution stoichiometry.<br>• The nature of light, atomic spectra, The Quantum-Mechanical model of the atom<br>• Electron configuration and Chemical periodicity<br>• Atomic properties and chemical bonds, The ionic bonding model, The covalent bonding model, Bond energy and chemical changes<br>• Gas pressure and its measurement, the Gas laws, rearrangement of the ideal gas law<br>• The types of Intermolecular forces, properties of liquid and solids<br>• Enthalpy, Calorimetry, Stoichiometry of thermochemical equation, Hess's law, Standard enthalpies of reaction<br>• Theories of covalent bonding<br>• Kinetics: The reaction rate, Rate laws, Integrated rate law, Theories of chemical kinetics<br>• Equilibrium: The reaction quotient and equilibrium constant, Expressing equilibria Kc and Kp<br>• Equilibrium: Q & K to determine the reaction direction, Solve the equilibrium problem, Le Chatelier's principle<br>• Acid-Base equilibria: Acids and bases in water, Autoionization of water, pH scale, Bronsted-Lowry theory, Problem solving weak-acid equilibria<br>• Ionic equilibria: Equilibria of acid-base buffers, Acid-base titration curves, Equilibria of slightly soluble ionic compounds<br>• Thermodynamics: Entropy, Free energy and Direction of chemical reaction<br>• Electrochemistry: Redox reaction<br>• Electrochemistry: Voltaic cells, Electrolytic cells, Cell potential, Nernst equation, electrochemical process in batteries, corrosion<br>• Transition elements and their Coordination compounds, Crystal filed theory<br>• Introduction to organic chemistry: Alkanes, Cycloalkane, Alkenes, Alkynes<br>• The monomer-polymer: Addition polymer, Condensation polymer, Sugar and polysaccharides,<br>• Nuclear chemistry | | | | |

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| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Explain the atomic structure of chemical elements and chemical bonds of molecules, apply chemical nomenclature to chemical compounds and stoichiometric calculations of the chemical reaction.<br>2. Use the chemical equilibrium concept in the practical application<br>3. Interpret the kinetics of chemical reactions and solve kinetics problems.<br>4. Apply the basic concepts of analytical chemistry in chemical analysis<br>5. Balance redox reactions, explain the electrochemical reaction, and design and apply electrochemical cells.<br>6. Apply the acquired basic definitions of thermodynamics in thermodynamic systems.<br>7. Explain the structure, properties and synthesis of hydrocarbons & and polymers<br>8. Interpret the basic concepts of nuclear chemistry and solve the nuclear chemical reaction problems.<br>9. Apply the acquired knowledge, and practice teamwork and presentation skills. |
| **Literature** | 1. Atkins P, Jones L, Laverman L. Chemical Principles: The quest for insight. 6th ed. Rossignol RB, editor. New York: W. H. Freeman and Company; 2013.<br>3. Silberberg MS. CHEMISTRY: The Molecular Nature of Matter and Change. 6th ed. Marty Lange JH, editor. New York: McGraw-Hill; 2012.<br>2. Brown LS, Holme TA. Chemistry for Engineering Students. 2nd ed. Charles Hartford RHAS, editor. Belmont, CA: Brooks/Cole, Cengage Learning; 2011. |
| **Form of teaching** | Lecture (3 UoI)<br>Recitation (2 UoI) |
| **Assessment methods** | Written examination (120 min.) and academic performance for lecture and recitation |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy & Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The grade of chemistry consists of the academic performance during the module accounting for 30% and the module examination accounting for 70% |

## GEOS101 – INTRODUCTION TO GEOSCIENCE

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Introduction to Geoscience | | | **Module code** | GEOS101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. G. Gantuya | | | **Language** | English |
| **Contents** | • Earth Processes<br>Earth's structure; endogenous processes (plutonism, volcanism, metamorphism; plate tectonics); exogenous processes (erosion, sedimentation); determination of rocks using simple aids (hand specimen of magmatic, metamorphic and sedimentary rocks).<br>• Earth Materials<br>Crystal forms, chemical and physical properties of minerals, classification of minerals; systematic mineralogy of selected native elements, hydroxides and halides, silicates, carbonates, oxides and sulphides; applied mineralogy of ore and industrial minerals and gems; environmental properties of minerals; determination of minerals using simple aids.<br>• Earth Resources<br>Origin of, prospecting for, and extraction of mineral raw materials, global distribution of ore deposits, endogenous and exogenous ore forming processes, classification of ore deposit types, plate-tectonic control on ore deposits formation, properties and uses of common ore and industrial minerals, and volume commodities, economic significance of mineral raw materials to the national economy, introduction to economic, technical and ecological aspects of raw materials extraction with respect to the sustainable use of geological resources; determination of ore samples using simple aids (small hand specimen of metallic and non-metallic ores).<br>• Earth's atmosphere<br>Fundamentals of the global atmospheric circulation system, weather and climate parameters; distribution of solar insolation and orbital parameters; its influence on the distribution of climate and ecological zones. Brief climate history of the Earth, climate change, future climate change scenarios. | | | | |
| **Learning outcomes** | I. Earth Processes<br>On successful completion of this module, the students should be able to:<br>1. Recall the shell structure of the Earth and plate-tectonic processes.<br>2. Differentiate between the structures of the Earth's oceanic and continental crust.<br>3. Recall the processes of plutonic, volcanic and metamorphic rock formation.<br>4. Recognize important rock types and describe their mineral composition and structure.<br><br>II. Earth Materials<br>On successful completion of this module, the students should be able to:<br>1. Identify the crystallographic and physical-chemical properties of minerals.<br>2. Classify minerals into crystallographic and chemical classes. | | | | |

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| | 3. Identify the salient properties (chemical formula, crystal form, Moh's hardness, density, color, cleavage and fracture) of native elements, hydroxide and halide, silicate, carbonate, oxide and sulphide minerals.<br>4. Identify the industrial uses and environmental properties of the metallic and non-metallic ores and gemstones.<br>5. Identify important minerals and know their respective chemical formulae.<br><br>III. Earth Resources<br>On successful completion of this module, the students should be able to:<br>1. Classify ore deposits into groups of metallic and non-metallic raw materials and recall the different types of ore deposits.<br>2. Recall the processes of endogenous and exogenous ore deposit formation in the context of plate tectonics.<br>3. Recall the global distribution of ore deposits of the various raw materials.<br>4. Recall the properties and uses of the main ores and industrial minerals and volume commodities.<br>5. Recall the economic, technical and ecological aspects of the extraction of raw materials.<br>6. Summarize terms measures for the sustainable use of Earth resources in qualitative terms.<br>7. Recognize relevant ore samples and describe their mineral composition and structure.<br><br>IV. Earth's atmosphere<br>On successful completion of this module, the students should be able to:<br>1. Identify weather and climate elements<br>2. Recognize monitoring tools of weather elements<br>3. Recall the fundamentals of the global atmospheric circulation system<br>4. Clarify past, current, and future climate scenarios. |
| **Literature** | 1. Klein C, Philpotts AR. Earth Materials: Introduction to Mineralogy and Petrology New York: Cambridge University Press; 2012.<br>2. Mukherjee S. Applied Mineralogy: Applications in Industry and Environment New York: Capital Publishing Company; 2011.<br>3. Kresan PL, Mencke R. Student study guide for UNDERSTANDING EARTH. 6th ed. New York: W. H. Freeman and Company; 2010.<br>4. Wnek HR, Bulakh A. Minerals: Their Constitutions and Origin United Kingdom: Cambridge University Press; 2004.<br>5. Hamblin WK, Christiansen EH. Earth's Dynamic Systems. 10th ed.; 2004.<br>6. Evans AM. Ore Geology and Industrial Minerals: An Introduction. 3rd ed. Hallam A, editor.: Blackwell Publishing; 1993. |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) |
| **Assessment method** | Written examination (90 min.) and academic performance |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering |

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| | B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 60% and the module examination accounting for 40%. |

## PROG101 – ALGORITHMS AND PROGRAMMING

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Algorithms and Programming | | | **Module code** | PROG101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Kh. Uyanga | | | **Language** | English |
| **Contents** | • Introduction of Programming Languages (, history of C programming language, syntax, programming process, structure, executing and debugging);<br>• Programming Methodologies (concepts of algorithm design, flowcharts and pseudo codes, number systems)<br>• Structured language (keywords, identifiers, declarations, operators, constants, variables, data types (integer, floating-point data), library functions)<br>• Control Statement and Expressions ( statements (if, if … else, switch, goto), arithmetic expressions)<br>• Looping (for, while, do while, jumping, break and continue)<br>• Arrays (one, two, multidimensional) and string (variables and functions)<br>• Functions and Program Structure (C: user-defined and system defined;<br>• File Processing, discipline of programming. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Implement a variety of algorithms for searching and sorting, including linear search, binary search, insertion sort, selection sort, merge sort, quicksort, and heap sort.<br>2. Describe abstract data types used in C/C++ and explain their usage<br>3. describe commonly used syntactic constructions used in C/C++<br>4. Develop programs and application<br>5. Apply knowledge in major courses and practical<br>6. Solve problems<br>7. Work independently | | | | |
| **Literature** | 1. Hanly JR, Koffman EB. Problem Solving and Program Design in C. 8th ed. Essex: Pearson Education Limited; 2016.<br>2. Deitel P, Deitel H. C How to Program. 6th ed. Horton MJ, editor. New Jersey: Pearson Education, Inc.; 2010.<br>3. Kernighan BW, Ritchie DM. C Programming Language. 2nd ed. New Jersey: Prentice-Hall, Inc; 1988. | | | | |
| **Form of teaching** | Lecture (1 UoI)<br>Laboratory (3 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 50% and the module examination accounting for 50%. |

## ENSO101 – ENGINEER IN SOCIETY (ETHICS)

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Engineer in Society (Ethics) | | | **Module code** | ENSO101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 2 CP | **Workload** | 60 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 36 h |
| **Module coordinator** | Prof. B. Battsengel | | | **Language** | English |
| **Contents** | Team teaching: The role of the engineers in the society; focus on science and responsibility. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Differentiate between basic tenets of engineering science, natural science, and the humanities and to recognize the relevance for their profession.<br>2. Think critically about the role of the engineers in the society.<br>3. Recognize the ethical responsibility of the engineers in concrete situations and analyze and reflect these problems by using approaches from engineering ethics and argue in.<br>4. Reflect ethical problems caused by new technological developments, future questions involving technological policies and questions of political shaping and guiding of technological developments while considering their context within society and politics.<br>5. Think critically about specialist literature on basic tenets of science and the ethics of engineering<br>6. Express oneself in a differentiated way but yet be clearly understood both in oral and written form questions involving the basic tenets of science and ethics in an interdisciplinary context. | | | | |
| **Literature** | 1. Martin MW. Introduction to Engineering Ethics. 2nd ed. Debra B. Hash DMS, editor. New York: McGraw-Hill; 2010.<br>2. Lawlor R. Engineering in Society Lawlor R, editor.; 2004.<br>3. Rees M. Our final hour: A scientist's warning: How terror, error, and environmental disaster threaten humankind's future in this century - on Earth and beyond New York: Basic Books; 2003. | | | | |
| **Form of teaching** | Lecture (1 UoI)<br>Recitation (1 UoI) | | | | |
| **Assessment method** | Essay and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |

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|---|---|
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | Pass/ Fail |

## PROJ101 – ENGINEERING PROJECT

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Engineering Project | | | **Module code** | PROJ101 |
| **Duration** | 1 week + report | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 2 CP | **Workload** | 60 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 36 h |
| **Module coordinator** | Prof. N. Battulga | | | **Language** | English |
| **Contents** | During the project, students work in small groups on an interdisciplinary assignment. Each student contributes to producing an interdisciplinary solution by working as a team with the resources from their individual disciplinary perspectives. The students of mechanical engineering experience the way an engineer deals with problems, they construct in methodology way and solve complex engineering tasks. The assignment is given out at the beginning of the project. Trained support staff accompanies the groups during the course of the project and encourages the development of social and subject-related skills. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Produce a goal-oriented solution through interdisciplinary teamwork.<br>2. Comprehend and work on an interdisciplinary assignment using design principles of mechanical engineering.<br>3. Moderate team processes.<br>4. Plan, organize and carry out tasks independently.<br>5. Discuss possible solutions and to reach a decision that is guided by criteria<br>6. Acquire competence in applying scientific methods and to analyze different problems of a task<br>7. Present different results to an auditorium and to discuss them respectively<br>8. Reflect scientific acting and assess its societal consequences. | | | | |
| **Literature** | Script | | | | |
| **Form of teaching** | Project course (2 UoI) | | | | |
| **Assessment method** | Successful participation, group presentation, poster, report | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | Pass/ Fail | | | | |

## ENGL101 – TECHNICAL ENGLISH

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Technical English | | | **Module code** | ENGL101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Robin Charpentier | | | **Language** | English |
| **Contents** | • General vs Technical English; Latin and Greek Roots<br>• Geotechnology<br>• Properties of Metals<br>• Material Formats<br>• Plastics, Elasticity<br>• Ceramics, Glass, Wood<br>• Precision, Accuracy in Measurements, Safety<br>• MID-TERM EXAM<br>• Process Engineering<br>• Fluid Dynamics, Architectural Drawings/Design<br>• Electricity and Magnetism<br>• Math, Statistics, Graphs, Data Ethics<br>• Invention/Innovation/ Spinoffs<br>• Sustainability; the Circular Economy<br>• Presentation Topic Approval; About Infographics, Poster Sessions<br>• Final Presentations – Poster Session (Infographics) | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Demonstrate understanding of, and properly express/describe STEM – related: abbreviations, root meanings, and definitions of symbols, words, and phrases; graphs and the behavior of lines; equations; and simple technical processes, using appropriate terminology and structures<br>2. Read short texts on a broad range of STEM – related topics at an intermediate to high-intermediate level, in order to understand some technical details and identify the core meanings, and summarize the information in their own words<br>3. Follow and grasp the main points in a lecture, including audio-visual material at an intermediate to high-intermediate level, on a broad range of topics in STEM – related fields<br>4. Effectively communicate both orally and in writing on a broad range of STEM – related topics, in English, using relevant stylistic structures | | | | |
| **Literature** | 1. Barbara A. Cornelen Campus: Englsih for Mechanical Engineering. B2 Coursebook: Cornelsen; 2011.<br>2. Supplementary materials related to topics covered | | | | |

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| **Form of teaching** | Recitation (4 UoI) |
| **Assessment method** | (70%) = Written final examination<br>(30%) = Active in-class participation (15%); tests, mid-term exam, final oral presentation [poster session] (15%) |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | • English at the C1 level in all 4 skills<br>• Have an expressed interest in engineering as their major |
| **Requirements for receiving credit points** | • Attendance is recorded for those arriving before the scheduled start time<br>• Students must attend at least 80% of the classes in this to be eligible to sit for the Final Exam<br>• Participation means: volunteering answers; asking and/or responding to questions; paying attention; actively focusing on in-class tasks; turning in assignments on time and with good quality |
| **Grading system** | The modes of assessment total 100% |

# INCC101 – INTRODUCTION TO INTERCULTURAL COMMUNICATION AND COMPETENCE

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Introduction to Intercultural Communication and Competence | | | **Module code** | INCC101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 2 CP | **Workload** | 60 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 36 h |
| **Module coordinator** | Robin Charpentier | | | **Language** | English |
| **Contents** | • Elements and Definitions of Culture<br>• Identity: Scale, Boundaries, Aspirational, Ascriptive<br>• Theories and Models of Culture<br>• Shared vs Unique Aspects of Identity<br>• Cultural Awareness<br>• Communication Types – Identification and Practice<br>• Direct/Indirect Communication in Different Cultures<br>• What do we Need to Know About Them?<br>• Mid-Term Exam<br>• Stereotypes, Prejudice<br>• Conscious/Unconscious Bias<br>• Exploring Communications Approaches - Models<br>• Meyers-Briggs Type Indicators<br>• Cultural Awareness Levels;<br>• Stages of Cultural Adjustment<br>• Case Studies: Analyzing Critical Incidents | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Understand their own cultural background and values, and their importance in dealing successfully with people from other cultures<br>2. Recognize sensitive cultural particularities, and try to respond to these differences in an appropriate and tactful manner<br>3. Analyze, post hoc, intercultural incidents that have occurred and develop problem solving strategies for future such cases | | | | |
| **Literature** | 1. Glaser E, Guilherme M, Garcia MCM, Mughan T. Intercultural Competence for Professional Mobility: Council of Europe Publishing; 2007.<br>2. Bennett MJ. Basic Concepts of Intercultural Communication: Paradigms, principles, and practices. 2nd ed. Boston: Intecultural Press; 1998. | | | | |
| **Form of teaching** | Recitation (2 UoI) | | | | |
| **Assessment method** | (70%) = Written final examination<br>(30%) = Active in-class participation (15%); turning in assignments on time and with good quality, mid-term exam (15%) | | | | |

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| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | English at the C1 level in all 4 skills |
| **Requirements for receiving credit points** | • Attendance is recorded for those arriving before the scheduled start time<br>• Students must attend at least 80% of the classes in this to be eligible to sit for the Final Exam<br>• Participation means: volunteering answers; asking and/or responding to questions; paying attention; actively focusing on in-class tasks; turning in assignments on time and with good quality |
| **Grading system** | The modes of assessment total 100% |

## TIME101 – TIME MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Time Management | | | **Module code** | TIME101 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st |
| **Credit points** | 2 CP | **Workload** | 60 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 36 h |
| **Module coordinator** | Prof. Sungchil Lee | | | **Language** | English |
| **Contents** | The students will learn time management skills and self-development skills.<br>• Time management for successful school life<br>• Shaping thinking frame<br>• Values & purpose of life<br>• Prioritizing tasks<br>• Systematic management of tasks<br>• Objective management<br>• Reading & study skills for enhancing intelligent capacity | | | | |
| **Learning outcomes** | On successful completion of this module, students should be able to:<br>1. Recognize the need of time management in their life.<br>2. Identify greatest time wasters and avoid them<br>3. Apply time management skills for effective school life.<br>4. Prioritize and organize tasks systematically.<br>5. Develop and align their long- and short-term objectives along with life-goals.<br>6. Motivates themselves for study at GMIT.<br>7. Apply reading and thinking skills for their study. | | | | |
| **Literature** | 1. Forsyth P. 100 Great Time Management Ideas from successful executives and managers around the world Singapore: Marshall Cavendish; 2009.<br>2. Handbook on Time Management Skills for Public Managers: Centre for Good Governance; 2009.<br>3. Mancini M. Time Management: McGraw-Hill; 2003. | | | | |
| **Form of teaching** | Lecture & workshop (2 UoI) | | | | |
| **Assessment method** | Active participation, individual & group presentation, homework | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |

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| **Requirements for receiving credit points** | Passing the thesis and the presentation |
| **Grading system** | Pass/Fail |

## MATH102 – MATHEMATICS II

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|---|---|---|---|---|---|
| **Module title** | Mathematics II | | | **Module code** | MATH102 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd |
| **Credit points** | 8 CP | **Workload** | 240 h | **Contact hours** | 96 h |
| | | | | **Individual study** | 144 h |
| **Module coordinator** | Prof. L. Altangerel | | | **Language** | English |
| **Contents** | • Series: numerical series, power series, Fourier series and Fourier transform;<br>• Differential calculus of functions of several variables: convergence and continuity, partial derivatives, total differentiability, extreme value problems<br>• Line integrals, integration over regions, surface integrals<br>• Basics of ordinary and partial differential equations: modelling using differential equations, first and second order ordinary differential equations, system of ordinary differential equations, basic concepts of partial differential equations. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Demonstrate and apply the basic concepts of series;<br>2. Explain and calculate differential and calculus of functions of several variables. Be aware of their connections and potential applications in other fields.<br>3. Demonstrate and apply the basic concepts of ordinary and partial differential equations;<br>4. Make use of mathematical models to solve complex scientific and engineering problems . | | | | |
| **Literature** | 1. Stewart J, Clegg DK, Watson S. Solutions Manuals for Calculus Early Transcendentals. 9th ed.: -Cengage Learning ; 2020.<br>2. Thomas GB, Hass J, Heil C. Thomas' CALCULUS Early Transcendentals. 14th ed. Weidenaar J, editor.: Pearson; 2018.<br>3. Nagle RK, Saff EB, Snider AD. Fundamentals of Differential Equations. 9th ed. Weidenaar J, editor.: Pearson Education, Inc.; 2018. | | | | |
| **Form of teaching** | Lecture (4 UoI)<br>Recitation (4 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Mathematics I recommended. | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |

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| **Grading system** | The final grade consists of the academic performance during the module accounting for 70% and the module examination accounting for 30%. |

## MATS101 – MATERIALS SCIENCE

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Materials Science | | | **Module code** | MATS101 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | R. Nyamdulam | | | **Language** | English |
| **Contents** | • Introduction to Interatomic bonding<br>Attractive and repulsive forces; Primary bonding, secondary bonding, and Van der Waals bonding<br>• Introduction to Crystal Structures<br>Crystalline and amorphous structures; single crystalline and polycrystalline materials, and crystal systems<br>• Imperfection in Solids<br>Chemical impurity; solid solution, point defect, linear defect, planar defect, volume defect<br>• Mechanical properties<br>Engineering stress, and engineering strain; Hooke's Law; Destructive, and Non-destructive testing techniques<br>• Thermal behavior<br>Heat capacity; Thermal expansion; Thermal conductivity, thermal shock<br>• Phase Diagrams/ Phase Transformations<br>Various phase regions; Compositions of phases; Binary phase equilibrium; Heat treatment processes; Kinetics of Phase transformation<br>• Structural Materials<br>Organic (Polymers and Composites) and Inorganic (Metals, Ceramics and glasses) materials, and their application<br>• Electrical properties and Electronic Materials<br>Conducting materials, insulators, semiconductors, and their application<br>• Optical properties and Materials<br>• Magnetic properties and Materials<br>• Social and Environmental impact | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Describe the connection between atomic structure, and identify different types of crystal structures.<br>2. Describe the impacts of defects at the atomic and microstructure scales<br>3. Explain thermally activated processes,<br>4. Explain the significance of the main mechanical properties in relation to component design.<br>5. Explain the fundamentals of non-destructive testing.<br>6. Select materials in a responsible manner. | | | | |

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| | 7. recognize and apply the significant properties for mechanically characterizing materials.<br>8. Explain diffusion processes.<br>9. Interpret states of phase equilibrium and non-equilibrium, understand the concepts of solid solution and solubility limits, and be able to define microscopic properties using the example of eutectic phase diagram.<br>10. Explain the qualities and quantifications of mechanical, thermal, electrical, optical, magnetic, and chemical properties. |
| **Literature** | 1. Shackelford JF. Introduction to MATERIALS SCIENCE FOR ENGINEERS. 8th ed. Stark H, editor. New Jersey: Pearson Higher Education, Inc; 2015.<br>2. Callister WD, Rethwisch DG. Materials Science and Engineering: An Introduction. 9th ed. Sayre D, editor. New Jersey: Wiley; 2000.<br>3. Anderson JC, Leaver KD, Rawlings RD, Alexander JM. Materials Science. 4th ed. Singapore: Springer-Science+Business Media, B.V.; 1990. |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) |
| **Assessment method** | Written examination (120 min.) and academic performance |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | Knowledge of the modules Chemistry and Physics |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## ENME101 – ENGINEERING MECHANICS I (STATICS)

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|---|---|---|---|---|---|
| **Module title** | Engineering Mechanics I (Statics) | | | **Module code** | ENME101 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Sungchil Lee | | | **Language** | English |
| **Contents** | General systems of forces. Equilibrium of rigid body. Reaction forces at structural supports. Moment by forces. Structural analysis of truss, beams, frame structures. Center of mass, area, volume. Virtual work principle. Friction. Stability of column structure. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Explain the concept of force, moment, and equilibrium state in Statics.<br>2. Establish equilibrium equations and solve statically determinate structures.<br>3. Compute support reaction forces in statically determinate systems by means of equilibrium conditions or the principle of virtual work.<br>4. Compute internal forces in beam and truss structures and discuss the effects of external forces on structures.<br>5. Use shear force diagram and bending moment diagram to interpret the effect of external forces on structures.<br>6. Compute the center of mass, volume, and area.<br>7. Apply Pappus principle to calculate volume and surface area of revolving objects.<br>8. Classify friction type in simple machines and compute proper friction forces. | | | | |
| **Literature** | 1. Gross D, Hauger W, Schroder J, Wall WA, Rajapakse N. Engineering Mechanics 1 Statics: Solutions to Supplementary Problems. 2nd ed.; 2012.<br>2. Meriam JL, Kraige LG. Engineering Mechanics Volume 1 Statics. 7th ed. Hoboken, NJ: John Wiley & Sons, Inc.; 2012. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Mathematics I recommended. | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## PHYS101 – PHYSICS

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|---|---|---|---|---|---|
| **Module title** | Physics | | | **Module code** | PHYS101 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 72 h |
| | | | | **Individual study** | 108 h |
| **Module coordinator** | Prof. N. Battulga | | | **Language** | English |
| **Contents** | **Statics:**<br>• Vector operations, Torque<br>**Kinematics:**<br>• projectile motion, uniform circular motion, centripetal acceleration<br>**Dynamics:**<br>• Newton's Laws and their applications, principle of conservation of momentum<br>**Energy and Work:**<br>• Kinetic and Potential energy, Conservation of Energy<br>**Fluid mechanics:**<br>• Fluid Properties, Fluid flows<br>**Electricity:**<br>• Electric field of a point charge, Electric potential, Capacitors and capacitance, Electric current, Potential difference, Resistance and resistivity<br>**Oscillations**:<br>• Simple harmonic motion, Energy in simple harmonic motion | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Demonstrate vector operations, torque, Newton's Laws, conservation of momentum and energy in various practical problems.<br>2. Determine different types of fluid flows, and fluid properties<br>3. Calculate the electric potential, eapacitors and capacitance, electric current, potential difference, resistance and resistivity.<br>4. Demonstrate simple harmonic motion, and related energy in various practical problems | | | | |
| **Literature** | 1. Young HD, Freedman RA. University Physics with Modern Physics. 14th ed.: Pearson Education; 2015.<br>2. Walker J. Fundamentals of physics. 10th ed. Hoboken, NJ: John Wiley and Sons, Inc.; 2014.<br>3. Wilson JD, Hernández-Hall CA. Physics Laboratory Experiments. 8th ed.: Brooks Cole; 2014.<br>4. Serway RA, Jewett JW. Physics for Scientists and Engineers with Modern Physics. 9th ed.: Cengage Learning; 2013. | | | | |
| **Form of teaching** | Lecture (1 UoI)<br>Recitation (1 UoI)<br>Laboratory (4 UoI) | | | | |
| **Assessment method** | Written examination (60 min.) and academic performance | | | | |

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| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | Completion of Mathematics I recommended. |
| **Requirements for receiving credit points** | Passing the module “Physics laboratory” is a prerequisite for the participation of the final module examination |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## CHEM102 – CHEMISTRY LABORATORY

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|---|---|---|---|---|---|
| **Module title** | Chemistry Laboratory | | | **Module code** | CHEM102 |
| **Duration** | 1 semester | **Semester** | Spring | **Module-start** | 2nd |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 36 h |
| | | | | **Individual study** | 54 h |
| **Module coordinator** | J. Bayardulam | | | **Language** | English |
| **Contents** | Selected experiments in the fields of general chemistry, analytical chemistry and electrochemistry: unaided acquisition of knowledge, colloquia and written reports.<br><br><u>Laboratory practical work</u><br><br>● Properties of matter – boiling point<br>● Reaction of magnesium and calcium with water – hydroxide<br>● Quantitative analysis of oxides and properties of mixture<br>● Formation of salts by reaction of metals with acids<br>● Detection of an acidic reaction with various indicators<br>● Estimation of copper by colorimetric method<br>● Electrolysis of water<br>● Rate of chemical reaction<br>● Electrochemical cell<br>● Observing Chemical Equilibrium<br>● Precipitates and Solubility Rules<br>● Hess's law | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. apply simple working procedures in the laboratory.<br>2. Determine physical and safety-related data for materials, and interpret it in context.<br>3. use experimental equipment in accordance with the safety regulations, and carry out experiments.<br>4. work together in small groups.<br>5. prepare a technical report on an experiment and present the results of the experiment in a suitable form.<br>6. use technical terms and expressions in English<br>. | | | | |
| **Literature** | 1. Allan BJ. Laboratory Manual for Principles of General Chemistry. 10th ed.: Wiley; 2014.<br>2. Atkins JL. Chemical Principles. 6th ed.: W.H. Freeman and Company; 2013.<br>3. Brown L, Holme T. Chemistry for Engineering Students. 2nd ed.: Brooks Cole; 2010. | | | | |
| **Form of teaching** | Laboratory (3 UoI) | | | | |

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| **Assessment methods** | Pre-lab questions before conducting lab experiments, and post-lab defense and written documentation (lab reports) after the experiment. Midterm exams after completing 6 modules each. |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy & Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The Lab grade consists of the lab performance (including prelab, participation in experiments and lab report defense) during the module accounting for 70% and the final examination accounting for 30% |

# BAEM101 – INTRODUCTION TO BUSINESS ADMINISTRATION AND ENGINEERING MANAGEMENT

| | | | | | |
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| **Module title** | Introduction to Business Administration and Engineering Management | | | **Module code** | BAEM101 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Ch. Enkhzaya | | | **Language** | English |
| **Contents** | Students will be introduced to basic principles of business administration. In addition, the module prepares students for courses to come in engineering management.<br><br>Business administration studies problems within the firm and relates to problems in the fields of production organization, strategy, marketing and logistics, finance and accounting, and information management:<br><br>1. History and state of the art of business administration as a discipline (fundamentals, managing, and performing, technology-driven management)<br>2. Why do firms exist? (causes and goals of firms, the structure of a firm, business environment)<br>3. How to manage processes, teams and firms?<br>4. Constitutive decisions<br>5. Production<br>6. Basics of marketing and sales<br>7. Investment and Financing<br>8. Business Accounting<br>9. Managerial communication<br>Additionally, the Module should enable the students to understand the specifics of the private sector - function and structure - in Mongolia | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br><br>• Remember and understand what is this discipline about.<br>• Describe the boundaries of the discipline towards other disciplines like e.g. macro economy or natural sciences<br>• Explain the principles on which firms exist and make decisions<br>• Identify various fields of the firm's activities<br>• Understand the legal environment in which firms operate<br>• Analyze core functions of firms by breaking them into constituent parts (purchase, production, sales and marketing, HR, operations and controlling, etc.), and by determining how the parts relate to one another<br>• Evaluate the performance of firms according to criteria and standards<br>• Develop or create solutions for general managerial tasks | | | | |
| **Literature** | 1. Wöhe. Einführung in die Allgemeine Betriebswirtschaftslehre. 27th ed.: Vahlen, Munich; 2020. | | | | |

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| | 2. Bauer T, Erdogan B, Short J. Principles of Management v. 4.0: Boston Academic Publishing; 2019.<br>3. Robbins SP, Coulter M. Management. 11th ed.: Pearson; 2012. |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) |
| **Assessment method** | Written examination (90 min) – optimally based on a case study from the technology world; and academic performance (report and oral presentation and attendance) |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounted for 30% (incl. term paper and midterm exam) and the module examination accounted for 70% |

## ENME201 – ENGINEERING MECHANICS II (DYNAMICS)

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|---|---|---|---|---|---|
| **Module title** | Engineering Mechanics II (Dynamics) | | | **Module code** | ENME201 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 3rd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Sungchil Lee | | | **Language** | English |
| **Contents** | Kinematics of particles and rigid body. Coordinate systems in Dynamics. Physical quantities in various coordinate systems. Projectile motion. Kinetics of particles and rigid bodies. Work and energy of particle and rigid body. Linear momentum and impulse of particle and rigid body. Angular momentum and impulse of rigid body. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Describe planar and spatial motions of particle and rigid bodies using coordinate systems.<br>2. Formulate dynamic problems into equation of motion applying the Newton´s law of motion.<br>3. Calculate acceleration, velocity of moving objects applying work and energy concept.<br>4. Calculate motion of rigid body applying angular momentum and impulse.<br>5. Integrate the principles of Dynamics and Statics to formulate engineering problems.<br>6. Distinguish the difference between linear and angular momentum and impulse theory and solve dynamic problems. | | | | |
| **Literature** | 1. Gross D, Hauger W, Schröder J, Wolfgang A. Wall, Sanjay Govindjee. Engineering Mechanics 3: Dynamics. 2nd ed.: Springer-Verlag Berlin Heidelberg; 2014.<br>2. Kraige LG, Meriam JL. Dynamics. 7th ed.: Wiley; 2013. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Mathematics I, Engineering Mechanics I (Statics) recommended | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. | | | | |

## STAT201 – INTRODUCTION TO STATISTICS

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|---|---|---|---|---|---|
| **Module title** | Introduction to Statistics | | | **Module code** | STAT201 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 3rd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | G. Dorjsundui | | | **Language** | English |
| **Contents** | The module has two strongly related parts as probability and statistics. The first part covers an introduction to probability and random variables. Topics include distribution functions, binomial, geometric, hypergeometric, and Poisson distributions. The other topics covered are uniform, exponential, normal, gamma and beta distributions; conditional probability; Bayes theorem; joint distributions; law of large numbers; and central limit theorem.<br><br>The second part offers an in-depth theoretical and practical foundation for statistical methods that are useful in many applications. The goal is to understand the role of statistical thinking in the engineering field | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br><br>1. Have fundamental approaches of probability calculation and conceptual definitions.<br>2. Set up and work with discrete and continuous random variables. In particular, understand the Bernoulli, binomial, geometric, Poisson distributions, uniform, normal and exponential distributions.<br>3. Know what expectation and variance mean and be able to compute them and extend the convergence of statistical inference.<br>4. Explain and interpret the quantitative data as descriptive statistical results including tables and graphs.<br>5. Understand the difference between probability and likelihood functions, and find the maximum likelihood estimate for a model parameter with basic confidence intervals.<br>6. Demonstrate null hypothesis significance testing to test the significance of results, and understand and compute the p-value for these tests.<br>7. Compute and interpret simple linear regression between two variables<br>. | | | | |
| **Literature** | 1. Mario TF. Elementary Statistics. 13th ed.: Pearson; 2018.<br>2. Moonjung C, Wendy ML. Statistics in MATLAB: A Primer: CRC Press; 2014.<br>3. Walpole RE, Myers RH, Myers SI, Ye KE. Probability and Statistics for Engineers and Scientists. 9th ed.: Pearson; 2012.<br>4. Ott L, Longnecker M. An Introduction to Statistical Methods and Data Analysis. 6th ed.: Brooks/Cole; 2010.<br>5. Navidi W. Statistics for Engineers and Scientists . 3rd ed.: McGraw-Hill Science/Engineering/Math; 2010.<br>6. Ross S. A First Course in Probability . 8th ed.: Pearson Prentice Hall; 2009.<br>7. Bertsekas DP, Tsitsiklis JN. Introduction to Probability: MIT; 2000. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br><br>Recitation (2 UoI) | | | | |

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|---|---|
| **Assessment method** | Written examination (90 min.) and academic performance |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | Mathematics II |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 70% and the module examination accounting for 30%. |

## THER201 – ENGINEERING THERMODYNAMICS

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|---|---|---|---|---|---|
| **Module title** | Engineering Thermodynamics | | | **Module code** | THER201 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 3rd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. B. Battsengel | | | **Language** | English |
| **Contents** | Fundamental terms of thermodynamics; thermodynamic equilibrium and temperature; different forms of energy (internal energy, heat, work, enthalpy); properties and equations of state for gases and incompressible substances; first law of thermodynamics and energy balances for technical systems; second law of thermodynamics and entropy balances for technical systems; exergy analysis; thermodynamics of phase changes; the Carnot cycle for power generation or refrigeration; energy efficiency and coefficient of performance; cyclic processes for gas turbines, combustion engines, power plants, refrigerators and heat pumps | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Explain the relationships between thermodynamic properties and the thermodynamic state of a system, and apply them in calculating a thermal system behavior.<br>2. Distinguish between different types of energy (e.g. work, heat, internal energy and enthalpy) and define them.<br>3. Analyze technical systems and processes using energy balances and equations of state.<br>4. Assess energy conversion processes by means of an exergy analysis.<br>5. Characterize the thermal behavior of gases, liquids and solids, and corresponding phase change processes.<br>6. Apply this basic knowledge (1.-5.) to examine machines (turbines, pumps etc.) and processes for energy conversion (combustion engines, power plants, refrigerators, heat pumps). | | | | |
| **Literature** | 1. Koretsky MD. Engineering and Chemical Thermodynamics. 2nd ed.: Wiley; 2012.<br>2. Çengel YA, Boles MA. Thermodynamics: An Engineering Approach. 8th ed.: McGraw-Hill Education; 2011. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |

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|---|---|
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## DESN201 – ENGINEERING DESIGN

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Engineering Design | | | **Module code** | DESN201 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 3rd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Sungchil Lee | | | **Language** | English |
| **Contents** | Drawing letters and numbers. Drawing polygon and ellipse. Isometric projection. Orthographic projection. Perspective projection. Oblique projection. Dimensions. Gears and Cams. Tolerance. Geometric tolerance. Mechanical design concept. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Draw alphabets and numbers following the engineering drawing custom.<br>2. Draw bisect line, perpendicular line, bisect angle line.<br>3. Make drawings of objects using isometric projection, orthographic projection, oblique projection, and perspective projection.<br>4. Interpret drawings of multi-view projection of objects and draw them using isometric projection.<br>5. Draw cam profile based on the cam drawing.<br>6. Explain gear parts and calculate gear shape.<br>7. Interpret and make tolerance drawing and geometric tolerance drawing.<br>8. Model mechanical drawing of parts. | | | | |
| **Literature** | 1 Giesecke et al. Technical drawings with engineering graphics. 14th ed.: Pearson; . 2014.<br>2 Mott RL. Machine Elements in Mechanical Design. 4th ed.: Prentice Hall; 2004. . | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |

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| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## ELEC201 – INTRODUCTION TO ELECTRICAL ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Introduction to Electrical Engineering | | | **Module code** | ELEC201 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 3rd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. P. Ariunbolor | | | **Language** | English |
| **Contents** | Electrical charge, electrical current, electrical voltage and power, linear DC circuits, Ohm's law, Kirchhoff rules, ideal and real sources, electrical field, capacitor, electrostatic forces, capacitors in linear networks, magnetic field, Lorentz force, Ohm's law of the magnetic network, Ampere's circuital law, ferromagnetism, induction, self-inductance, inductors in linear networks, basic of electric machines and electric safety and power supply system | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Use electrical quantities and units.<br>2. Calculate linear DC circuits.<br>3. Calculate work, power, and energy.<br>4. Analyze and calculate simple linear AC circuits.<br>5. Design simple electronic circuits<br>6. Apply the knowledge of electric safety. | | | | |
| **Literature** | 1. Theraja BL, Theraja AK. A Textbook of Electrical Technology in SI Units. Volume I: Basic Electrical Engineering: S Chand & Co Ltd; 1999.<br>2. Cathey JJ, Nasar SA. Schaum's Outline Series Theory and Problems of Basic Electrical Engineering: McGraw-Hill; 1983. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and oral examination for documentation and presentation (10-30 min. per each student | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Mathematics I is recommended | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |

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| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## MINE201 – INTRODUCTION TO MINING

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Introduction to Mining | | | **Module code** | MINE201 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 3rd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. T. Hollenberg | | | **Language** | English |
| **Contents** | The course aims to support students in acquiring the knowledge about extraction of raw materials and the influence of the mining industry on the development of resource rich countries through mining, processing and value adding.<br>• Market economics<br>• Prospection and Exploration, Deposit assessment<br>• Ground mechanics<br>• Equipment Selection and Requirements<br>• Mining method selection<br>• Surface Opening and Development<br>• Surface Ore Handling Techniques<br>• Surface Mining Operations and Variations<br>• Underground Development<br>• Underground Ore Handling Techniques<br>• Underground Mining Operations and Variations<br>• Hydraulic and Pipeline Mining<br>• Shallow and Deep Drilling<br>• Mineral processing<br>• Mining and Environment<br>• Community and social issues | | | | |
| **Learning outcomes** | Upon successful completion of this module, students will, through assessment activities, show evidence of their ability to:<br>1. Analyze different raw material deposits and evaluate the economic value.<br>2. Identify the principles of the technologies and apply selection methods for mining operations.<br>3. Plan and design mining operations and choose appropriate technologies for given circumstances.<br>4. Recognize the machines and technologies used in open pit and underground mining.<br>5. Calculate the main parameters of simple technological chains<br>. | | | | |
| **Literature** | 1. Kuchta HWA, Martin M, Randall K. Open Pit Mine Planning and Design, Two Volume Set & CD-ROM Pack, Third Edition. 3rd ed.: CRC Press; 2013.<br>2. Peter D. SME mining engineering handbook. 3rd ed.: Society for Mining, Metallurgy, and Exploration; 2011.<br>3. Milojcic G, Asmus SC, Thielemann T, Ernst H. Christian Niemann-Delius, Rolf Dieter Stoll, Carsten Drebenstedt, Klaus Müllensiefen. Der Braunkohlentagebau: Bedeutung, Planung, Betrieb, Technik, Umwelt. 1st ed.: Springer-Verlag Berlin Heidelberg; 2009.<br>4. Howard HL. Introductory Mining Engineering. 2nd ed.: Wiley; 2007. | | | | |
| **Form of teaching** | Lecture (4 UoI) | | | | |

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|---|---|
| **Assessment method** | Written examination (90 min.) and academic performance |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | Basic knowledge of mathematics and natural science |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## ECON201 – INTRODUCTION TO ECONOMICS

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Introduction to Economics | | | **Module code** | ECON201 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 3rd |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Dr. P. Bolormaa | | | **Language** | English |
| **Contents** | This module provides:<br>● Introduction: What is economics, Economic Problem<br>● How market works: Demand and Supply, Market Equilibrium, Elasticity, Markets in Action<br>● Firms and Markets: Organizing Production, Output and Costs, Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly<br>● Factor Markets: Markets for factors of production such as labor market and capital market | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Explain big questions of economics and key ideas that define the economic way of thinking;<br>2. Describe a competitive market, explain the influences on demand and supply, explain how demand and supply determine market equilibrium.<br>3. Calculate and explain the factors that influence the elasticities of demand and supply.<br>4. Explain what a firm is and describe the economic problems that all firms face, describe and distinguish between different types of markets in which firm operates.<br>5. Explain the relationship between a firm's output and labor employed in the short run, explain the relationship between a firm's output and costs in the short run and derive a firm's short-run cost curves, and explain the relationship between a firm's output and costs in the long run and derive a firm's long-run average.<br>6. Define perfect competition, monopoly, monopolistic competition and oligopoly, explain how firms make their supply decisions in these markets, and why perfect competition is efficient and why others are inefficient.<br>7. Explain the link between a factor price and factor income, explain what determines demand, supply, the wage rate, and employment in a competitive labor market, and explain what determines demand, supply, the interest rate, saving, and investment in the capital market. | | | | |
| **Literature** | 1. Parkin M. Economics. 12th ed.: Pearson; 2015.<br>2. Mankiw NG. Principles of Economics. 7th ed.: Cengage Learning; 2014.<br>3. Atkinson B, Miller R. Business Economics: Addison Wesley; 1998. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## MEAS201 – MEASUREMENT, INSTRUMENTATION AND CONTROL BASICS

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Measurement, Instrumentation and Control Basics | | | **Module code** | MEAS201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. P. Ariunbolor | | | **Language** | English |
| **Contents** | • Measurement technology: physical significance, measuring arrangement, measurement chain, errors, the main procedures for measuring temperature, pressure, flow and filling levels<br>• Data-processing technology: measuring transducers, measured value boards (hardware), measurement software, processing and analysis programs<br>• Regulator technology: product-integrated regulators, autonomous regulators (industry standard regulators), compact regulator stations, programmable regulator stations<br>• Process control technology: signal/packet-based data transmission, bus systems, transmission paths, coupling stations, engineering stations, software process manager, MES, ERP | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Demonstrate the physical principles of measurement and recognize the process relationships in specific application examples.<br>2. Describe the digital processing of measurements.<br>3. Describe the operating method of control and regulating equipment, and set up the parameters of these devices.<br>4. Assess the options for optimizing automation equipment and evaluate existing automation systems. | | | | |
| **Literature** | 1. Rossi GB. Measurement and Probability: A Probabilistic Theory of Measurement with Applications : Springer; 2014.<br>2. Rossi GB, Huang S, Wang S. Springer Series in Measurement Science and Technology: Springer; 2014.<br>3. Hebra A. The Physics of Metrology: Springer; 2010.<br>4. Kimothi SK. Uncertainty of Measurements: Physical and Chemical Metrology. 1st ed.: Asq Pr; 2002.<br>5. Pennella CR. Managing the Metrology System. 2nd ed.: Amer Society for Quality; 1997. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI)<br>Laboratory (1 UoI) | | | | |
| **Assessment method** | Written (90 min.) and oral (30 min.) examination and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering | | | | |

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| | B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | Completion of Introduction to Electrical Engineering, Mathematics I and II and Physics recommended. |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## CAD201 – COMPUTER AIDED DESIGN (CAD)

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Computer Aided Design (CAD) | | | **Module code** | CAD201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Sungchil Lee | | | **Language** | English |
| **Contents** | Development of CAD software. Environment of AutoCAD. Basic drawing commands: line, circle, polygon, etc. Modification commands: copy, move, trim, extends, join, break, array, insert, etc. Text commands. Miscellaneous commands. Dimensions. Geometric tolerance. Hatching. Layers. Blocks. Drawing mechanical parts. Drawing multi-view projections of object. Design mechanical parts. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Draw basic geometrics: line, circle, rectangle, etc.<br>2. Edit drawings using modification commands.<br>3. Apply each line style appropriately in drawings.<br>4. Draw dimensions and modify existing dimensions.<br>5. Interpret and make general tolerance and geometric tolerance<br>6. Utilize layers to draw efficiently.<br>7. Make and save blocks and utilize them in drawing.<br>8. Criticize mechanical drawings. | | | | |
| **Literature** | 1. Dix M, Riley P. Discovering AutoCAD. 1st ed.: Pearson; 2015.<br>2. Lang K. AutoCAD Tutor for Engineering Graphics. 1st ed.: Cengage Learning; 2013. | | | | |
| **Form of teaching** | Lecture (1 UoI)<br>Laboratory (3 UoI) | | | | |
| **Assessment method** | Drawing using AutoCAD software (30 min) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Engineering Design recommended. | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. | | | | |

## FLME201 – FLUID MECHANICS

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|---|---|---|---|---|---|
| **Module title** | Fluid Mechanics | | | **Module code** | FLME201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. N. Battulga | | | **Language** | English |
| **Contents** | • Basic concepts in fluid mechanics, such as continuum, velocity field, and vorticity.<br>• Dimensional analysis<br>• Principle of the mass conservation and the Newton's law to describe the fluid motion and solve basic engineering problems.<br>• Fluid motion for inviscid fluids, internal flows (e.g. pipe flows), external flows (airfoils and bluff bodies), and flows with a free surface. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Calculate fluid flow regimes, including laminar vs turbulent flows; boundary layers and velocity profiles;<br>2. Apply Dimensional Analysis techniques;<br>3. Compute basic hydrostatics problems involving manometers and submerged surfaces.<br>4. Demonstrate the concept of continuity,<br>5. Demonstrate Bernoulli's principle, and apply it in flow measurement (orifice and Venturi meter, Pitot-static tube), and to a variety of problems involving area change and height change.<br>6. Solve basic problems involving pressure losses through pipes and pipe bends and fittings.<br>7. Apply Momentum equation and the concept of a control volume.<br><br>Use the equation to calculate impulse and reaction forces due to the interaction of a fluid stream with objects, and pressure drops. | | | | |
| **Literature** | 1. Elger DF, Crowe CT , Roberson JA, Williams BC. Engineering Fluid Mechanics. 10th ed.: Wiley; 2012. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | PHY101, THER220, | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## RREC201 – RAW MATERIALS AND RECYCLING

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Raw Materials and Recycling | | | **Module code** | RREC201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Dr. T. Narangarav | | | **Language** | English |
| **Contents** | The technical and legal principles will be covered in relation to selected topics in raw material management and recycling:<br>● Legal principles (material-specific and country-specific).<br>● Quantities of waste material and primary raw material.<br>● Raw material prices and recycling costs.<br>● The market for secondary raw materials.<br>● Quality requirements, and basic technical principles.<br>● Examples of recycling processes.<br>● Current legal requirements, and the effects and repercussions upon trade, industry, and local authorities.<br>● Demonstration of various different economic measures for recycling by means of practical examples.<br><br>Cycles will be considered in the following industrial sectors: iron and steel, non-ferrous metals, mineral raw materials, and wood. | | | | |
| **Learning outcomes** | On successful completion of this module, students should be able to:<br>1. Describe the technical and economic principles of lifecycle economy, recycling, and the identification and remediation of contaminated sites.<br>2. Explain the technical relationships, the differences between free and regulated markets, and the controlling function of the legal system in recycling, and the remediation of contaminated sites.<br>3. Apply the gained knowledge by carrying out a piece of independent practical work, and publicly presenting their knowledge and experience of complex technical/economic/legal matters. | | | | |
| **Literature** | 1. Pichtel J. Waste Management Practices: Municipal, Hazardous, and Industrial. 2nd ed.: CRC Press; 2014.<br>2. Bilitewski B, Härdtle G, Marek K. Waste Management. 1st ed.: Springer; 2010.<br>3. Bagchi A. Design of Landfills and Integrated Solid Waste Management. 2nd ed.: Wiley; 2004.<br>4. Rowe DR, Abdel-Magid IM. Handbook of Wastewater Reclamation and Reuse. 1st ed.: CRC Press; 1995. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation/Field trip (2 UoI)) | | | | |
| **Assessment method** | Written examination (60 min) and academic performance | | | | |

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| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 50% and the module examination accounting for 50%. |

## SCIM201 – SCIENTIFIC METHODS

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Scientific Methods | | | **Module code** | SCIM201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 2 CP | **Workload** | 60 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 36 h |
| **Module coordinator** | Prof. L. Altangerel | | | **Language** | English |
| **Contents** | This topic introduces students to the broad quantitative and qualitative approaches to research in the field of education. Students examine the key steps in the process of conducting research including identifying research problems, reviewing the literature, developing research questions, collecting and analyzing data, and reporting and evaluating research. Students are asked to consider the context, nature and purposes of research in selecting a research method. Students are encouraged to integrate their research interest in their learning process.<br>The module aims to<br>● Introduce to a range of approaches to scientific research and relationship to philosophical thinking;<br>● Critically examine the similarities and differences between quantitative and qualitative research works and their effect on research method selection;<br>● Develop an understanding of the key elements of the research process including: research problems, literature, reviews, research questions, collecting and analyzing data as well as reporting and evaluating research | | | | |
| **Learning outcomes** | On successful completion of this module, students should be able to:<br>1. Identify and describe a variety of approaches to research, their similarities and differences, and arguments for and against the use of each approach.<br>2. Develop an understanding of the key elements of the research process including research problems, literature reviews, research questions, collecting and analyzing data; and reporting and evaluating research.<br>3. Understand scientific research papers and recognize articles that addresses an area of research from different philosophical perspectives.<br>4. Identify original contributions to research, to policy and/or management and/or practice.<br>5. Carry out independently a small-scale research. | | | | |
| **Literature** | 1. Deb D, Dey R, Balas WE. Engineering Research Methodology. 1st ed.: Springer; 2019.<br>2. Ormrod LPD, Ellis J. Practical research : planning and design. 11th ed.: Pearson; 2015.<br>3. Kumar R. Research Methodology. 3rd ed.: SAGE Publications; 2010. | | | | |
| **Form of teaching** | Recitation (2 UoI) | | | | |
| **Assessment method** | Academic performance and final presentation, report | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering | | | | |

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| | B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | Pass/Fail |

## HSE201 – HEALTH SAFETY ENVIRONMENT (HSE)

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Health Safety Environment (HSE) | | | **Module code** | HSE201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | B. Erdenebaatar | | | **Language** | English |
| **Contents** | a. Principles of Health/Safety/Environment Management (HSE)<br>History, terminology, basis, duties and quality goals of HSE; overview of national and international law, sustainability model/indicators; principles of complex working systems, cause and effect model, risk reduction model, regional material flow and area management, operational material flow management; health/safety/environmental technology, working environment, organization and human behavior; overview, selected risks and stresses, emissions and immissions; event statistics, environmental auditing, environmental compatibility, environmental declaration, environmental performance assessment, principles of ecological life cycle balancing, principles for constructing and implementing management systems (PDCA cycle)<br>b. Methods for Health/Safety/Environment Management<br>Assessment of HSE effects (basis and methods for form-based assessment, determination and evaluation of risks and stresses, analysis methods); hierarchy of protective measures, key performance indicators (KPIs), ecological book-keeping, estimation of technical consequences, methods for quantifying the environmental relevance of emissions and immissions, audits, continuous improvement process, etc.); prevention, operation with goals, influencing behavior, environmental cost calculation, eco-cost control;<br>Certification of management systems (e.g. EMAS, EN ISO 14001 ff., EN ISO 9001 ff., OHSAS 18001 ff.), integrated management system | | | | |
| **Learning outcomes** | On successful completion of this module, students should be able to:<br>1. Describe the basic scientific principles, methods and instruments for protection of the workplace, health and the environment, and sustainability management, and to apply the requirements of the standards to selected operational examples.<br>2. List the risks and stress factors and evaluate emissions and immissions.<br>3. Analyze complex work systems in terms of the causal chain (cause-effect-damage) and select protective measures.<br>4. Describe the structure, Contents and goals of the main HSE management systems, describe the duties of the technical and managerial personnel in terms of analysis, organization and activities | | | | |
| **Literature** | 1. Center for the Advancement of Process. Safety, Health & Environment: Prentice Hal; 2009. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI)<br>Field trip (1 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering | | | | |

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|---|---|
| | B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | None |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## LAW201 – LAW

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Law | | | **Module code** | LAW201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 2 CP | **Workload** | 60 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 36 h |
| **Module coordinator** | G. Surakhbayar | | | **Language** | English |
| **Contents** | This module introduces students to the basics of national and international environmental law. Including:<br>• Overview of Environmental Concepts, Theories, Sources;<br>• Protecting Environmental Objects such as Air, Water, and Wildlife in Mongolia<br>• International Environmental Norms | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Describe the roles of contemporary theories, concepts, and sources concerning environmental protection.<br>2. Examine the importance of environmental laws & regulations and its application within the Mongolian court system.<br>3. Assess interactions between environmental laws & regulations and other domestic laws.<br>4. Apply environmental rules and norms to specific environmental issues in Mongolia. | | | | |
| **Literature** | 1. Amarkhuu O. Contemporary Environmental Law of Mongolia; 2013.<br>2. Percival RV, Schroeder CH, Miller AS, James P. Leape. Environmental Regulation: Law, Science, and Policy. 7th ed.: Wolters Kluwer; 2013.<br>3. Hunter D, Salzman J, Zaelke D. International Environmental Law and Policy. 4th ed.: Foundation Press; 2010. | | | | |
| **Form of teaching** | Lecture (2 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance. | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. | | | | |

## INTR201 – BASIC INTERNSHIP

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|---|---|---|---|---|---|
| **Module title** | Basic Internship | | | **Module code** | INTR201 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 4th |
| **Credit points** | 2 CP | **Workload** | 120 h | **Contact hours** | NA |
| | | | | **Individual study** | 120 h |
| **Module coordinator** | Department of Academic and Student Affairs | | | **Language** | English |
| **Contents** | During the internship, students will be introduced to the social structures in the company, work processes, the relationship between employees, supervisors and executives, and teamwork as well as the responsibility of the individual employee. The Basic Internship helps the students to decide on a major or confirm the decision they have already made. | | | | |
| **Learning outcomes** | After taking part in the industrial placement, the student should be able to:<br>1. Explain the company structure and its work processes.<br>2. Describe the duties and tasks of positions in the company.<br>3. Do simple SWAT analysis for the company.<br>4. Provide a written statement of the activities carried out, an appropriately record their observations and experiences. | | | | |
| **Literature** | None | | | | |
| **Form of teaching** | Basic internship (6 weeks) | | | | |
| **Assessment method** | Written report (min. 10 p.) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |
| **Requirements for receiving credit points** | Confirmation of participation in the internship, Acceptance of the written report. | | | | |
| **Grading system** | Pass / Fail | | | | |

# PROFESSIONAL MODULES (5TH – 8TH SEMESTER)

## MECH301 – ENGINEERING MECHANICS III (MECHANICS OF MATERIAL)

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|---|---|---|---|---|---|
| **Module title** | Engineering Mechanics III (Mechanics of Materials) | | | **Module code** | MECH301 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Kim Young Suk | | | **Language** | English |
| **Contents** | This module aims to educate students to analyze structural members under various loading conditions and to design members satisfying design criteria. The Contents of module include as follows:<br>• Definition of stresses in 2D and 3D representation<br>• Deformation and strain, Hooke's law, Mohr's circle, strength hypotheses,<br>• Structural analysis under axial force, bending moment, torsional force, and shear force<br>• Energy principles in electrostatics,<br>• Stability and buckling of column members. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Describe one-, two- and three-dimensional stress states and to identify the corresponding principal stresses.<br>2. Design beams and shafts on the basis of strength<br>3. Determine deflection beams and shafts<br>4. Apply the theorem of work balance and the principle of virtual forces<br>5. Analyze simple stability problems and apply Euler's buckling cases. | | | | |
| **Literature** | 1. Hibbeler RC. Mechanics of Materials, 11th edition; 2011.<br>2. Beer FP, Johnston ER, DeWolf JT. Mechanics of Materials. 3th edition; 2004. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Engineering Mechanics I: Statics | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |

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| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examinations accounting for 70% |

## MECH302 – PRODUCTION PROCESS TECHNOLOGY

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|---|---|---|---|---|---|
| **Module title** | Production Process Technology | | | **Module code** | MECH302 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 54 h |
| | | | | **Individual study** | 126 h |
| **Module coordinator** | Prof. Kim Young Suk | | | **Language** | English |
| **Contents** | Basic principles and typical production processes and main process groups (DIN 8580); relationship between design form, material and production processes as the basis for manufacturing technology; details of the main material groups; process development and the basic procedures for component production and assembly in machine-tool and vehicle manufacturing using examples; main factors affecting, and basic principles of, the organization of production for manufacturing and assembling components; principles of geometric production measurement technology, metrological procedures, equipment and test procedures for machine tools. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Systematically compare and evaluate particular production processes under given circumstances.<br>2. Design customized production processes, allocate resources, and determine the economic parameters (times and costs). | | | | |
| **Literature** | 1. Kalpakjian S, Schmid SR. Manufacturing Engineering and Technology. 7th edition. Pearson; 2013.<br>2. Groover M. Fundamentals of Modern Manufacturing; 2007.<br>3. Hooford W. Metal Forming; 2007.<br>4. Koenig D. Manufacturing Engineering; 2006.<br>5. Groza J. Material Processing Handbook; 2006.<br>6. Krar S. Metalworking and Manufacturing Technology; 1998.<br>7. Karlson L. Modeling in Welding, Hot Powder Forming and Casting; 1997.<br>8. Krause C. Heat Treatment and Surface Engineering; 1988. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Reciation (1 UoI)<br>Laboratory (0.5 UoI)<br>Excursion (1 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Materials Science; Engineering Mechanics I-II | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examinations accounting for 70% |

# MECH303 – ENGINEERING MECHANICS IV (MACHINE ELEMENTS)

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|---|---|---|---|---|---|
| **Module title** | Engineering Mechanics IV (Machine Elements) | | | **Module code** | MECH303 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 5th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 54 h |
| | | | | **Individual study** | 126 h |
| **Module coordinator** | Prof. N. Odbileg | | | **Language** | English |
| **Contents** | **Machine Design** is for engineers a key qualification and responsibility as it integrates and combines basic **Engineering Mechanics** (where forces are acting, how large these forces are), **Materials Science** (which materials are suitable to withstand these forces) and also **Engineering Design** (i.e. the documentation and communication of a design by technical drawings / CAD) into the ability to calculate the dimensions of machine elements, i.e. standard elements or specifically designed components or combinations. The course includes the properties, construction, dimensioning including calculations of (basic) machine elements, especially shafts, joints (form-locked: rivets, pins, bolts etc., force-locked: screws, nuts & bolts etc, material-bonded: welding, brazing, gluing etc.), shaft-hub-joints, springs, bearings (friction bearings, ball bearings etc.), couplings, seals, and gearing mechanisms | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Determine a group of mechanical components (simple machines) is supposed to achieve by looking at the CAD/technical drawing.<br>2. Decide which standard elements are suitable to perform a set of given tasks and document that decision.<br>Calculate the dimensions of simple mechanical components and combinations to perform a given task (and document the course of these calculations). | | | | |
| **Literature** | 1. Norton RL. Machine Design: An Integrated Approach, 5th edition, Pearson; 2016.<br>2. Shigley JL. Mechanical Engineering Design, 10th edition, McGraw-Hill Education; 2016. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI)<br>Laboratory (0.5 UoI)<br>Excursion (1 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance. | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Mechatronic Engineering<br>B.Sc. Raw Materials and Process Engineering | | | | |
| **Prerequisites for participation** | Engineering Mechanics III | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## EEEN304 - ELECTRONICS

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Electronics | | | **Module code** | EEEN304 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 72 h |
| | | | | **Individual study** | 108 h |
| **Module coordinator** | Prof. Kim Young Suk | | | **Language** | English |
| **Contents** | Analog and digital electronic components as integral parts of Mechatronic Systems. Basics of linear circuits with resistors, capacitors and inductor<br>**Analog Electronics:**<br>• Semiconductor Electronic Devices. Semiconductor materials (Si, Ge) and their electrical conductive properties<br>• .Components of analog electronic circuits:<br>• Switching Devices: Diodes, (Bipolar)-Transistors, Metal Oxide Semiconductor Field Effect Transistors (MOSFET).<br>• Operational Amplifiers (op-amps): with operation to add, subtract, multiply, compare, convert, etc. Examples: Basic op-amps, Common op-amps, e.g. comparator, positive feedback, negative feedback, etc.<br>• Filter: Low pass, high pass, band pass, band stop and all-pass filters.<br>• Modelling, Design, Construction and Debugging of Analog Electronic circuits. Basic principles of operation. Basic properties, Transistor models and higher frequencies, Properties and applications of Operational Amplifiers, Circuit Simulation with SPICE, Small signal modelling, Single Stage Amplifiers, Frequency Response of of analog electronic circuits.<br>**Digital Electronics:**<br>• Presentation of the most popular Digital Electronic Device types, e.g. the Complementary Metal Oxide Silicon (CMOS). Consideration of Power consumption, Voltage levels and Speed of operation. Explanation of Logic Devices .The most common logic gates: Decoders, Multiplexer and Flip Flops. Boolean Algebra,<br>• Analog-Digital-Converters (ADC) to convert Analog signals to Digital numbers (e.g. from Sensor to Microcontroller) and Digital-Analog-Converters (DAC) to convert Digital numbers to Analog signals (e.g. Microcontroller to Actuator). Resolution of ADCs and DACs, Error quantification.<br>**Projects** | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Recall properties, theorems and mathematical representations of open and closed loop systems<br>2. Define behaviours of the transient and steady-state responses of systems (first order, second order, integral and derivative)<br>3. Derive transfer functions of systems<br>4. Sketch responses in time domain and frequency domain<br>5. Apply knowledge in design of control systems and filters<br>6. Solve problems related to control systems by using Matlab | | | | |
| **Literature** | 1. Lowe D. Electronics All-in-One For Dummies. 3rd ed. For Dummies; 2022.<br>2. Debnath S. 270 Electronics Projects with Circuit Diagrams. Mechanical Engineering Publications; 2020. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI)<br>Laboratory (2 UoI) | | | | |

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| **Assessment method** | Written examination (180 min) and academic performance |
| **Associated study program** | B.Sc. Mechatronic Engineering<br>B.Sc. Energy and Electrical Engineering |
| **Prerequisites for participation** | Completion of Physics, Introduction to Electrical Engineering or Fundamentals of Electrical Engineering, Material Science, Introduction to Computer Science |
| **Requirements for receiving credit points** | Passing the examinations |
| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examinations accounting for 70% |

## EEEM302 – MECHATRONICS AND CONTROLLERS

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|---|---|---|---|---|---|
| **Module title** | Mechatronics and Controllers | | | **Module code** | EEEM302 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | B.Myagmarjav | | | **Language** | English |
| **Contents** | • **Mechatronics:** Basic concepts of mechatronics, control of mechatronic systems; modelling of systems.<br>• **Introduction**: Concept of PLC, building block of PLC, function of various blocks, limitation of relays, advantage of PLC over electromagnetic relays, different programming languages, PLC manufacturer, working of PLC, basic operation and principles of PLC, architectural details<br>• **Instruction Set**: Basic instructions like latch, master control self-holding relays, timer instruction like retentive timers, resetting of timers, counter instructions like up counter, resetting of counters. Ladder Diagram Programming : programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program)<br>• **Microcontroller series (STF04)**: Pin details, I/O ports structure, memory organization, special function registers instruction set, addressing modes, timers operation, serial port operation, interrupts<br>• **Keil language programming** : Assemblers and Compilers, assembler directives, desi,gn and interface. Examples like: keypad interface, 7- segment interface, LCD, Stepper motor, A/D, D/A, RTC interface, the introduction of PIC microcontrollers**.**<br>• **Practical projects using PLC training and Microcontroller training, Computer Diagnostics Tools** | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Operate and demonstrate microcontroller and PLC-based systems in electrical control circuits for domestic and industrial processes<br>2. Program and develop microcontroller-based systems<br>3. Use of PLC and make suitable ladder logic programs for different applications<br>4. Understand various control system devices and components the performance of various controllers, and control system | | | | |
| **Literature** | 1. Rathore U, Verma VP. Programmable Logic Controller and Microcontrollers. S.K. Kataria & Sons; 2016.<br>2. Dunning G. Introduction to Programmable Logic Controllers, 3rd Edition. Thomson/Delmar Learning; 2005. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Lab (2 UoI) | | | | |
| **Assessment method** | Written examination (90 min) and academic performance and project assessment | | | | |

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|---|---|
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Mechatronics Engineering |
| **Prerequisites for participation** | Fundamentals of Electrical Engineering I |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examinations accounting for 70% |

## EEEM309 – ELECTRIC MACHINE AND DRIVE

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|---|---|---|---|---|---|
| **Module title** | Electric Machine and Drive | | | **Module code** | EEEM309 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 6th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Nikita Abramov | | | **Language** | English |
| **Contents** | • Construction and operating mode of<br>- transformer<br>- DC machine/drive<br>- asynchronous machine/drive<br>- synchronous machine/drive<br>• Theory of rotating magnetic field<br>• Stationary operating behavior of the machines in engine/generator operatio<br>• Application in drive technology (mains fed / inverter feed). | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Clarify the fundamentals of electrical-mechanical energy conversion<br>2. Describe and explain the implementation of the basic concepts of Electromagnetic fields and forces in their application to electrical machines<br>3. Discuss the individual components of electrical machines in their function and explain in their mode of action<br>4. Design and explain the stationary operating behavior of the three basic types of electrical machines (DC machine, asynchronous machine, synchronous machine) in both generator and engine operation. | | | | |
| **Literature** | 1. Sahdev SK. Electrical Machines. Cambridge University Press; 2018.<br>2. Petruzella FD. Electric Motors and Control Systems. McGraw-Hill Education; 2015.<br>3. Wildi T. Electrical Machines, Drives, and Power Systems. 6th ed. Pearson New International Edition; 2014.<br>4. Hughes A, Drury B. Electric Motors and Drives. 4th ed. Elsevier; 2013. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Laboratory (2 UoI) (Practice) | | | | |
| **Assessment method** | Written examination (90 min) and academic performance | | | | |
| **Associated study program** | B.Sc. Electrical Engineering-Energy<br>B.Sc. Mechanical Engineering<br>B.Sc. Mechatronic Engineering<br>B. Sc. Raw Materials and Process Engineering | | | | |
| **Prerequisites for participation** | Completion of Introduction to Electrical Engineering, Electronics is required. | | | | |

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| **Requirements for receiving credit points** | Passing the examinations |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## MECH304 – HYDRAULIC AND PNEUMATIC DRIVES

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Hydraulic and Pneumatic Drives | | | **Module code** | MECH304 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 6th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 36 h |
| | | | | **Individual study** | 84 h |
| **Module coordinator** | Prof. N. Odbileg | | | **Language** | English |
| **Contents** | Hydraulic and pneumatic drives and control technology, that is, fluid technology, is used to control or regulate motions or forces in machines, plant systems and vehicles. The module provides the introduction to the physical principles, the methods of construction, and the methods of operation of the main component elements, together with the basic circuits for designing simple mechanical engineering systems. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Describe and apply the principles of electro-mechanical energy conversion.<br>2. Describe the key functions of fluid drive systems.<br>3. Develop and calculate solutions for simple systems. Analyze complex machine controls and evaluate different solution options. | | | | |
| **Literature** | 1. Paal G. Hydraulic and Pneumatic Systems; 2006.<br>2. Kumar P. Hydraulic Machines, CRC Press; 2004.<br>3. Parr A. Hydraulics and Pneumatics, Butterworth-Heinemann; 1999. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Mechatronics Engineering<br>B.Sc. Electrical and Energy Engineering | | | | |
| **Prerequisites for participation** | Fluid Mechanics | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examinations accounting for 70% | | | | |

## EEEM307 – POWER ELECTRONICS

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|---|---|---|---|---|---|
| **Module title** | Power Electronics | | | **Module code** | EEEM307 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 6th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Kim Young Suk | | | **Language** | English |
| **Contents** | **Overview of power semiconductor devices**: Diodes, Thyristors, BJT, MOSFET, IGBT.<br>**Rectifiers**: Single-phase and three-phase diode rectifiers with different types of loads, Average power output, Performance parameters, Harmonic analysis.<br>**Switch-mode DC-DC converters**: Design, analysis and control of Step-down (Buck), Step-Up (Boost), Buck-Boost and Full bridge topologies, Pulse-width modulation (PWM) scheme, characteristics of controllable switches, continuous and discontinuous current mode.<br>**Switch-mode DC-AC converters**: Basic inverter concept, Sinusoidal PWM.<br>**Project: Practical Application** | | | | |
| **Learning outcomes** | **Overview of power semiconductor devices**: Diodes, Thyristors, BJT, MOSFET, IGBT.<br>**Clarify r**ectifiers: Single-phase and three-phase diode rectifiers with different types of loads, Average power output, Performance parameters, Harmonic analysis.<br>**Explain switch-mode DC-DC converters**: Design, analysis and control of Step-down (Buck), Step-Up (Boost), Buck-Boost and Full bridge topologies, Pulse-width modulation (PWM) scheme, characteristics of controllable switches, continuous and discontinuous current mode.<br>**Identify switch-mode DC-AC converters**: Basic inverter concept, Sinusoidal PWM.<br>**Project: Practical Application** | | | | |
| **Literature** | 1. Alaküla M, Karlsson P, Bängtsson H. Power Electronics: Devices, Converters, Control and Applications. Lund University; 2019.<br>2. Trzynadlowski AM. Introduction to Modern Power Electronics. 3rd ed. Wiley; 2016.<br>3. Erickson RW, Maksimovic D. Fundamentals of Power Electronics. 3rd ed. Springer Nature Switzerland AG; 2020.<br>4. Wiener AE. Power Electronics: Practical Calculation Dynamo-Electric Machines. Uran Press; 2015. | | | | |
| **Form of teaching** | Lecture (1 UoI)<br>Recitation (1 UoI)<br>Laboratory (2 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Electrical Engineering-Energy<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Electronics is required. | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |

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| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

## EEEM308 – CONTROL SYSTEM

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|---|---|---|---|---|---|
| **Module title** | Control System | | | **Module code** | EEEM308 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. Kim Young Suk | | | **Language** | English |
| **Contents** | • Open and closed loop systems (basic properties, mathematical representations);<br>• Transfer functions, block diagrams, signal flowing chart (input, output), state space models<br>• Responses in time domain and frequency domain<br>• Stability criteria, root locus analysis, Nyquist analysis, and analytic analysis<br>• Design and corrections of control systems (analyses and syntheses)<br>• Applications (PID controllers and filters). | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Recall properties, theorems and mathematical representations of open and closed loop systems<br>2. Define behaviors of the transient and steady-state responses of systems (first order, second order, integral and derivative)<br>3. Derive transfer functions of systems<br>4. Sketch responses in time domain and frequency domain<br>5. Apply knowledge in design of control systems and filters<br>6. Solve problems related to control systems by using MATLAB | | | | |
| **Literature** | 1. Keviczky L, Bars R, Hetthéssy J, Bányász C. Control Engineering. Springer Nature Singapore; 2019.<br>2. Golnaraghi F, Kuo BC. Automatic Control Systems. 10th ed. Orchard Publications; 2017.<br>3. Nise NS. Control Systems Engineering. 7th ed. Wiley; 2015. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written (90 min.) and oral (30 min per each student.) examination and academic performance | | | | |
| **Associated study program** | B.Sc. Mechatronic Engineering<br>B.Sc. Energy and Electrical Engineering | | | | |
| **Prerequisites for participation** | Completion of Introduction to Electrical Engineering is required. | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. | | | | |

## INTR301 – INDUSTRIAL INTERNSHIP + REFLECTION

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Industrial Internship + Reflection | | | **Module code** | INTR301 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 6th |
| **Credit points** | 10 CP | **Workload** | 14 weeks internship | **Contact hours** | |
| | | | | **Individual study** | 300 h |
| **Module coordinator** | Prof. N. Odbileg | | | **Language** | English |
| **Contents** | TBD prior to internship. The Industrial Internship experience provides students with opportunities to explore career interests while applying knowledge and skills learned in the classroom in a work setting.<br>Internship experience also helps students gain a clearer sense of what they still need to learn and provides an opportunity to create professional networks. | | | | |
| **Learning outcomes** | After taking part in the industrial placement, the student should be able to:<br>1. Explain the social side of the work process based on secondary socializing in the business, and describe the business as a social structure.<br>2. Assess his or her future position and prospects in the business.<br>3. Provide a written statement of the activities carried out, and appropriately record their observations and experiences.<br>4. Assess the specialization that he/she will choose for his/her career based on the studies to date, and the overall appreciation that has been gained by exposure to the practical, and in-depth experience of their theoretical knowledge.<br>5. Describe and evaluate the complex interrelationships between the areas preceding and following the production area.<br>6. Produce a written record of complex technical relationships and production processes. | | | | |
| **Literature** | None | | | | |
| **Form of teaching** | Industrial internship (14 weeks) | | | | |
| **Assessment method** | Written report (min. 10 p.) and oral presentation (20 min.) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Basic Internship | | | | |
| **Requirements for receiving credit points** | Confirmation of participation in the internship, Acceptance of the written report , participation in the seminar | | | | |
| **Grading system** | Pass / Fail | | | | |

# MECH401 – ENGINEERING MECHANICS V (DYNAMICS OF MACHINERY)

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|---|---|---|---|---|---|
| **Module title** | Engineering Mechanics V (Vibrations) | | | **Module code** | MECH401 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 7th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 54 h |
| | | | | **Individual study** | 126 h |
| **Module coordinator** | Prof. N. Odbileg | | | **Language** | English |
| **Contents** | This course comprises the following topics:<br>Part I (TMM): Position and displacement analysis, Velocity analysis, Acceleration analysis, Force analysis<br>Part II (Mechanical Vibrations): Free vibration of Single Degree of Freedom System, Harmonically Excited Vibration of SDF, Free and Forced Vibrations of Two Degree of Freedom System, Vibrations of Multiple Degree of Freedom System.<br>Lab: Alignment, Vibration Measurement, Vibration Analysis | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Calculate positions, velocities, accelerations, and forces of links of mechanisms<br>2. Recognize and analyze oscillating systems.<br>3. Calculate system responses with MATLAB.<br>4. Avoid regions of resonance.<br>5. Measure shaft alignment<br>6. Analyze vibration of machines | | | | |
| **Literature** | 1. Myszka DH. Machines and Mechanisms Applied Kinematic Analysis, Prentice Hall; 2012.<br>2. Isermann R. Identification of Dynamic Systems, Springer; 2011.<br>3. Rao SS. Mechanical Vibrations, Pearson; 2010.<br>4. Dresig H. Dynamic of Machinery, Springer; 2010.<br>5. Sir J. Handbook of Learning and Approximate Dynamic Programming. J*ohn* Wiley and Sons; 2004.<br>6. Astasev V. Dynamics and Control of Machines, Springer; 2000. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI)<br>Laboratory (0.5 UoI)<br>Excursion (1 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Mechatronics Engineering<br>B.Sc. Electrical and Energy Engineering | | | | |
| **Prerequisites for participation** | Engineering Mechanics I and II | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examinations accounting for 70% |

## MECT401 – CNC MACHINES

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | CNC Machines | | | **Module code** | MECT401 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 7th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 54 h |
| | | | | **Individual study** | 126 h |
| **Module coordinator** | Prof. N. Odbileg | | | **Language** | English |
| **Contents** | This course comprises the following topics: Mechanics of CNC, CNC Coordinates, Systems of the CNC Machines, Design of Mechanical System, Design of Control System, 3D Modeling of the machine, CNC Machine G and M Code | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Explain and to apply the basics of CNC machines.<br>2. Design and test 3 axis CNC machines for cutting and engraving<br>3. Generating G and M codes using software ArtCam<br>4. Install and test CNC machines<br>5. Managing maintenance of CNC machines. | | | | |
| **Literature** | 1. Kief HB, Roschiwal HA. CNC Handbook, McGraw-Hill Education, 1st edition; 2012.<br>2. Overby A. CNC Machining Handbook: Building, Programming, and Implementation, McGraw-Hill Education, 1st edition; 2010.<br>3. Goldenberg VJ. Introduction to Computer Numerical Control (CNC), Prentice Hall, 5th edition; 2003. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI)<br>Laboratory (0.5 UoI)<br>Excursion (1 UoI) | | | | |
| **Assessment method** | Written examination (120 min) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Engineering Mechanics III and Power Electronics | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module accounted for 30% and the module examination accounted for 70% | | | | |

## MECT402 – SOFTWARE ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Software Engineering | | | **Module code** | MECT402 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 7th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 36 h |
| | | | | **Individual study** | 84 h |
| **Module coordinator** | B. Myagmarjav | | | **Language** | English |
| **Contents** | This course comprises the following topics:<br>• Software development process<br>• V-Development Process<br>• Design Patterns<br>• Verification methods<br>• Software version management | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Explain the steps in a software development process<br>2. Apply the Unified Modeling Language (UML)<br>3. Create design patterns in software engineering<br>4. Apply and assess the verification of software<br>5. Perform software version management | | | | |
| **Literature** | 1. Sommerville I. Software Engineering. 10th ed. Pearson; 2021.<br>2. Pressman RS, Maxim B. Software Engineering: A Practitioner's Approach. 9th ed. McGraw-Hill Education; 2020. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Reciation (1 UoI) | | | | |
| **Assessment method** | Written examination (90 min) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechatronics<br>B.Sc. Electrical Power Engineering | | | | |
| **Prerequisites for participation** | Passing the modules Introduction to Computer Science and Programming | | | | |
| **Requirements for receiving credit points** | Passing the examinations | | | | |
| **Grading system** | The final grade consists of the academic performance during the module accounted for 30% and the module examination accounted for 70% | | | | |

## MECT403 – SYSTEMS ENGINEERING AND NETWORK TECHNOLOGY

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Systems Engineering and Network Technology | | | **Module code** | MECT403 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 7th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 60 h |
| | | | | **Individual study** | 126 h |
| **Module coordinator** | B. Myagmarjav | | | **Language** | English |
| **Contents** | This course comprises the following topics:<br>• Integrated Product Development<br>• Product Life Cycle<br>• Object Oriented Systems Engineering<br>• System Modeling Language (SysML)<br>• Requirement, Operational and Functional Analysis<br>• Systems Verification and Validation Process<br>• Project Management<br>• ISO/OSI layer model<br>• Bus access methods<br>• Ethernet<br>• ICP/IP model<br>• Some selected examples of network systems. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Apply a simplified integrated product development process<br>2. Explain SysML<br>3. Describe the ISO/OSI model layers<br>4. Explain the mechanisms of data transfer<br>5. Apply the most important terms and protocols of network technology. | | | | |
| **Literature** | 1. Bursa E, Cala A, Ferretto D. Systems Engineering and Its Application to Industrial Product, Springer; 2018.<br>2. Tanenbaum AS. Computer Networks, Prentice Hall; 2007.<br>3. Tanenbaum AS. Distributed Systems, Prentice Hall; 2003. | | | | |
| **Form of teaching** | Lecture (3 UoI)<br>Laboratory (2UoILab) | | | | |
| **Assessment method** | Written examination (120 min) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Introduction to Computer Science and Programming recommended | | | | |

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| **Requirements for receiving credit points** | Passing the examinations |
| **Grading system** | The final grade consists of the academic performance during the module accounted for 30% and the module examination accounted for 70% |

## STWR401 – SCIENTIFIC WRITING

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Scientific Writing | | | **Module code** | STWR401 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 7th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 96 h |
| **Module coordinator** | Prof. G. Gantuya | | | **Language** | English |
| **Contents** | This module instructs the basics required for the scientific writing and publishing of project works and bachelor theses, and for producing reasonable presentations for conferences, seminars, etc. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Utilize the principles of scientific writing.<br>2. Competently recapitulate issues.<br>3. Carry out literature research.<br>4. Grasp didactically prepared mediation.<br>5. Give and assess verbal presentations.<br>6. Apply moderation techniques. | | | | |
| **Literature** | None | | | | |
| **Form of teaching** | Recitation (2 UoI) | | | | |
| **Assessment method** | Homework, Project work, Presentations | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | Pass / Fail | | | | |

## MECT404 – ROBOTICS

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Robotics | | | **Module code** | MECT404 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 8th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 54 h |
| | | | | **Individual study** | 126 h |
| **Module Coordinator** | Prof. N. Odbileg | | | **Language** | English |
| **Contents** | The lecture comprises the following topics:<br>• Robotic arm: classification of robotic systems; transformation of coordinates; kinematics and inverse kinematics; Jacobians and robot dynamics; trajectory generation; modelling; robotic arm calibration; control.<br>• Wheeled mobile robot; machine vision basics; introduction to air, space and underwater robots; robot plume tracing, mobile robot dynamics, motion planning, trajectory generation; robotics in mining; Kalman filtering.<br>• In the laboratory, students will work on the practical operation of robots as mechatronic lab systems with their different components, i.e. controllers (microprocessor, DSP), actuators (drive), process (mechanical system, to be controlled), sensors. The laboratory work involves tests that are accompanied by numerical simulations (MATLAB/Simulink). | | | | |
| **Learning outcomes** | On successful completion of the lecture part of this module, the students should be able to:<br>1. Explain and to apply the basics of robotic systems and related topics, i.e. machine vision, mobile robot, robot design and development processes, and their vast applications.<br>2. Define the needs, to acquire necessary information and to select appropriate robots for various industrial applications.<br>3. Explain the principles of and to apply robot kinematics, dynamics, motion planning, trajectory generation and control.<br>4. Assess the responsibility of engineers for safety issues and the importance associated with the use of robots for various applications<br>On successful completion of the laboratory part of this module, the students should be able to:<br>1. Describe the function of and to develop a block diagram for the complete mechatronic lab systems and their individual components: process (mechanics), actuator, sensor and controller; and with the signals in the control loop: reference input, sensor output, control deviation, control output, corrective action, process disturbance and process output.<br>2. Operate the mechatronic lab system for specified system configurations (system parameters, reference inputs, disturbances and controller settings) and to determine the static and dynamic behavior with an evaluation of the control deviation, the convergence behavior (stability), the accuracy, the mechanical loads and the required power. | | | | |

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|---|---|
| | 3. Analyse the influence of controller parameters on the performance of the mechatronic lab systems and to find controller configurations for an optimal performance.<br>4. Compare the measured static and dynamic behaviour (experiment) with the calculated behaviour from a numerical simulation for the investigated mechatronic lab systems by means of MATLAB/Simulink. |
| **Literature** | 1. Groover MP, Weiss M. Industrial Robotics – SIE: Programming and Applications, Prentice Hall; 2017.<br>2. Bruno S, Lorenzo S. Robotics: Modelling, Planning and Control, Springer; 2009.<br>3. Craig JJ. Introduction to Robotics, Mechanics and Control, 3rd Edition, Addison Wesley; 2008.<br>4. Isermann R. Mechatronic Systems, Springer; 2005.<br>5. Low KH. Robotics, principles and systems modeling, 2nd edition, Prentice Hall; 2004.<br>6. Additional literature related to the lab project. |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (1 UoI)<br>Laboratory (0.5 UoI)<br>Excursion (1 UoI) |
| **Assessment method** | Written examination (120 min) and academic performance (lab report 20 p., tests). |
| **Associated study program** | B.Sc. Mechatronics Engineering |
| **Prerequisites for participation** | Engineering Mechanics IV and V, Measurement, Instrumentation and Sensors, Control Systems, Power Electronics, and Software Engineering |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of written module examination accounted for 50 % and the academic performance during the module accounted for 50% (lab report/tests). |

## PROJ401 – FINAL STUDY PROJECT

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Final Study Project | | | **Module code** | PROJ401 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 8th |
| **Credit points** | 6 CP | **Workload** | 180 h | **Contact hours** | 54 h |
| | | | | **Individual study** | 126 h |
| **Module coordinator** | Prof. M.Hampe | | | **Language** | English |
| **Contents** | Students from different engineering disciplines will work as a team on a current research topic. Through the module students will learn and practice: Soft skills to cooperate. Brainstorming to find a solution. Formulate engineering problems. Problem solving procedures. Application of engineering knowledge for solution. Computation of initial and life cycle cost of system. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Solve a design task with the help of systems engineering.<br>2. Recognize and specify complex problems occurring in industrial practice.<br>3. Ascertain and evaluate variants within a team solution.<br>4. Carry out the main features of an exact time and work schedule team, repeatedly, if necessary.<br>5. Perform different roles in a team.<br>6. Represent and assess divergent positions, and develop a problem solution. | | | | |
| **Literature** | The literature for this module depends on the project and will be provided be the program coordinators. | | | | |
| **Form of teaching** | Project course (2-week interdisciplinary project work, and 1-day field trip), supervised by lecturers of all disciplines involved. | | | | |
| **Assessment method** | Written report and oral presentation | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | None | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade is based on the written report (70%), and based on the academic performance /oral presentations (30%) | | | | |

## THES401 – BACHELOR THESIS + COLLOQUIUM

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|---|---|---|---|---|---|
| **Module title** | **Bachelor Thesis + Colloquium** | | | **Module code** | THES401 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 8th |
| **Credit points** | 12 CP | **Workload** | 360 h | **Contact hours** | |
| | | | | **Individual study** | 360 h |
| **Module coordinator** | Thesis supervisors | | | **Language** | English |
| **Contents** | Current research topics from the general research area of the administering institute. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Solve scientific questions in a structured manner using engineering science methods.<br>2. Critically differentiate between various solutions.<br>3. Present their results in written and oral form in a scientifically acceptable manner. | | | | |
| **Literature** | Depends on topic | | | | |
| **Form of teaching** | Thesis supervision | | | | |
| **Assessment method** | Written thesis (14 weeks handover deadline) and a colloquium (20 min talk followed by a discussion) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Possible prerequisites will be prescribed by the individual institute supervising the thesis.<br>At least 171 credit points must have been earned. | | | | |
| **Requirements for receiving credit points** | Passing the thesis and the presentation | | | | |
| **Grading system** | The final grade for the Bachelor thesis consists of the grade of the thesis and of the grade of the performance in the colloquium with a weighting of 4:1 provided that the thesis grade was rated at least as “passed”. | | | | |

# ENGINEERING ELECTIVE MODULES

## ENSS150 – ENGINEERING SUMMER SCHOOL

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|---|---|---|---|---|---|
| **Module title** | Engineering Summer School | | | **Module code** | ENSS150 |
| **Duration** | 2 weeks | **Semester** | Fall or Spring | **Module start** | 2nd |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 60 h |
| | | | | **Individual study** | 30 h |
| **Module coordinator** | Dr. T. Narangarav | | | **Language** | English |
| **Contents** | Interdisciplinary summer school with reference to GMIT's profile consisting of lab work, excursions, field trips and lectures.<br>The following topics will be covered:<br>• Engineering, especially in the context of the resource industry<br>• Environmental aspects of industrial activities<br>• Mining & industry in Germany<br>• Geology<br>• Intercultural competence & self-organization<br>• Higher education institutions and student life abroad<br>The Summer school is accompanied by social events that enforce intercultural contacts. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Explain the general function of industrial or scientific processes covered and the interaction of different processes with another.<br>2. Identify different materials and their properties and explain their uses in the industrial processes observed.<br>3. Explain the difference between open pit and underground mining and of the difference technology in use.<br>4. Describe impacts on the environment and health along the added value chain of natural resources.<br>5. Perform different activities which are part of mining engineering, such as loading, drilling etc.<br>6. Identify minerals and rocks and explain their properties<br>7. Identify different periods in German history, to compare with Mongolian history and to evaluate the impact of historical developments on the present<br>8. Apply presentation skills. | | | | |
| **Literature** | None | | | | |
| **Form of teaching** | Lab work, excursion, field trip, lectures | | | | |
| **Assessment method** | Report, presentation on major program points | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Open to 1st year students, in exceptional cases, students of other semesters are eligible, selection criteria, e.g. academic performance, motivation, personal qualification | | | | |

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| **Requirements for receiving credit points** | Attendance of all parts of the program and successful completion of module |
| **Grading system** | Pass / Fail. Final report and presentation accounting for 50% each. |

## ENSS151 – ENGINEERING SUMMER SCHOOL

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Engineering Summer School | | | **Module code** | ENSS151 |
| **Duration** | 4 weeks | **Semester** | Fall or Spring | **Module start** | 4th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 60 h |
| | | | | **Individual study** | 30 h |
| **Module coordinator** | German Professors (TDB) | | | **Language** | English |
| **Contents** | Interdisciplinary summer school consisting of lectures, recitations, lab works, excursions and intercultural activities.<br>The following topics will be covered:<br>• Introduction to mining safety engineering<br>• Mining & industry in China<br>• Geology<br>• Culture and language<br>• Modern coal mining technology<br>The Summer school is accompanied by social events that enforce intercultural contacts. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Recognize the work process in the mining area and its social and technical aspect.<br>2. Assess career prospects in the business.<br>3. Explain the general function of industrial or scientific processes covered and the interaction of different processes with another.<br>4. Identify different materials and their properties and explain their uses in the industrial processes observed.<br>5. Explain underground mining and of the difference technology in use.<br>6. Describe impacts on the environment and health along the added value chain of natural resources.<br>7. Identify different periods in Chinese history, to compare with Mongolian history and to evaluate the impact of historical developments on the present.<br>8. Apply skills in writing of reports and essays. | | | | |
| **Literature** | None | | | | |
| **Form of teaching** | Lab work, excursion, field trip, lectures | | | | |
| **Assessment method** | Report, presentation on major program points | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Open to 2nd year students, in exceptional cases, students of other semesters are eligible, selection criteria, e.g. academic performance, motivation, personal qualification. | | | | |

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| **Requirements for receiving credit points** | Attendance of all parts of the program and successful completion of module |
| **Grading system** | Pass / Fail. Certificate of the course |

## EEEM310 – ENERGY STORAGE

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Energy Storage | | | **Module code** | EEEM310 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Nikita Abramov | | | **Language** | English |
| **Contents** | • Necessity of energy storage, especially with regard to Renewable Energies<br>• Application areas for electrical and thermal energy storage: portable devices, consumer products, industrial processes, solar systems, power grids, vehicles<br>• High-and low-temperature thermal storage systems<br>• Mechanical systems for electrical energy storage: flywheel, pumped storage, compressed air energy storage, hydroelectrical stations<br>• Electric storage (inductors, capacitors, supercapacitors)<br>• Electrochemical energy storage for electrical energy: primary batteries, rechargeable electrochemical energy storage<br>• Various types batteries: Lead-acid, Lithium-Ion, NiCd and others Hydrogen Storage Systems<br>• Hydrogen Storage Systems<br>• Feasibility studies for various applications, eg storage in power grids<br>• Economic analysis of energy storage systems<br>• Completion of case studies for big storage systems<br>• Safety aspects, recyclability. | | | | |
| **Learning outcomes** | On successful completion of this module, students should be able to:<br>1. Comprehend various technologies of energy storage and storage systems<br>2. Evaluate various storage systems and calculate and size the components of a storage system<br>3. Use of an universal storage model, independently of the used technology, they can solve various energy storage problems. | | | | |
| **Literature** | 1. Job R. Electrochemical Energy Storage: Physics and Chemistry of Batteries. De Gruyter; 2020.<br>2. Sterner M, Stadler I, editors. Handbook of Energy Storage: Demand, Technologies, Integration. 1st ed. Springer Berlin Heidelberg; 2019.<br>3. Huggins RA. Energy Storage: Fundamentals, Materials and Applications. 2nd ed. Springer; 2016.<br>4. Demirel Y. Energy: Production, Conversion, Storage, Conservation, and Coupling. 2nd ed. Springer; 2016. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (120 min) and academic performance and project assessment | | | | |
| **Associated study program** | B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Completion of Chemistry and Introduction Electrical Engineering are required. | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examination accounting for 70%. |

## RMPE301 – HEAT AND MASS TRANSFER

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|---|---|---|---|---|---|
| **Module title** | Heat and Mass Transfer | | | **Module code** | RMPE301 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | Prof. N. Battulga | | | **Language** | English |
| **Contents** | Steady and non-steady, one- and multi-dimensional heat conduction. Convective heat transport: balance equations for mass, momentum and energy, Nusselt equations. Evaporation and condensation: basic calculations for heat exchangers. Heat transport and heat exchange by radiation. Mass transfer and analogies to heat transfer | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Analyze stationary and transient heat conduction problems, and derive the described differential equations.<br>2. Solve such equations for simple geometries and boundary conditions.<br>3. Derive differential equations for convective heat transport problems, and outline the path for their solution.<br>4. Calculate heat transfer coefficients from the Nusselt equations.<br>5. Analyze and calculate heat flow in heat exchangers.<br>6. Describe heat radiation problems.<br>Use the analogy between heat and mass transport for mass transport calculations | | | | |
| **Literature** | 1. Baehr HD, Stephan K. Heat and mass transfer, Springer; 2011. | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Recitation (2 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance. | | | | |
| **Associated study program** | B.Sc. Raw Materials and Process Engineering | | | | |
| **Prerequisites for participation** | None | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. | | | | |

## MECH402 – FINITE ELEMENT METHOD

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|---|---|---|---|---|---|
| **Module title** | Finite Element Method | | | **Module code** | MECH402 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 7th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 36 h |
| | | | | **Individual study** | 84 h |
| **Module coordinator** | Prof. Sungchil Lee | | | **Language** | English |
| **Contents** | The basic methods will be covered for numerically solving partial elliptical differential equations with boundary conditions in mechanics. The main components of these are: the difference method, the Ritz method, the Galerkin method, the collocation method, the finite element method (FEM), and FEM practical work.<br>Truss elements, beam elements, 2-D plane elements of triangle and rectangle shapes are covered. The matlab code of FE analyasis will be written for the application to real structures | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Solve linear boundary value problems by numerical methods.<br>2. Apply truss elements, beam elements to solve general grid structures<br>3. Apply 2-D plane elements to solve 2-D engineering problems.<br>4. Interpret analysis results and evaluate FE analysis performance.<br>5. Adjust and refine FE model for more accurate results. | | | | |
| **Literature** | 1. Peter W. Introduction to computational mechanic, Springer; 2008.<br>2. Klaus J. Finite-Elemente Methoden, Springer; 2002.<br>3. Schäfer M. Computational Engineering-Introduction to Numerical methods, Springer; 1999.<br>4. Numerical computer programs (Matlab and Python) | | | | |
| **Form of teaching** | Lecture (2 UoI)<br>Laboratory (1 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Mechatronics Engineering | | | | |
| **Prerequisites for participation** | Engineering Mechanics I and Statistics and Numerics | | | | |
| **Requirements for receiving credit points** | Passing the module | | | | |
| **Grading system** | The final grade consists of the academic performance during the module, accounting for 30%, and the module examinations accounting for 70% | | | | |

## EEEM311 – DIGITAL SIGNAL PROCESSING

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|---|---|---|---|---|---|
| **Module title** | Digital Signal Processing | | | **Module code** | EEEM311 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th |
| **Credit points** | 4 CP | **Workload** | 120 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 72 h |
| **Module coordinator** | E. Bold | | | **Language** | English |
| **Contents** | **Basics of Digital Signal Processing**<br>• Sampling and Quantization, Kotelnikov /<br>• Nyquist–Shannon sampling theorem.<br>• Amplitude, phase, frequency.<br>• Periodic signals, aliasing.<br>**Introduction to The Fourier Transform**<br>• Properties of the Fourier Transform.<br>• Digital Fourier transforms<br>**Fast Fourier Transform algorithms**<br>• FIT, DIT. Window functions.<br>**Correlation Analysis**<br>• Cross Correlation and Autocorrelation<br>**Wavelet transforms**<br>• Wavelet digital transform, Wavelet<br>• continuous transform. Orthogonal basis.<br>• Types of wavelets<br>**Discrete Time Systems**<br>• Filter classification in the frequency<br>• domain, FIR and IIR filters.<br>• Transfer function, Impulse Response,<br>• Convolution.<br>• Design of filters by windowing<br>**The Z-transform**<br>• Properties of the z transform. Poles, Zeros.<br>• Pole-zero diagram and frequency response<br>**Modulation and demodulation**<br>• Amplitude and Angle Modulation.<br>• Quadrature modulation. Deviation.<br>• Spectral characteristics.<br>**Digital Communication Systems**<br>• PWM, Keying, Symbol rate, Constellation and Scatter plots. QAM. Filter shaping.<br>• Sigma-Delta modulation. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Identify and describe different techniques in modern digital communications, in particular in source coding, modulation and detection, carrier modulation, and channel coding.<br>2. Develop simple software, for example using Matlab, and use this software to simulate and analyze problems within the field, as well as report the development and results.<br>3. Describe and motivate the fact that the implementation and development of modern digital signal technology requires mathematical modeling and problem solving.<br>4. Apply mathematical modeling to problems in digital communications, and explain how this is used to analyze and synthesize methods and algorithms within the field. | | | | |

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| **Literature** | 1. Palani S. Principles of Digital Signal Processing. 2nd ed. 2022.<br>2. Oppenheim AV, Schafer RW. Discrete-Time Signal Processing. Prentice-Hall Signal Processing Series. 3rd Edition; 2021.<br>3. Tan L. Digital Signal Processing: Fundamentals and Applications. Elsevier Inc; 2008. |
| **Form of teaching** | Lecture (2 UoI)<br>Laboratory (2 UoI) |
| **Assessment method** | Written examination (100 min) and academic performance |
| **Associated study program** | B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronics Engineering |
| **Prerequisites for participation** | Completion of Measurement, Instrumentation, Control Basics is required. |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for 30% and the module examination accounting for 70%. |

# LANGUAGE ELECTIVE MODULES

## ENGL010 – ENGLISH

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | English C1 | | | **Module code** | ENGL010 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | BEP, 1st |
| **Credit points** | | **Workload** | | **Contact hours** | 96 h |
| | | | | **Individual study** | |
| **Module coordinator** | Prof. Ch. Gunpilmaa, D. Suvdanchuluun | | | **Language** | English |
| **Contents** | **Grammar Syllabus:** Gerund/ infinitive, the present and stative verbs, used to and would, passive, causative, future, conditionals and wishes, inversion, modal verbs, relatives, indirect speech and reporting verbs, articles and punctuation<br>**Vocabulary and Topical Syllabus:** ambition, career success, pastimes and hobbies, family, media, social problems, technology, science jobs, health problems, school, college, university, advertising, communication | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Express themselves clearly and talk about complex facts in a structured and detailed way.<br>2. Write correctly to a large degree on a number of complex topics.<br>3. Follow and grasp different kinds of spoken language, live or broadcast<br>4. Read with ease complex texts and summarize correctly and concisely written texts and oral presentations in their own words.<br>5. Deliver a presentation using a clear organized structure, helpful slides, and signposting<br>6. Integrate their reading, writing, and speaking skills to promote creative thinking and independent learning | | | | |
| **Literature** | 1. Dooley VEJ, Edwards L. Upstream Advanced C1, Express Publishing; 2005.<br>2. Evans V, Edwards L, Dooley J. Upstream Advanced C1, Workbook, Express Publishing; 2005. | | | | |
| **Form of teaching** | Recitation (14 UoI in BEP, 8 UoI in 1st Semester in B.Sc. Programs) | | | | |
| **Assessment method** | (70%) = Final examination (written and oral)<br>(30%) = Short presentations, in-class assignments, quizzes,mid-term exam | | | | |
| **Associated study program** | BEP / 1st Semester of Bachelor programs | | | | |
| **Prerequisites for participation** | Participants must have successfully completed level B2 or have a comparable knowledge of English | | | | |
| **Requirements for receiving credit points** | • 80% attendance<br>• Academic performance<br>• Final examination : written and oral examination<br>• Students who failed the exam in the first semester may retake the module in the second semester | | | | |

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| **Grading system** | The modes of assessment total 100%. |

## ENGL150 – ACADEMIC WRITING I

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|---|---|---|---|---|---|
| **Module title** | Academic Writing I | | | **Module code** | ENGL150 |
| **Duration** | 1 semester | **Semester** | Fall and Spring | **Module start** | 1st, 2nd, 3rd, 4th, 5th, 6th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | D. Suvdanchuluun | | | **Language** | English |
| **Contents** | The goal of this module is to offer an introduction to formal writing to the undergraduates which is required in their academic studies at the university. The objectives of the module are to familiarize learners with a formal tone, use of the third-person rather than first-person, focus on the topic, precise word choice on the one part, and to introduce them with a paragraph and essay structures, unity and coherence, outlines, first and second drafts and editing on the other part. The goal and objectives will be achieved by offering the below-mentioned syllabus:<br>• Paragraphs<br>• The five-paragraph essay<br>• Unity within a paragraph and within an essay<br>• Coherence<br>• Brainstorming and making outlines<br>• Drafts and editing<br>• Descriptive essays<br>• Formal emails<br>• CV and motivation or cover letters<br>• Process Analysis Essays<br>• Cause and Effect Essays<br>• Argumentative Essays<br>• Opinion Essays<br>• Reports<br>• Lab report discussions<br>• Reviews | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Recognize, understand and recall the structural components of academic writing at paragraph and essay levels.<br>2. Identify and apply formal register and tone.<br>3. Analyze and evaluate different types of academic writing, e.g. essays, reviews and reports.<br>4. Summarize the main points of academic texts in writing.<br>5. Organize and present arguments in a logical fashion.<br>6. Apply cohesive devices.<br>7. Create their own pieces of academic writing.<br>8. Critically examine and improve upon their own writing.<br>9. Apply the skills acquired in the module to their further academic studies<br>. | | | | |
| **Literature** | 1. Savage A, Mayer P. Effective Academic Writing 2; 2006.<br>2. Jordan RR. Academic Writing Course, Longman; 2003. | | | | |

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| | 3. Barnet S, Stubbs M. Practical Guide to Writing, Harper Collins. Websites: IELTS Writing Skills, British Council, BBC Learn English Writing skills; 1985. |
| **Form of teaching** | Recitation (4 UoI) |
| **Assessment method** | Assignments: written and oral in the form of essays or presentations |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | C1 English level |
| **Requirements for receiving credit points** | Passing the module. |
| **Grading system** | Continuous assessment (presentations and essays): Pass or Fail |

## MNGL150 – MONGOLIAN STYLISTICS

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|---|---|---|---|---|---|
| **Module title** | Mongolian Stylistics | | | **Module code** | MNGL150 |
| **Duration** | 1 semester | **Semester** | Fall and Spring | **Module start** | 1st, 2nd, 3rd, 4th, |
| **Credit points** | 2 CP | **Workload** | 60 h | **Contact hours** | 24 h |
| | | | | **Individual study** | 36 h |
| **Module coordinator** | D. Suvdanchuluun | | | **Language** | English |
| **Contents** | Participants will read texts of different genres, discuss text comprehension and analyze how the texts are structured and which stylistic means, grammatical structures and vocabulary are used. Grammar and spelling rules will be revised.<br>Participants will practice text analyses, summaries and, furthermore, apply their knowledge of style, academic vocabulary and grammar to their own text production. Participants will also learn how to express their thoughts in oral speech, e.g. in discussions and presentations. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Comprehend and analyze texts of different genres and recognize their specific characteristics,<br>2. Write text summaries,<br>3. Structure their thoughts in a text<br>4. Write a formal letter, an application and other short texts as well as an essay with correct grammar, spelling and using appropriate stylistic means<br>5. Give an academic presentation using appropriate language | | | | |
| **Literature** | 1. Мөнхцэцэг С. Орчин цагийн монгол хэлний найруулга зүйн дасгал, Улаанбаатар; 2016.<br>2. Оюунбат Ц, Мөнхцэцэг С. Монгол хэлний найруулга зүй, Улаанбаатар; 2012.<br>3. Мон судар. Монгол хэлний хураангуй тайлбар толь, Мон судар; 2009.<br>4. Сүхбаатар Ц. Монгол хэлний найруулга зүй, Улаанбаатар; 2007. | | | | |
| **Form of teaching** | Recitation (2 UoI) | | | | |
| **Assessment method** | Final paper and academic performance (tests and homework assignments) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | C1 level of English and successful completion of Academic Writing | | | | |
| **Requirements for receiving credit points** | At least 70% of the course grade will be based on evaluation of the formal writing. Formal research writing assignments are required | | | | |

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| **Grading system** | Preliminary Research Portfolio: 20%<br>Critical Presentation: 30%<br>Final Portfolio: 50% |

## HIST150 – EUROPEAN HISTORY

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|---|---|---|---|---|---|
| **Module title** | European History | | | **Module code** | HIST150 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 5th, 7th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | Robin Charpentier | | | **Language** | English |

**Contents**

European Pre-History: Themes, Questions in the Study of History

- Time and Space Considerations; How and Why we Study History
- Stone Age: Paleolithic and Neolithic

Early European Civilization:

- Early Bronze Age – The Minoans
- Archaic Greece
- Classical Greek Period
- Hellenistic Culture
- Central European Late Iron Age Cultures (Hallstatt, La Tène)
- City of Rome to Roman Kingdom/Punic Wars
- Formation and Expansion of Roman Empire
- The Fall of the Roman Empire

Mid-Term Exam

Late Antiquity/Early Middle Ages

- Nomadic Conquests of Western Roman Empire
- Eastern Roman Empire and Byzantium
- Holy Roman Empire
- Age of Vikings
- Muslim Conquests
- Holy Wars: The Crusades
- The Mongol Conquests in its Western Empire and in Eastern Europe; Pax Mongolica

**Learning outcomes**

On successful completion of this module, the students should be able to:

1. Identify factors associated with the major cultural changes that have contributed to and shaped Europeans' distinctive worldview
2. Compare and contrast these factors with relevant time periods in Mongolian history
3. Think critically about: the role and presence/absence of original sources; and about the role of spatiality and time in the creation of an historical record.

**Literature**

1. Duiker WJ, Spielvogel JJ. World History 8th edition; 2016.
2. Spielvogel JV. Glencoe World History, Glencoe-McGraw Hill. Various primary source materials in photocopy; 2008.

**Form of teaching**

Recitation (4 UoI)

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| **Assessment method** | (70%) = Written final examination<br>(30%) = Active in-class participation (15%); tests, mid-term exam, final oral presentation (15%) |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | English at the C1 level in all 4 skills |
| **Requirements for receiving credit points** | 1. Attendance is recorded for those arriving before the scheduled start time<br>2. Participation means: volunteering answers; asking and/or responding to questions; paying attention; actively focusing on in-class tasks; turning in assignments on time and with good quality |
| **Grading system** | The modes of assessment total 100% |

## GERL151 – GERMAN A1.1

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|---|---|---|---|---|---|
| **Module title** | Deutsch A1.1/ German A1.1 | | | **Module code** | GERL151 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st, 3rd, 5th, 7th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | Basic knowledge and skills in pronunciation, spelling (alphabet), intonation (word and sentence stress) of the German language.<br>Main topics are first contact, classroom language, languages/ countries/ sights, jobs, living, time, numbers, making appointments, how to find the way in the city and in buildings, means of transport.<br>Grammar problems, e.g. sentence structure (statements and questions), present tense of verbs, past tense of "haben" and "sein", negation, articles, possessive pronoun, use of prepositions (place/time), cardinal numbers, dative and accusative cases, are introduced and practiced.<br>Basic information about German geography and culture is introduced. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Know the basic principles of pronunciation, intonation, spelling of German.<br>2. Construct grammatically and semantically correct sentences, produce simple statements and questions in oral communication as well as in writing.<br>3. Introduce themselves and others and make themselves understood in the classroom.<br>4. Talk about the geographical location of places and say where people work/study and ask for the way.<br>5. Describe houses/apartments.<br>6. Tell the time and make appointments.<br>7. Apply integrated learning strategies to improve upon their learning independently. | | | | |
| **Literature** | 1. Paar-Grünbichler F, Finster WKJ. Panorama. Deutsch als Fremdsprache. Kursbuch A1 und Übungsbuch A1, Cornelsen Verlag; 2018.<br>2. Funk K. Studio 21. Das Deutschbuch. A1.1, Cornelsen Verlag; 2013. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance (tests and homework assignments) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | C1 English level | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module ( 30%) and the module examination (70%). |

## GERL152 – GERMAN A1.2

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|---|---|---|---|---|---|
| **Module title** | Deutsch A1.2/ German A1.2 | | | **Module code** | GERL152 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd, 4th, 6th, 8th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | Basic knowledge and skills in pronunciation, spelling, grammar and vocabulary of the German language as well as basic aspects of German culture.<br>The main topics include: food/shopping, professions, daily routine/everyday life, holidays, seasons/weather, fashion, the human body/health.<br>Grammar points include: modal verbs, perfect tense, comparison, adjectives, imperative and personal pronouns.<br>In this module A1 (beginner) level is completed. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Pronounce and spell German words and intone sentences correctly.<br>2. Construct grammatically and semantically correct sentences and make simple statements in oral communication as well as in writing.<br>3. Understand simple everyday conversation and short and simple oral material.<br>4. Talk about professions, clothes, the weather, the human body, feelings, food, holidays and daily routines.<br>5. Give recommendations and write simple letters.<br>6. Understand weather forecasts, recipes and various other short texts of different genres.<br>7. Provide basic facts about Germany and German culture.<br>8. Apply integrated learning strategies to improve upon their learning independently. | | | | |
| **Literature** | 1. Paar-Grünbichler F, Finster WKJ. Panorama. Deutsch als Fremdsprache. Kursbuch A1 und Übungsbuch A1, Cornelsen Verlag; 2018.<br>2. Funk K. Studio 21. Das Deutschbuch. A1.1, Cornelsen Verlag; 2013. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and oral examination (15 min.) as well as academic performance (tests and homework assignments) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Successful completion of the module German A1.1 or equivalent knowledge of German | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for and the module examination accounting for 70%. |

## GERL251 – GERMAN A2.1

| | | | | | |
|---|---|---|---|---|---|
| **Module title** | Deutsch A2.1/ German A2.1 | | | **Module code** | GERL251 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st, 3rd, 5th, 7th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | This module will pursue further work to improve students' skills in pronunciation and spelling as well as grammar and vocabulary.<br><br>Language tasks will include: talking about one's self and one's family, describing people and pictures, extending invitations and congratulating people, expressing one's opinion, talking about trips and one's hobbies, describing one's emotions, discussing advertisements and the media, ordering food in a restaurant and explaining one's leisure time activities<br><br>The grammar points covered in this module include: subordinate clauses with *weil, dass*, and *ob* comparative and superlative adjectives, possessive article and adjectives in the dative case, the genitive /s/, main clauses with *aber* and *oder* , the modal verb sollen, reflexive pronouns, adverbs of time, verbs with prepositions, indefinite pronouns, personal pronouns in the dative case.<br><br>Further understanding of aspects of German culture. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Apply their knowledge of German pronunciation, intonation and spelling to new words and sentences.<br>2. Construct grammatically and semantically correct sentences at a basic level.<br>3. Use proper vocabulary to discuss topics such as family, biography, languages, travelling, leisure and media.<br>4. Produce written texts that go beyond the sentence level.<br>5. Interact successfully and appropriately in everyday oral communication.<br>6. Understand short oral texts.<br>7. Grasp the meaning of various short written texts.<br>8. Describe in more detail many aspects of German culture (e.g. migration, literature, geography).<br>9. Apply integrated learning strategies to improve upon their learning independently. | | | | |
| **Literature** | 1. Paar-Grünbichler F, Finster WKJ. Panorama. Deutsch als Fremdsprache. Kursbuch A1 und Übungsbuch A1, Cornelsen Verlag; 2018.<br>2. Funk K. Studio 21. Das Deutschbuch. A1.1, Cornelsen Verlag; 2015. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and academic performance (tests and homework assignments) | | | | |

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| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering |
| **Prerequisites for participation** | Successful completion of the module German A1.2 or equivalent knowledge of German |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for and the module examination accounting for 70%. |

## GERL252 – GERMAN A2.2

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|---|---|---|---|---|---|
| **Module title** | Deutsch A2.2/ German A2.2 | | | **Module code** | GERL252 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd, 4th, 6th, 8th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | This module will pursue further work to improve students' skills in pronunciation and spelling as well as grammar and vocabulary.<br>The language tasks of this module include: talking about moving from the countryside to the city; discussing various forms of culture, applying for a job and describing one's future career plans; celebrations and holidays; emotions and films; innovative ideas and inventions<br>The grammar points covered in this module include: modal verbs in the past, adverbs of time, comparison of the preterite and perfect verb tenses, subordinate clauses with *wenn, als um…zu* and *damit*, the verb *werden*, nominalization, polite requests, prepositions and verbs with the dative case, verbs with accusative complements, genitive case, relative clauses with in and mit, *werden/wurden*.<br>Acquisition of additional aspects of German culture.<br>Completion of level A2 (elementary). | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Correctly apply their knowledge in the pronunciation, intonation and spelling of German to new words and sentences.<br>2. Construct grammatically complex and semantically correct sentences.<br>3. Use proper vocabulary to discuss topics such as culture and arts, the workplace and professions, celebrations and holidays, country and city life and inventions and technology.<br>4. Produce more complex written text.<br>5. Interact effectively and appropriately in everyday speaking situations.<br>6. Understand various types of short written texts.<br>7. Grasp the core meaning of a variety of audio and video material of intermediate difficulty.<br>8. Provide basic facts about German culture, geography and society.<br>9. Apply integrated learning strategies to improve upon their learning independently. | | | | |
| **Literature** | 1. Paar-Grünbichler F, Finster WKJ. Panorama. Deutsch als Fremdsprache. Kursbuch A2 und Übungsbuch A2, Cornelsen Verlag; 2018.<br>2. Funk K. Studio 21. Das Deutschbuch. A2.2, Cornelsen; 2015. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment method** | Written examination (90 min.) and oral examination (15 min.) as well as academic performance (tests and homework assignments) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |

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| **Prerequisites for participation** | Successful completion of the module German A2.1 or equivalent knowledge of German |
| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for and the module examination accounting for 70%. |

## GERL351 – GERMAN B1.1

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| **Module title** | Deutsch B1.1/ German B1.1 | | | **Module code** | GERL351 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st, 3rd, 5th, 7th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | Development and application of the knowledge and skills acquired in the A1 and A2 levels. Additional topics include: German/European history, men/women, aspects of professional life and the education system. Grammar points include: subordinated sentences, past tense of irregular verbs, word formation and conditional forms. | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Interact adequately in most situations of everyday life.<br>2. Speak in a simple but well-structured way about topics like politics, history, and culture.<br>3. Give recommendations; agree or disagree; express their opinion and give reasons.<br>4. Describe dreams, wishes and goals; and report about experiences and events.<br>5. Read and understand short newspaper articles.<br>6. Write texts on a number of everyday topics that consist of several paragraphs and employ cohesive structures to organize the text as a whole.<br>7. Deliver short presentations on a number of topics related to everyday life, history and culture.<br>8. Understand everyday conversations as well as audio and video material of intermediate difficulty.<br>9. Apply integrated learning strategies to improve upon their learning independently. | | | | |
| **Literature** | 1. Paar-Grünbichler F, Finster WKJ. Panorama. Deutsch als Fremdsprache. Kursbuch B1 und Übungsbuch B1, Cornelsen Verlag; 2018.<br>2. Funk K, Kiontke W. Studio 21. Das Deutschbuch. B1.1, Cornelsen Verlag; 2015. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and academic performance (tests and homework assignments) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Successful completion of the module German A2.2 or equivalent knowledge of German | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for and the module examination accounting for 70%. |

## GERL352 – GERMAN B1.2

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|---|---|---|---|---|---|
| **Module title** | Deutsch B1.2/ German B1.2 | | | **Module code** | GERL352 |
| **Duration** | 1 semester | **Semester** | Spring | **Module start** | 2nd, 4th, 6th, 8th |
| **Credit points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | Development and application of the knowledge and skills acquired in the A1 and A2 levels. Additional topics include: climate/environment, conflicts, generations and age, migration and (European) politics.<br>Grammar points include: future and past perfect tense, genitive case, conjunctions and subordinated sentences, word formation and phrasal verbs. Completion of level B1 (intermediate). | | | | |
| **Learning outcomes** | On successful completion of this module, the students should be able to:<br>1. Interact adequately and appropriately in all situations of everyday life.<br>2. Speak and write in a simple but well-structured way about topics like climate change and the environment, politics, history and culture.<br>3. Express their opinion and give reasons as well as provide arguments.<br>4. Talk about advantages and disadvantages, give alternatives, comment on various topics of intermediate difficulty.<br>5. Express their problems, fears and hopes both orally and in writing.<br>6. Understand and write basic literary texts.<br>7. Grasp the meaning of a variety of discursive texts of intermediate difficulty.<br>8. Understand conversations as well as authentic audio and video material on a number of topics of intermediate difficulty.<br>9. Give presentations.<br>10. Apply integrated learning strategies to improve upon their learning independently | | | | |
| **Literature** | 1. Paar-Grünbichler F, Finster WKJ. Panorama. Deutsch als Fremdsprache. Kursbuch B. und Übungsbuch B1, Cornelsen Verlag; 2018.<br>2. Funk K, Kiontke W. Studio 21. Das Deutschbuch. B1.2, Cornelsen Verlag (tests and homework assignments; 2015. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment method** | Written examination (120 min.) and oral examination (15 min.) as well as academic performance | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Successful completion of the module German B1.1 or equivalent knowledge of German | | | | |

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| **Requirements for receiving credit points** | Passing the module |
| **Grading system** | The final grade consists of the academic performance during the module accounting for and the module examination accounting for 70%. |

## GERL451 – GERMAN B2.1

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|---|---|---|---|---|---|
| **Module Title** | Deutsch B2.1/German B2.1 | | | **Module code** | GERL451 |
| **Duration** | 1 semester | **Semester** | Fall | **Module start** | 1st, 3rd, 5th, 7th |
| **Credit Points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | Development and application of the knowledge and skills acquired at A1, A2 and B1 levels. Additional topics include: Language learning methods<br>live and work in big cities, digital worlds and climate change.<br>Grammar points include: conjunctions and subordinated sentences, passive forms with modal verbs, relative clauses, word formation and conditional are introduced or revised. | | | | |
| **Learning Outcomes** | Upon successful completion of this module, students are able to:<br>1. understand the main and detail ideas of complex texts on concrete and abstract topics;<br>2. communicate so spontaneously and fluently that a normal conversation with native speakers is easily possible without much effort on either side.<br>3. produce clear, detailed text on a wide range of subjects, explaining a point of view on a topical issue giving the advantages and disadvantages of various options.<br>4. reflect the structure of emails and write emails with link forms<br>5. compare and comment on information<br>6. interpret graphics<br>7. Arranging sections of text logically and arguing<br>8. write a structured statement<br>9. respond to speeches and conduct discussions<br>10. summarize articles in writing and orally<br>11. write formal emails | | | | |
| **Literature** | 1. Braun B, Mautsch FJ, Schmeiser SS. Kompass DaF B2.1 Deutsch für Studium und Beruf. Das Kurs-und Übungsbuch. B2.1, Ernst Klett Sprachen Verlag; 2020. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment methods** | Written examination (120 min.) and academic performance (tests and homework assignments) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Successful completion of the module German B1.2 or equivalent knowledge of German | | | | |
| **Requirements for receiving credit points** | Passing the module. | | | | |

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| **Grading system** | The final grade consists of the academic performance during the module accounted for 30% and the module examination accounted for 70% |

## GERL452 – GERMAN B2.2

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|---|---|---|---|---|---|
| **Module Title** | Deutsch B2.2/German B2.2 | | | **Module code** | GERL452 |
| **Duration** | 1 semester | **Semester** | Spring semester | **Module start** | 2nd, 4th, 6th, 8th |
| **Credit Points** | 3 CP | **Workload** | 90 h | **Contact hours** | 48 h |
| | | | | **Individual study** | 42 h |
| **Module coordinator** | B. Batsuren, B. Bolormaa | | | **Language** | German |
| **Contents** | Development and application of the knowledge and skills acquired at A1, A2 and B1 levels. Additional topics include: education/dual system, healthy foods/eating, sports/health insurance, motivation and praise and intercultural Competence.<br>Grammar points include: conjunctions and subordinated sentences, indirect speech Subjunctive I, modal sentences, Partizip I and II-forms as an adjective, unreal conditions, unreal comparison sentences, word formation and phrasal verbs are introduced or revised. Completion of level B2 (Upper-Intermediate). | | | | |
| **Learning Outcomes** | Upon successful completion of this module, students are able to:<br>1. reflect/recognize the structure of emails and use emails with link forms<br>2. compare and comment on information<br>3. interpret graphics<br>4. arrange texts logically and argue<br>5. write a structured statement<br>6. respond to speeches and conduct discussions<br>7. summarize articles in writing and orally<br>8. write formal emails | | | | |
| **Literature** | 1. Braun B, Mautsch FJ, Schmeiser SS. Kompass DaF B2.1 Deutsch für Studium und Beruf. Das Kurs-und Übungsbuch. B2.1, Ernst Klett Sprachen Verlag; 2020. | | | | |
| **Form of teaching** | Recitation (4 UoI) | | | | |
| **Assessment methods** | Written examination (120 min.) and oral examination (15 min.) as well as academic performance (tests and homework assignments) | | | | |
| **Associated study program** | B.Sc. Mechanical Engineering<br>B.Sc. Raw Materials and Process Engineering<br>B.Sc. Environmental Engineering<br>B.Sc. Industrial Engineering<br>B.Sc. Energy and Electrical Engineering<br>B.Sc. Mechatronic Engineering | | | | |
| **Prerequisites for participation** | Successful completion of the module German B2.1 or equivalent knowledge of German | | | | |
| **Requirements for receiving credit points** | Passing the module. | | | | |

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| **Grading system** | The final grade consists of the academic performance during the module accounted for 30% and the module examination accounted for 70% |