



HUNGARIAN UNIVERSITY OF
AGRICULTURE AND LIFE SCIENCES
INSTITUTE OF MATHEMATICS AND
BASIC SCIENCE

Address: 2100 Gödöllő, Páter Károly u. 1.

COURSE CATALOGUE for Exchange students

2026/27 Academic year

The Institute of Mathematics and Basic Science of MATE at Gödöllő Campus is currently offering the following core courses for the 2026/27 academic year.

Exchange students are integrated with full degree international students during the semesters' workflow in the following study programmes:

- BSc in Horticultural Engineering – Buda Campus
- BSc in Food Engineering – Buda Campus
- BSc in Mechanical Engineering – Gödöllő Campus

Exchange students can take both bachelor's and master's subjects regardless of their study level or semester; however, timetable conflicts may occur.

Available subjects (based on MATE [curricula](#)) are mostly part of full degree study programmes, as exchange students are integrated with full degree international students during the semesters' workflow. Additional courses will be announced before the start of the semester, providing a wider range of courses to choose from.

2026/27 Autumn semester

Lectures: from early September to mid December.

Exams: mid December to late January

2026/27 Spring semester

Lectures: from early February to mid May.

Exams: mid May to late June

2026/27 Autumn semester

BACHELOR PROGRAMME	SUBJECT CODE	SUBJECT NAME	ECTS Credits	relevant semester of the study program at MATE
Mechanical Engineering - Gödöllő	MATER094N	Chemical fundamentals of materials	3	1
Horticulture Engineering - Buda	MATER021N	Chemistry	3	1
Mechanical Engineering - Gödöllő	MATER005N	General and Inorganic Chemistry	4	1
Mechanical Engineering - Gödöllő	MATER038N	Engineering Mathematics 1	6	1
Environmental Engineering - Gödöllő	MATER027N	Environmental Physics 1	5	1
Buda Campus, Gödöllő Campus	MATER053N	Introduction to Rstudio	3	1
Food Engineering - Buda Campus	MATER031N	Mathematics	3	1
Mechanical Engineering - Gödöllő	MATER095N	Physics 1.	4	1

2026/27 Spring semester

BACHELOR PROGRAMME	SUBJECT CODE	SUBJECT NAME	ECTS Credits	relevant semester of the study program at MATE
Buda Campus	MATER092N	Applied statistics	3	
Buda Campus	MATER051N	Data analysis and visualization in R	3	
Mechanical Engineering - Gödöllő	MATER039N	Engineering Mathematics 2	6	2
Environmental Engineering - Gödöllő	MATER028N	Environmental Physics 2	3	3
Buda Campus, Gödöllő Campus	MATER025N	Experimental design and evaluation	3	
Mechanical Engineering - Gödöllő	MATER096N	Physics 2	5	2

Chemical fundamentals of materials

Study Programme: BSc in Mechanical Engineering – Gödöllő

SEMESTER: 2025/26/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER094N

ECTS Credits: 3

AIM OF SUBJECT:

The purpose of teaching the subject is to develop a scientific way of thinking, which is essential for engineering practice, and as part of that, to impart basic chemical knowledge. During the lectures, we review the general, inorganic and organic chemical knowledge that is essential for understanding the chemical background of material science.

CONTENT:

1. Introduction of requirements and topics. Basic concepts of atomic structure. Rules for the construction of the electronic structure. Practicing the electronic structure of atoms.

2. Structure and importance of the periodic table. Relationships between the properties of the elements and the electronic structure. Solving simple multiple-choice test questions.

3. Formation of chemical bonds of high energy (ionic, covalent and metallic bonds) and their properties. Formation of ionic compounds and molecules. Practicing the short formula of ionic compounds. The role of covalent bonding in the formation of different groups of organic compounds. Presentation of some important organic compounds. Spatial shape and polarity of molecules. Practicing structural formulae.

4. The relationship between electronegativity and the bonds of high energy. Intermolecular bonds (van der Waals bonds, hydrogen bonds). Characterization of aggregations (gas, liquid, solid). Practicing calculation tasks based on gas laws.

5. Solutions, practicing calculations related to the composition of solutions (percentage compositions, molar concentration) and preparation of solutions.

6. Mechanism of dissolution. Solubility; dependence of dissolution heat on lattice energy and hydration energy. Solid materials (amorphous, crystalline,

quasi-crystalline). Characterization of atomic, metallic, ionic and molecular lattice materials. Magnetism, thermal expansion. Metal processing. Transitional grid type (graphite).

7. Chemical reactions, reaction equations. General principles of balancing reaction equations. Grouping of chemical reactions. Redox reactions; determination of oxidation number and practicing solving equations. Stoichiometric calculations.

8. Inorganic chemistry I. Overview of the properties of non-metallic elements based on the periodic table and the summary table.

9. Oxidation and reduction separated in space: galvanic cells. Daniell cell; electrode potential, electromotive force. Prediction of redox reactions based on standard potentials. Corrosion, corrosion protection.

10. Inorganic chemistry II. Overview of the properties of metallic elements based on the periodic table and summary table. Important compounds and alloys of metals.

11. Electrolysis. Quantitative relations of electrolysis. Energy changes accompanying chemical reactions; exothermic, endothermic reactions.

12. Reaction rate, reversible processes, catalysis. Chemical equilibrium, the law of mass action. Acid-base reactions. Calculation of the pH of solutions of strong acids and strong bases.

13. Hydrolysis of salts. Overview of the physical and chemical properties of the most important groups of organic compounds based on the summary table. Plastics.

GRADING SYSTEM:

Preconditions for obtaining a signature:

attending the lectures in accordance with the Study and Examination Regulations, and

writing the 20-point first and 30-point second test of the study period, as well as obtaining at least 26 points out of a total of 50 points available. (In the last week of the study period or the first week of the exam period, one of the tests can be replaced or corrected.)

The subject ends with an exam, which is also worth 50 points. Depending on the number of examinees and the epidemic situation, the exam is conducted in writing and/or orally by completing a task sheet, or via the e-learning system.

Exam grade

The final score is the sum of the points obtained on the mid-term papers and the exam, and determines the exam mark as follows:

– 50 failure (1)

51 – 60 pass (2)

61 – 75 satisfactory (3)

76 – 85 good (4)

86 – excellent (5)

LITERATURE:

József Kampfl, Györgyi Kampfl: A programmed guide to Chemistry.

Chemistry

Study Programme: BSc in Horticulture Engineering – Buda

SEMESTER: 2025/26/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER021N

ECTS Credits: 3

AIM OF SUBJECT:

The aim of the course is to provide knowledge in general, inorganic and organic chemistry, to interpret and explain the background, interrelations and interactions of certain processes. The general, inorganic and organic chemical knowledge acquired by students is essential for the successful study and completion of further chemical subjects (biochemistry, agrochemistry and food chemistry) and for understanding the chemical aspects of professional subjects. The basic knowledge of chemical calculations acquired in the practical/seminar sessions will help to develop quantitative chemical thinking and problem-solving skills, and provide an opportunity to improve understanding of the topics covered in lectures. While the learning of some important chemical laboratory operations and the independent laboratory measurements will contribute significantly to the development of general laboratory activities and manual skills.

CONTENT:

Lectures (2 hours per week)

Introduction; Structure of atoms and their position in the periodic table

Subject information. The subject of chemistry. The purpose of experimentation.

Model building. Materials and their properties: physical and chemical properties.

Elementary particles, atomic number, mass number. Composition of atomic nuclei, nuclear forces, isotopes, nuclear stability, radioactivity, radiations. Mass of atoms, Avogadro number, amount of matter, molar mass, relative atomic mass. Electron structure of atoms, building up electron shells, atomic orbits of electrons. Building up / Aufbau principle, Pauli principle, Hund rule. Structure of the periodic table, periodic properties.

Chemical bonds

Ion formation, ionisation energy, electron affinity, electronegativity. Ionic bonding, formula of ionic compounds. Metallic bonding. Covalent bonding, molecular elements, compounds, empirical, sum and structural formula. Bonding and polarity of molecules. Dipole momentum. Molecular ions.

Aggregations and their properties, chemically pure substances

Secondary chemical bonds (Hydrogen bond, van der Waals interactions). Intensive and extensive state markers, states of matter and their properties. Homogeneous and heterogeneous systems, mixtures, blends, colloidal systems. Ideal and real gases, gas laws. Structure and characterisation of liquids; surface tension, vapour pressure. Structure and characterisation of solids; crystal lattice types. Changes of states, phase diagrams.

Mid-semester test 1

Multicomponent homogeneous systems

Gas laws for gas mixtures, partial pressure, Dalton law. Liquid mixtures, solutions. Solubility, dissolution mechanism, unsaturated, saturated and supersaturated solutions. Composition of solutions, concentration, concentration units. Osmosis, boiling point rise, freezing point depression. Solid mixtures, alloys

Chemical reactions

Chemical changes; meaning and interpretation of the reaction equations, laws of conservation of mass, matter and charge. Types of chemical reactions: fusion, decomposition, reactions involving gas formation and precipitation. Conditions for chemical reactions. Reaction rate. Serial and parallel reactions. Activation energy of chemical reactions; catalysts and their characteristics.

Fundamentals of thermodynamics

Heat, heat quantity, temperature. Internal energy. Theorem I of thermodynamics, enthalpy, volumetric work. Theorem II of thermodynamics, entropy. Energy relations of chemical reactions: reaction heat, exothermic and endothermic reactions, Hess-theorem.

Chemical equilibria, 1.

Law of mass action, equilibrium constant, principle of least constraint. Electrolytic dissociation. Equilibrium reactions. Autoprotolysis of water, ionic product of water, definition and interpretation of pH and pOH. Acid-base theories (Arrhenius and Brønsted acid-base concepts). Strength of acids and bases. Amphoteric compounds, neutralization, indicators.

Mid-semester test 2

Chemical equilibria, 2.

Hydrolysis of salts; composition and mechanism of buffers, buffer solutions (buffer systems). Precipitation reactions. Solubility product. Lewis acid-base theory. Basic concepts of complex chemistry, ligands, coordination number, chelate complexes. Formula writing for complex compounds. Aquacomplexes.

Chemical reactions involving electron transfer

Reduction and oxidation. Oxidation numbers and their determination, redox equations. Disproportion, synproportion.

Fundamentals of electrochemistry

Electrodes, electrode potential, Nernst formula, electrochemical standard potential. The voltage at the terminals and electromotive force; electrolytic cells capable of generating electricity. Electrochemical corrosion. Electrolysis; Faraday laws. Fundamentals of battery operation

Fundamentals of organic chemistry

Bonding relationships of carbon atoms. The concept of organic substances. Types of organic chemical formulas; molecular representations, types of molecular models. Organic chemical functional groups and the classification of organic compounds derived from them, their basic characteristics. Isomerism in organic chemistry (constitutional, configurational, and conformational isomerism). Electron displacement effects in organic compounds: inductive and conjugation (mesomeric) effects.

Mid-semester test 3

Organic compounds and their reactions.

Classification of organic compounds based on the nature of their carbon skeleton. Organic chemical nomenclature. Typical reactions in organic chemistry and their characterization with examples: substitution, addition, polymerization, elimination, condensation, redox reactions. Classification of hydrocarbon compounds (saturated, unsaturated, straight-chain or branched-chain, cyclic, aromatic), their names, reactions, occurrence, and uses.

Characterization of the most important organic compound groups and their representatives, their chemical reactions

Oxygen-containing organic compounds and their characteristics, as well as examples of important reactions: alcohols, ethers, oxo compounds (aldehydes,

ketones), carboxylic acids, esters. Occurrence, production, and use of oxygen-containing organic compounds. Nitrogen-containing organic compounds.

Evaluation and conclusion of the semester

Seminars (2 hours per week)

1. Learning approach. Structure of atoms: elementary particles, Avogadro number, relative atomic mass, molar mass, isotopes; related computational problems.
2. The electron structure of atoms, the atomic orbits of electrons, the formation of the electron structure, the periodic table and its use
3. Chemical bonds. Aggregations. Gas laws, interpretation of phase diagrams; related computational problems
4. Chemical formulae (chemical symbols, sum formula, empirical formula, molecular formula); Concentration units; practice calculating concentration; Composition, dilution, mixing of solutions and related arithmetical problems
5. Chemical reactions; writing, interpreting and solving equations of reactions. Stoichiometric calculations.
6. Acid-base theories; pH of solutions
7. Redox reactions, oxidation and reduction, redox equations; oxidation numbers and their use in equation solving.
8. Complex compounds and basic concepts of complex chemistry based on Lewis acid-base theory. Aquacomplexes. Metal complexes. Coordination number. Single and multifunctional ligands, chelates. Designation of complex compounds
9. Thermochemistry and thermodynamics; reaction heat, Hess theorem and related computational problems. Interpretation of the main theorems of thermodynamics. Thermodynamic potential functions and their significance in the interpretation of chemical and physical changes.
10. Basic fundamental concepts of reaction kinetics.
11. Calculations related to chemical equilibria; ionic product of water. pH and pOH; calculations of pH in aqueous solutions.
12. Electrochemical concepts and calculations
13. Extra tests. Closing of the semester.

Laboratory exercises (2 hours per week or 4 hours per fortnight, depending on the campus)

1. Fire and accident prevention. Presentation and familiarization with laboratory equipments.

2. Grouping of materials and chemicals. Measurement of mass, volume and temperature.

3. Solution preparation from solid materials, density measurement. Solubility tests.

4. Solution preparation by dilution. Principles of quantitative volumetric analysis, measuring solutions; acid-base indicators.

5. Acid-base titration. Spectrochemical methods of chemical analysis, principle of UV-VIS photometry.

6. Determination of phosphate content of solutions by photometry.

Attendance at lectures, seminars and laboratory exercises is compulsory at the fixed times scheduled by the group.

GRADING SYSTEM:

Obtain the end-of-semester signature, accept the semester:

- Mid-semester tests

During the semester, students will write three mid-semester tests, typically from the course content of 3-5 weeks of the semester from the beginning of the semester or the date of the previous examination.

Each test will cover the theoretical, seminar and laboratory practical course content (together) of the current term.

The 3 ZH's are worth for 30-30-40 points each and are compulsory.

The end-of-semester signature requires a minimum of 51 points out of the available 100 points.

At the end of the semester, 1 test per student may be corrected or replaced.

- Laboratory exercises/measurements

Absences from compulsory laboratory exercises are possible up to a maximum of 2 times (° 6 lessons), regardless of whether the absence is justified or not.

Students are required to keep a protocol of the laboratory exercises, in the format specified by the laboratory supervisor, which is accepted and evaluated by the supervisor; if the student is absent from the laboratory exercise, writing/submission of a protocol is not required.

In the laboratory exercises related to the topics in red, the students will perform graded work (acid–base titration, determination of phosphate content), which means that, the measurement/identification of unknown substance/ion/concentration using the previously learned/recognised/practised method, the correctness/accuracy of which is graded by the tutor and if the student's measurement/identification is not correct/accurate, the exercise is not accepted and is therefore graded as 'failed', which is equivalent to absence.

A minimum of three graded exercises must also be accepted for the semester.

If the student does the workflow of the graded exercise correctly and measures accurate data, but calculates the final result incorrectly from the data obtained, the student does not have to repeat the laboratory work, but only receives his/her protocol back for modification/correction of the calculation/evaluation.

If the student receives/measures an incorrect/incorrect result/measurement, he/she must repeat the laboratory exercise for acceptance.

Only one of the two graded laboratory exercises may be repeated.

Examination

Written examination on the content of the theoretical lectures.

The written examination shall be worth for 100 points.

Successful written examination requires a minimum of 51 out of the 100 points available.

Examination grade

The examination grade is calculated as the sum of the points for the written mid–term tests and the points for the written examination paper, i.e. 200 points, converted as follows:

0 – 99 points: failure (1)

100 – 120 points: pass (2)

121 – 150 points: satisfactory (3)

151 – 170 points: good (4)

171 – 200 points: excellent (5)

LITERATURE:

According to the teacher's suggestions. (In Gy.K.'s courses: József Kampfl, Györgyi Kampfl: A programmed guide to Chemistry.)

General and Inorganic Chemistry

Study Programme: BSc in Mechanical Engineering - Gödöllő

SEMESTER: 2025/26/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER005N

ECTS Credits: 4

AIM OF SUBJECT:

The aim of the course is to provide students with a solid understanding of the fundamental principles of general chemistry and inorganic chemistry, including key concepts, classifications, and systems of units. Students are expected to acquire the essential knowledge and laws related to these fields, as well as their areas of application. This knowledge contributes to a better understanding and learning of the general and specific content of subsequent courses built upon this subject. Furthermore, the course supports the development of engineering-oriented thinking and the establishment of modern scientific literacy, thereby facilitating the more efficient and successful completion of chemistry-related interdisciplinary tasks associated with the agri-economy.

CONTENT:

GRADING SYSTEM:

The final grade is determined based on the sum of the points obtained from the midterm tests written during the semester and the points achieved in the written exam. The maximum total score is 200 points, which is converted into a grade according to the following scale:

LITERATURE:

ppt presentations of lecture

Engineering Mathematics 1

Study Programme: BSc in Mechanical Engineering - Gödöllő

SEMESTER: 2026/27/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER038N

ECTS Credits: 6

AIM OF SUBJECT:

The aim of the course is to establish the basics of higher mathematics. During education students learn methods, the language of mathematics, and in addition acquire the ability of conceptualization and improve higher order cognition through the main topics of calculus such as limits of sequences and functions, differential calculus, and integrals. A further aim of the course is to deepen these topics to a level that underpins the theoretical knowledge required in the field of technical sciences and the mathematical approach to problem solving. During practice relevant secondary school topics are also revised.

CONTENT:

Sets. Sets and operations on sets. Power set. Ordered pairs, Cartesian product of sets, relation. Ordered sets. Set of real numbers.

Functions. Operations on function. Inverse function. Notable functions. Inverse trigonometric functions. Properties of functions.

Sequences. Limits of sequences. Squeeze theorem. Induction. Binomial theorem, Bernoulli's inequality. Limit of notable sequences. Cantor property. Bolzano-Weierstrass Theorem, Cauchy's convergence test. Euler's e number.

Numeric series. Convergence and sum of numeric series. Notable series. Criteria of convergence (comparison, Cauchy's D'Alembert's). Alternating series, criterium of Leibniz.

Real functions. Limits of real functions. Continuity. The exponential and logarithmic functions. Weierstrass Theorem. Bolzano's Theorem.

Derivatives. Tangents and the derivative at a point. Differentiation rules. The Mean Value Theorem. A L'Hospital's rule. Monotonic functions and the First Derivative Test. Concavity and curve sketching. Hyperbolic functions.

Integrals I. Antiderivative. Basic integrals. Methods of integration: integration by parts, substitutional integral, integration of rational fractions.

Integrals II. Definite integral. Sufficient condition of integrability. The Mean Value Theorem of Integral. The Fundamental Theorem of Calculus. Applications.

GRADING SYSTEM:

ASSESSMENT

Signature

Signature is a prerequisite of the exam. Signature can be denied, if the course participating requirements assigned by study rules and regulations are not fulfilled.

Exam

The exam consists of two parts:

Theoretical part (20 minutes) 24 pts (multiple choice test), a minimum of 8 points required for a successful exam

Practical part (70 minutes) 76 pts, a minimum of 30 points required for a successful exam

Completion of each part remains active within the given exam period (the student may request to include the previous result in the current exam), however, in the case of repeated attempts, the previous result will be overwritten in each case. To request the consideration of a previous result the student must notify the lecturer on the elearning until a given deadline before the exam.

To participate in an exam the registration in the electronic study system (Neptun) is mandatory (in the manner specified in the Study and Examination Regulations). Without registration the student cannot participate in the exam.

Practical part of the exam

The practical part of the exam can be completed in advance during the learning period (hereinafter: midterm tests). Dates of the midterm tests are 9 Oct. (Test 1), 30 Oct. (Test 2), 20 Nov. (Test 3) and 4 Dec. (Test 4). All midterm tests can be retaken during the first week of the exam period. Practical part of the exam is retakeable as part of the exam during the exam period.

Theoretical part of the exam

The theoretical part of the exam is a multiple choice test, which consists of 8 questions. On the test, students receive 3 points for each correct answer and penalized by losing one point for each incorrect answer. Empty answers count as zero point. The total score has a minimum value of zero.

Questions are based on definitions, theorems and practical problems. List of definitions and theorems included in the test must be published by the lecturers in the e-learning system.

Evaluation

The total score of the exam is the sum of the theoretical and the practical part of the exam- The final grade is determined as follows:

	-	50	failed (1)
51	-	60	pass (2)
61	-	75	satisfactory (3)
76	-	85	good (4)
86	-		excellent (5)

LITERATURE:

- ☒ **Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill, New York, 1976.**
- ☒ **B. P. Demidovich, Problems in Mathematical Analysis, Mir Publishers, Moscow, 1989.**
- ☒ **Frank Ayres, Elliott Mendelson, Schaum's Outline of Calculus, McGraw-Hill, New York, 2012.**
- ☒ **James Stewart, Calculus, Brooks Cole, 2002, ISBN: 9780534393397**
- ☒ **James Stewart, Lothar Redlin, Saleem Watson Precalculus, Mathematics for Calculus, Brooks Cole, 2015, ISBN: 1305071751**

Environmental Physics 1

Study Programme: BSc in Environmental Engineering – Gödöllő

SEMESTER: 2026/27/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER027N

ECTS Credits: 5

AIM OF SUBJECT:

The aim of the subject is to give an overview of the laws of physics with a focus on environmental aspects. The subject

puts an emphasis on environmental currents/flows in the context of fluid dynamics; noise pollution in the context of

acoustics; energy sources and their impact on the environment in the context of thermodynamics.

CONTENT:

Reviewing basic Physics is integrated into the teaching of university-level material. The mechanics and

thermodynamics parts each end with a practical exam and include homework assignments. The chapters of the

subject are as follows (university-level sections in italics):

Introduction, Kinematics

Types of motion and equations describing motion. Relationship between displacement-time, velocity-time, acceleration-time graphs for arbitrary motion. Projectile motion, extremum exercises.

Dynamics

Types of forces: gravity, weight, friction and elastic forces and their laws. Inertial forces in the environment.

Stability and equilibrium

Center of mass, moment of inertia, torque. Physical pendulum.

Hydrostatics

Special properties of water, its phase diagram. Dew point.

Hydrostatic pressure, units of pressure. Pascal's law, buoyancy, Archimedes' principle. Force acting on side surfaces.

Atmospheric pressure and its environmental role, barometric formula.

Surface tension, capillary action

Definition of surface tension, how to measure it, practical manifestations.

Adhesion, cohesion, wetting, non-wetting liquids, contact angle. Capillary action, capillary rise. Role of surface tension

and capillarity in the environment.

Ideal fluid flow

Continuity equation, Bernoulli's principle, Torricelli's law and their applications, environmental manifestations.

Viscous fluid flow

Measurement of viscosity. Laminar and turbulent flow. Reynolds number and its critical values. Environmental

currents. Stokes' law, sedimentation, Hagen-Poiseuille equation. Similarity of flows. Measuring viscosity laboratory

practice, criteria of lab reports, propagation of uncertainty.

Acoustics

Mechanical waves. Wave equations and its solutions. Longitudinal and transversal waves. Sounds in the environment.

Basic concepts of acoustics. Sound intensity. dB scale. Phon scale. Acoustic characteristics of the human ear (hearing

threshold, pain threshold, frequency range). Weber-Fechner psychophysical law. Sound emission and perception.

Noises, noise levels, factors influencing noise propagation, hearing protection. Infrasound, ultrasound. Doppler effect.

Basics of thermodynamics

Energy, broadening of the concept of energy, units of energy, trends in energy consumption.

Temperature, heat. Thermometers. Thermal expansion.

Heat transport

Convection. Conduction. Fourier's law. Thermal radiation. Kirchhoff's law. Black body. Stefan-Boltzmann law. Wien's

displacement law. Black body radiation spectrum. Planck's law of radiation. Practical applications and environmental

manifestations of heat transfer modes. Building energetics.

Calorimetry

Heat capacity, Specific heat, ratio of specific heats, basic calorimetric equation. Measurement of specific heat.

Phase transitions. Phase change materials (PCM). Physics of precipitation formation.

Fundamental laws of thermodynamics

Internal energy, entropy, enthalpy. Ideal gas law. Isothermal, isochoric, isobaric and adiabatic processes. Gay-Lussac's

laws, Boyle-Mariotte law, Adiabatic equation. Characteristics of humid air. Heat engine, refrigerator, heat pump.

Living organisms as 'heat engines'. Exergy.

Energy sources

Fossil energy sources and pollution. Renewable energy sources (passive and active use of solar power, geothermal,

wind, hydro-, biomass, tidal, wave power. Biodiesel, bioethanol. Solar constant. Greenhouse effect. Greenhouse gases.

Solar collectors,

GRADING SYSTEM:

The subject ends with a theoretical exam. The grade can only be obtained after receiving a signature.

Points obtainable through assessments:

10 homework assignments $10 \times 1 = 10$ points

2 laboratory practices $2 \times 3 = 6$ points

2 practical exams $2 \times 12 = 24$ points

Theoretical exam 60 points

Total: 100 points

To receive the course signature, in addition to attendance at lectures and practices (in accordance with the Study and Examination Regulations), a minimum of 40% (i.e. at least 5 points out of 12) must be achieved on both practical

exams, both laboratory practices must be completed and evaluable laboratory reports must be submitted.

When using artificial intelligence in assignments, the Rector's Directive (11/2025 (VIII. 29.)) on the Use of Artificial

Intelligence must be observed.

The practical exams and make-up opportunities are administered by the lecturer, consultation can be requested.

The theoretical exam is held in the examination period.

The grade received based on the achieved points:

86 – excellent (5)

76 – 85 good (4)

61 – 75 satisfactory (3)

51 – 60 pass (2)

0 – 50 fail (1)

LITERATURE:

Egbert Boeker, Rienk van Grondelle: Environmental Physics, Willey & Sons, 2011

Introduction to Rstudio

Study Programme: Buda Campus, Gödöllő Campus

SEMESTER: 2026/27/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER053N

ECTS Credits: 3

AIM OF SUBJECT:

The course will provide a general introduction to RStudio, with an emphasis on the tools used for data analysis, with the aim of providing students with a powerful tool to help them in their first steps of learning R. In a computer-based environment, students will learn the basics of the R statistical language and the practical usage of RStudio. The course is interactive and practice-oriented.

CONTENT:

1. Getting started (installation, upgrade, structure, calculator, simple functions, creating simple objects, data types, installing and reading packages, finding functions, packages, reading and saving data, warning and error messages, reference, help)

2. R Markdown

3. Data management (creating, deleting, cleaning, sorting, filtering, merging, splitting, indexing, using pipes, detecting missing data, graphical detection of data outliers, etc.)

4. Simple diagrams (dot, line, column, circle)

5. Constructing simple and complex tables (e.g. for descriptive statistics (or other) purposes)

6. Defining and using your own functions

7. Clean coding, commenting, debugging

8. Loops (for, while, repeat)

9. Automatic fetching and saving of large amounts of data by function

10. Using different date and number formats

11. Handling bioinformatics data

12.Distributions

GRADING SYSTEM:

project work

LITERATURE:

Special handouts are available during the course via e-learning.

Mathematics

Study Programme: BSc in Food Engineering – Buda

SEMESTER: 2026/27/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER031N

ECTS Credits: 3

AIM OF SUBJECT:

The aim of the course is to establish the basics of higher mathematics. During education students learn methods, the language of mathematics, and in addition acquire the ability of conceptualization and improve higher order cognition through the main topics of calculus such as limits of sequences and functions, differential calculus, and integrals.

CONTENT:

Sets. Sets and operations on sets. Power set. Ordered pairs, Cartesian product of sets, relation.

Functions. Operations on function. Inverse function. Properties of functions.

Sequences. Limits of sequences. Squeeze theorem. Bolzano-Weierstrass Theorem, Cauchy's convergence test. Euler's e number.

Real functions. Limits of real functions. Continuity. The exponential and logarithmic functions. Weierstrass Theorem. Bolzano's Theorem.

Derivatives. Tangents and the derivative at a point. Differentiation rules. The Mean Value Theorem. A L'Hospital's rule. Monotonic functions and the First Derivative Test. Concavity and curve sketching.

Integrals. Antiderivative. Methods of integration. Definite integral. The Fundamental Theorem of Calculus.

Applications. (Optional topic) Area and volume. Differential equations.

GRADING SYSTEM:

Signature

Signature is a prerequisite of the exam.

Conditions to obtain a signature:

- ☒ **course participating stated by study rules (students may have no more than three absences from practice classes),**
- ☒ **achieve at least 25 of 76 available points from activities during the study period.**

Possible semester tasks (campus-dependent):

- ☒ **midterm tests,**
- ☒ **homework assignments (maximum 20 points of total 76 points).**

Decisions on retakes of mid-term assessments are determined by the lecturer of each campus, so they may differ.

Exam

The exam consists of two parts (neither part of the exam is obligatory):

Theoretical part (multiple choice test), 20 minutes 24 pts

Practical part, 70 minutes 76 pts

Practical part of the exam

The practical part of the exam can be completed in advance during the learning period via midterm assessments (tests and homeworks are inseparable).

Theoretical part of the exam

The theoretical part of the exam is a multiple choice test, which consists of 8 questions. On the test, students receive 3 points for each correct answer and penalized by losing one point for each incorrect answer. Empty answers count as zero point. The total score has a minimum value of zero.

Questions are based on definitions, theorems and practical problems. List of definitions and theorems included in the test must be published by the lecturers in the e-learning system.

Evaluation

The final grade is determined as follows:

	-	50	fail (1)
51	-	60	pass (2)
61	-	75	satisfactory (3)
76	-	85	good (4)
86	-		excellent (5)

LITERATURE:

- ☒ **Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill, New York, 1976.**
- ☒ **B. P. Demidovich, Problems in Mathematical Analysis, Mir Publishers, Moscow, 1989.**
- ☒ **Frank Ayres, Elliott Mendelson, Schaum's Outline of Calculus, McGraw-Hill, New York, 2012.**
- ☒ **James Stewart, Calculus, Brooks Cole, 2002, ISBN: 9780534393397**
- ☒ **James Stewart, Lothar Redlin, Saleem Watson Precalculus, Mathematics for Calculus, Brooks Cole, 2015, ISBN: 1305071751**

Physics 1.

Study Programme: BSc in Mechanical Engineering – Gödöllő

SEMESTER: 2026/27/1

Relevant semester of the Study Programme at MATE: 1

SUBJECT CODE: MATER095N

ECTS Credits: 4

AIM OF SUBJECT:

The purpose of the subject is to provide the basic physical knowledge related to engineering studies, to increase natural science and technical literacy, and to develop natural science model making. The subject deals with mechanics, wave theory, acoustics, hydrostatics and hydrodynamics from classical physics. The purpose of the laboratory work related to the subject is to introduce basic measurement methods, measurement evaluation and the use of the SI measurement system.

CONTENT:

week topic

- 1 Introduction, getting to know each other, basic kinematics concepts (path, displacement, average speed), uniformly accelerating linear motion**
- 2 instantaneous speed, two-dimensional movements, projectiles**
- 3 Basic law of dynamics (Newton laws), dynamics of a mass point (movement on a slope, circular movement)**
- 4 non-inertia forces (inertia force, centrifugal force, Coriolis force), mass point movement in an accelerating and rotating coordinate system.**
- 5 Statics of mass points and rigid bodies, center of mass, Pappus theorem, 1st test**
- 6 General motion of rigid bodies (progressive and rotational motion), moment of inertia, Steiner's theorem, constraints on the relationship between progressive and rotational motion.**
- 7 Laws of conservation (momentum, energy), work,**

8 Mechanical properties of deformable bodies. Hooke's law. Dynamics of harmonic vibrational motion. Damped vibrational motion, forced vibration, resonance, Rotating vibrations, mathematical and physical pendulum,

9 Mechanical waves, wave function, longitudinal and transverse wave, polarization, interference, acoustics, characteristics of sound (loudness, pitch, timbre), decibel scale, Doppler effect.

2nd test

10 Hydrostatics, Pascal's law, hydrostatic pressure, buoyancy force, pressure force calculation for the base plate and side plate of a liquid tank

11 Flow of ideal fluids, law of continuity, Bernoulli's law, Torricelli's law, tank emptying time calculation

12 Viscosity, Stokes law, Reynolds number, flow of viscous fluids, parabolic velocity profile, Hagen-Poiseuille law

**13 Surface tension. Capillarity. Surface pressure, end of semester,
3rd test**

GRADING SYSTEM:

Points that can be obtained during the semester:

Homework: 10 x 2 = 20 points

Laboratory measurement: 2 x 5 = 10 points

Tests: 22+2 x 25 = 70 points

Total: 100 points

Conditions for obtaining a signature:

- 3 tests with a completion level of at least 40% (8 and 10 points).

- carrying out 2 laboratory measurements and submitting evaluable records of the measurements

GRADE

The maximum number of points earned during the semester is 100 points. The total points earned determine the grade as follows:

0	-	50	failed (1)
51	-	60	sufficient (2)
61	-	75	medium (3)

76 - 85 good (4)

86 - excellent (5)

LITERATURE:

The electronic version of the educational material, which can be found in the subject's E-learning course

OPENSTAX University Physics 1. book

(online: <https://openstax.org/details/books/university-physics-volume-1/>)

Applied statistics

Study Programme: Buda Campus

SEMESTER: 2026/27/2

Relevant semester of the Study Programme at MATE:

SUBJECT CODE: MATER092N

ECTS Credits: 3

AIM OF SUBJECT:

The goal of the instruction is (1) to give an overview about the most important basic methods of mathematical statistics, their theoretical background and practical usability, and (2) to develop the ability and the skills of the students to solve problems based on these methods and statistical (or general) software. After this course students will be able to apply the methods of data analysis in their own field.

CONTENT:

- 1. Probability theory**
- 2. Descriptive statistics, methods of estimation**
- 3. One- and two-sample tests**
- 4. Analysis of variances**
- 5. Nonparametric tests (chi-square tests)**
- 6. Correlation and regression analysis**

GRADING SYSTEM:

Students must write two midterm tests at predetermined dates via the e-learning system. The final grade is based on the result score of the tests with the following evaluation system:

- 0–49%: fail (1),**
- 50–60%: pass (2),**
- 61–75%: satisfactory (3),**
- 76–85%: good (4),**
- 86–100%: excellent (5).**

LITERATURE:

Students will get the compulsory subject-matter of instructions through the e-learning course of the subject in electronic version.

Further recommended literature:

Walpole, Myers, Myers, Ye: Probability & Statistics for Engineers & Scientists (9th ed.)

Data analysis and visualization in R

Study Programme: Buda Campus

SEMESTER: 2026/27/2

Relevant semester of the Study Programme at MATE:

SUBJECT CODE: MATER051N

ECTS Credits: 3

AIM OF SUBJECT:

In our rapidly improving digital world, we are faced with tons of data to analyse. One of the fastest and most persuasive ways to perceive data is through data visualisation. R is one of the fastest growing tools in data science and statistics, providing all the necessary tools for visualisation. The aim of this course is to give you a quick and proper practical introduction to creating statistical plots with R.

CONTENT:

- 1. Simple plots**
- 2. Introduction to the ggplot2 package (from now on we make publication-quality plots)**
- 3. Plotting distributions**
- 4. Comparative plots**
- 5. Dual plots**
- 6. Using dates in plots**
- 7. Multivariate plots (faceting)**
- 8. Regression plots**
- 9. Frequency and ratio charts**
- 10. Dendrograms**
- 11. Heat Maps**
- 12. Response surfaces**

GRADING SYSTEM:

project work

LITERATURE:

Special handouts are available during the course via e-learning.

Engineering Mathematics 2

Study Programme: BSc in Mechanical Engineering – Gödöllő

SEMESTER: 2026/27/2

Relevant semester of the Study Programme at MATE: 2

SUBJECT CODE: MATER039N

ECTS Credits: 6

AIM OF SUBJECT:

The goal of the course is to widen and complement the material of Mathematics I in focus of applications in engineering. Students will be introduced to the basics of differential equations, e.g. some elementary methods for solving equations, direction fields, some of their applications and the Laplace transform. By introducing differentiation of functions of several variables, students will also learn about parametric curves, polar coordinates and their applications to calculus in preparation for the MSc level course Advanced Engineering Mathematics. The introduction to probability theory and elements of statistics serves as a basis for further studies in the field of statistics.

The goal of the course is to widen and complement the material of Mathematics I in focus of applications in engineering. Students will be introduced to the basics of differential equations, e.g. some elementary methods for solving equations, direction fields, some of their applications and the Laplace transform. By introducing differentiation of functions of several variables, students will also learn about parametric curves, polar coordinates and their applications to calculus in preparation for the MSc level course Advanced Engineering Mathematics. The introduction to probability theory and elements of statistics serves as a basis for further studies in the field of statistics.

The goal of the course is to widen and complement the material of Mathematics I in focus of applications in engineering. Students will be introduced to the basics of differential equations, e.g. some elementary methods for solving equations, direction fields, some of their applications and the Laplace transform. By introducing differentiation of functions of several variables, students will also learn about parametric curves, polar coordinates and their applications to calculus in preparation for the MSc level course Advanced Engineering Mathematics. The introduction to probability theory and elements of statistics serves as a basis for further studies in the field of statistics.

CONTENT:

COURSE TOPICS

Week	Lecture	Practice
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1	10–14 February	Complex numbers. Eigenvalues and eigenvectors of matrices. Complex numbers. Eigenvalues and eigenvectors of matrices.
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2	17–21 February	Equation of line and plane.
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Basic topology of the n -dimensional space (\mathbb{R}). Limit and continuity of functions of several variables. Partial derivative. Equation of line and plane.

3	24–28 February	Total derivative of functions in several variables. Gradient. Directional derivative. Calculus of vector valued functions. First midterm test. Partial and directional derivative of functions in several variables. Calculus of vector valued functions. Divergence and rotation.
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4	3–7 March	Tangent function, tangent line, tangent plane. Extrema of functions of two variables. Tangent plane. Extrema of functions of two variables.
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5	10–14 March	Differential equations, direction field, initial value problem. Existence and uniqueness of solutions, Picard–Lindelöf theorem. Separable differential equations.
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Applications in physics: radioactive decay, Newton's law of cooling. Linear differential equations, method of variation of parameters. Second midterm test. Integrable and separable differential equations.

6	17–21 March	Second order linear differential equations, Newton's second law of motions. Homogeneous second order linear differential equations. Inhomogeneous second order linear differential equations, test function method. First order linear differential equations.
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Second order linear differential equations with constant coefficients, test function method.

7	24–28 March	Decomposition of rational fractions. Laplace transform. Laplace transform as a method to solve differential equations. Third midterm test. Decomposition of rational fractions. Laplace transform. Laplace transform as a method to solve differential equations.
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8	31 March–4 April	Events. Probability spaces. Axioms of probability. Classical probability spaces. Conditional probability, law of total probability, theorem of Bayes. Elements of combinatorics. Event space. Classical probability spaces.
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9 7-11 April Geometric probability. Random variables. Cumulative distribution function. Discrete and continuous random variables. Expected value and standard deviation. Fourth midterm test. Conditional probability, law of total probability, theorem of Bayes.

10-11 14-25 April Notable discrete random variables. Notable continuous random variables. Random variables. Expected value and standard deviation. Notable discrete random variables.

12 28 April- 2 May Law of large numbers. Central limit theorem. Statistical sample. Empirical cumulative distribution function. Fundamental theorem of statistics.

Statistical estimations. Descriptive statistics. Confidence intervals. Fifth midterm test. Notable continuous random variables.

13 6-10 May One sample u-test and t-test. F-test. Two-sample t-test. Analysis of variance. Chi-squared test.

Descriptive statistics. Confidence intervals. One sample u-test and t-test. F-test. Two-sample t-test. Chi-squared test.

14 13 May - 17 May Covariance, correlation. Regression.

Mechanical oscillations. Sixth midterm test.

GRADING SYSTEM:

ASSESSMENT

Exam

The exam consists of two parts:

Theoretical part (20 minutes) 24 pts (multiple choice test), a minimum of 8 points required for a successful exam

Practical part (70 minutes) 76 pts, a minimum of 30 points required for a successful exam

Completion of each part remains active within the given exam period (the student can request that his/her already achieved result of either the theoretical or the practical part is accepted at a later exam). However, in the case of repeated attempts, the previous result will be overwritten in each case. The crediting of the already achieved result is an option tied to the administration on e-learning belonging to the exam days. Missing the administrative act means that that day's result will be considered.

In all cases, participation in the exam entails registration in the electronic study system (Neptun). The condition for taking the exam is to apply for the exam in the electronic study system (Neptun) in the manner specified in the Study and Examination Regulations.

Signature and practical part of the exam

The practical part of the exam can be completed in advance during the learning period (hereinafter: midterm tests). Dates of the midterm tests must be published by the lecturer in oral and written form. The maximum points on Test 1-4 are 13, and the maximum points on Test 5-6 are 12. The topic of each test is going to be given in advance. A minimum of 15 points in total is required to get signature from the subject. During the first week of the exam period all six tests can be written or rewritten. The results of these tests overwrite the original scores of the corresponding tests. Practical part of the exam is retakeable as part of the exam during the exam period.

Signature is a prerequisite of the exam. Signature can be denied, if the course participating requirements assigned by study rules and regulations are not fulfilled. (Students may have no more than three absences from practice classes.)

Theoretical part of the exam

The theoretical part of the exam is a multiple choice test, which consists of 8 questions. On the test, students receive 3 points for each correct answer and penalized by losing one point for each incorrect answer. Empty answers count zero point. The total score has a minimum value of zero.

Questions are based on definitions, theorems and practical problems. List of definitions and theorems included in the test must be published by the lecturers in the e-learning system.

Evaluation

The total score of the exam is the sum of the theoretical and the practical part of the exam. The final grade is determined as follows:

	-	50	fail (1)
51	-	60	pass (2)
61	-	75	satisfactory (3)
76	-	85	good (4)
86	-		excellent (5)

LITERATURE:

- ☒ **Walter Rudin, Principles of Mathematical Analysis, McGraw-Hill, New York, 1976.**
- ☒ **B. P. Demidovich, Problems in Mathematical Analysis, Mir Publishers, Moscow, 1989.**
- ☒ **Frank Ayres, Elliott Mendelson, Schaum's Outline of Calculus, McGraw-Hill, New York, 2012.**
- ☒ **James Stewart, Calculus, Brooks Cole, 2002, ISBN: 9780534393397**
- ☒ **James Stewart, Lothar Redlin, Saleem Watson Precalculus, Mathematics for Calculus, Brooks Cole, 2015, ISBN: 1305071751**
- ☒ **Richard Bronson, Gabriel Costa, Schaum's Outline of Differential equations. McGraw-Hill, New York, 2009.**
- ☒ **Electronic study material (elearning)**
- ☒ **Lane, D. M.: HyperStat Online Statistics Textbook, www.davidmlane.com/hyperstat**
- ☒ **Pearson, F. A. Bennett, K. R.: Statistical Methods. John Wiley & Sons, New York – London, 1955.**
- ☒ **Billingsley, P.: Probability and Measure. John Wiley, New York, 1986.**

Environmental Physics 2

Study Programme: BSc in Environmental Engineering – Gödöllő

SEMESTER: 2026/27/2

Relevant semester of the Study Programme at MATE: 3

SUBJECT CODE: MATER028N

ECTS Credits: 3

AIM OF SUBJECT:

The aim of the subject is to provide a technical foundation, with a focus on environmental and environmental protection aspects. The subject reviews the basic physics knowledge related to each topic through problem solving and then builds on this to process the university material. The energetics chapter discusses in detail the relationships between heat propagation and heat transfer, and the thermodynamics of gases in a phenomenological and statistical approach. An important part of the subject is the energetics of traditional and renewable energy sources. It describes the basic phenomena of optics, covering light pollution and polarized light pollution. Application-centrally reviews the chapters of electrodynamics, shows examples of the application of the laws through the solution of typical problems, and deals with electrosmog. The modern physics part discusses the basic laws of nuclear physics and quantum physics, deals in detail with the utilization of nuclear energy.

CONTENT:

The subject covers the theoretical lectures and problem solving as well.

Week Topics

- 1. Heat transfer: Fourier's law of heat conduction, thermal resistance, Convection. Thermal radiation, absolute black body, Stefan-Boltzmann law, Wien's law, Kirchhoff's radiation law. Surface heat transfer.**
- 2. Thermodynamics of gases: Special state changes of gases. Cycles. Carnot cycle. Energetics of gases: Laws of thermodynamics and their applications. Kinetic gas theory. Real gases.**
- 3. Greenhouse effect. Traditional and renewable energies.**

4. Geometrical optics: Basic quantity of photometry, Fermat's principle and application, plane-parallel plate, prism. Total reflection, optical cable. Thin lenses, imaging of mirrors. Applications, eye and vision. Light sources.

5. Wave optics: Interference, light diffraction, holography. Measuring hair thickness with a laser. Polarization, polarized light pollution, colors, color mixing, atmospheric light phenomena, optical illusions.

Measurement 1.

6. Electrostatics: Coulomb's law, Gauss's law, Second law of electrostatics, Electric potential, voltage. Conductors in electrostatics space. Capacitors. Electrostatics applications.

7. Electric current: Current, Ohm's law, resistance. Kirchhoff's laws, Joule's law. Current sources, internal resistance. Determination of the maximum power of a solar cell by measurement.

1st test

Measurement 2.

8. Magnetism: Basic phenomena. Basic laws of magnetostatic field. Magnetic field around of current, Lorentz force, movement of free charge in a magnetic field. Applications. Magnetic induction, Lenz's law, Faraday's law of induction. Applications of induction.

9. Alternating current: Effective and average value. Alternating current resistances, Alternating current power, physiological effects of current.

10. Electromagnetic vibrations: Oscillating circuit, forced oscillation, resonance, Generation of electromagnetic waves. Electromagnetic spectrum, electrosmog.

11. Nuclear physics: Specific binding energy, Nuclear fusion, nuclear fission, Radioactive decay, decay series, decay law,

12. Operating principle of nuclear power plant, Radioactive isotopes, dosimetry concepts, measurement of radioactivity. Radiocarbon dating. Nuclear energy and environment.

GRADING SYSTEM:

Writing 2 tests with a minimum 5-5 points.

- Evaluating 10 homework.
- Performing two laboratory measurements and producing reports of them.

The point values of the different tasks:

The students can collect maximum 100 points from the tasks listed below:

- 2 test: $2 \times 12 = 24$ points
- 10 homework: $10 \times 1 = 10$ points
- 2 laboratory measurements + reports: $2 \times 3 = 6$ points
- exam: 60 points

Total: 100 points

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The achieved mark can be calculated automatically from the table below:

86	-100	excellent (5)
76	- 85	good (4)
61	- 75	fair (3)
51	- 60	weak (2)
0	- 50	unsatisfactory, failed (1)

LITERATURE:

Presentations of lectures, recommended problems for solving

- e-book: <https://openstax.org/details/books/college-physics>
- Egbert Boeker, Rienk van Grondelle: Environmental Physics, Willey & Sons, 2011.

Experimental design and evaluation

Study Programme: Buda Campus, Gödöllő Campus

SEMESTER: 2026/27/2

Relevant semester of the Study Programme at MATE:

SUBJECT CODE: MATER025N

ECTS Credits: 3

AIM OF SUBJECT:

In a computer-based environment, based on real research issues, students learn experimental design, data management and evaluation methods that directly support the analysis required for their experiment-based thesis work and or literature review. We pay special attention to the correct documentation of the methods and results required for scientific reports and publications.

CONTENT:

data management (data cleaning methods, handling of outstanding, missing data, methods used in case of violation of normality and standard deviation homogeneity, data transformation); basics and pitfalls of experimental design (first and second type error, strength of the test, correct determination of the sample size); advanced univariate and multivariate ANOVA models; multivariate regression models with a collinearity problem; nonlinear regression models, data reduction and compression methods (PCA) and grouping (clustering) for similarity analysis; comparison of models; comparison of ratios; crosstabulation, evaluation, documentation, communication and presentation of the results of the methods.

GRADING SYSTEM:

project work

LITERATURE:

Handouts, lecture notes are regularly uploaded to the course e-learning cite that is available for the registered students.

Andy Field, Jeremy Miles, Zoë Field (2012): *Discovering statistics using R*. SAGE Publications. ISBN 978-1-4462-0045-2, ISBN 978-1-4462-0046-9

Rice W virtual Lab in Statistics: <http://onlinestatbook.com/rvls.html>

Physics 2

Study Programme: BSc in Mechanical Engineering - Gödöllő

SEMESTER: 2026/27/2

Relevant semester of the Study Programme at MATE: 2

SUBJECT CODE: MATER096N

ECTS Credits: 5

AIM OF SUBJECT:

The aim of the Physics subject is to give the knowledge background for the later engineering studies and to form a

scientific approach. The subject presents the most important laws of thermodynamics (heat propagation forms, kinetic

gas theory, gas laws, fundamental theorems), electrodynamics (electrostatics, DC circuits, electromagnetic field theory,

alternating current circuits), and optics in an application-centric manner. The atomic physics part summarizes the basic

laws of quantum mechanics and nuclear physics. The physics of semiconductor devices is mainly presented through

applications.

CONTENT:

week topic

1 Hydrostatics, Pascal's law, hydrostatic pressure, buoyancy force, pressure force calculation for

the base plate and side plate of a liquid tank

2 Thermal expansion, calorimetry, phase changes,

3 kinetic gas theory, ideal gas processes,

4 Energetic background of the gas processes, Laws of thermodynamics

5 Heat transfer methods (convection, conduction, radiation)

6 Electrostatics, capacitors

7 DC current, DC circuits, Kirchhoff laws 1st test

8 magnetic field properties, current induced magnetic field, Lorentz force

9 electromagnetic induction, AC generators

10 effective value of AC voltage, AC circuits (with complex numbers)

11 Electromagnetic waves, geometrical optics

12 Nuclear Physics, specific binding energy, fusion, fission, radioactive decay

13 nuclear power plant, ITER, LIGO/VIRGO, ELI ALPS 2nd test

GRADING SYSTEM:

Points that can be obtained during the semester:

Homework: $10 \times 1 = 10$ points

Laboratory measurement: $2 \times 3 = 6$ points

Tests: $2 \times 12 = 24$ points

Exam: 60 points

Total: 100 points

Conditions for obtaining a signature:

- 2 tests with a completion level of at least 4 points (40%).

- carrying out 2 laboratory measurements and submitting evaluable records of the measurements

GRADE

The maximum number of points earned during the semester is 100 points. The total points earned determine the grade as

follows:

0 – 50 failed (1)

51 – 60 sufficient (2)

61 – 75 medium (3)

76 – 85 good (4)

86 – excellent (5)

LITERATURE:

The electronic version of the educational material, which can be found in the subject's E-learning course

• OPENSTAX University Physics II. book

(online: <https://openstax.org/details/books/university-physics-volume-2/>)

• OPENSTAX University Physics III. book

(online: <https://openstax.org/details/books/university-physics-volume-3/>)