Subject name: **Probability Theory & Mathematical Statistics**	**Neptun code:** Full time: GEMAK629-Ma Part time: **Organizational unit:** Mathematics
	Type of subject: TT2
Responsible Lecturer: dr. habil. Nutefe Kwami Agbeko, Associate Professor	
Co-Lecturer(s): dr. habil. Nutefe Kwami Agbeko,, Associate Professor	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The aim of the course is to introduce the students to the basic concepts in probability theory, and in mathematical statistics. The acquired knowledge would be applied to practical problems in civil engineering areas through evaluation and selection of appropriate statistical techniques. These skills can help in the use of statistical software.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Broad theoretical and practical background as well as methodological and practical knowledge of design, manufacture, operation and control of complex mechanical systems and processes.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to solve problems in a creative, and complex tasks in a flexible way, as well as to pursue life-long learning and to demonstrate a commitment to diversity and value-basedness.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Striving to comply with and enforce quality standards. Examining the possibilities of setting research, development and innovation objectives and striving to achieve them during their work.

Autonomy and responsibility: Encouraging colleagues and subordinates to practising engineering in a responsible and ethical way. Acting independently and initiatively to solve professional problems.

Subject description:

Part one: Probability Theory 1.) Elements of Probability: sample space and events, venn diagrams and the algebra of events, Kolmogorov type of probability space, sample spaces having equally likely outcomes, conditional probability, Bayes' formula, independent events. 2.) Random variables and its characteristics: definition, types of random variables, probability distribution function, probability mass function for discrete random variables, probability density function for continuous random variables; joint probability distribution function, joint probability mass function, joint probability density function, conditional distribution and independence 3.) Expectations and moments: mean, median, and mode, central moments, variance, and standard deviation, conditional expectation, Chebyshev inequality, moments of two or more random variables, covariance and correlation coefficient, Schwarz inequality. 4.) Some important discrete distributions: Bernoulli trials, binomial distribution, geometric distribution, negative binomial distribution, multinomial distribution, Poisson distribution, special distributions, approximations of the binomial distribution. 5.) Some important continuous distributions: uniform distribution, bivariate uniform distribution, Gaussian or normal distribution, exponential distribution, chi-squared distribution, conditional expectation, the laws of numbers, the central limit theorem. Part two: Mathematical Statistics 1.) Statistical inference, histogram and frequency diagrams, parameter estimation. 2.) Parameter

estimation: samples and statistics, sample mean, sample variance, sample moments, order statistics, quality criteria for estimates, unbiasedness, minimum variance, consistency, sufficiency, methods of estimation, point estimation. 3.) Methods of Estimation: point estimation, interval estimation. 4.) Hypothesis testing (based on rejection region and the P-value): tests concerning the mean of a normal population, case of known variance (the z-test), case of unknown variance (the t-test), testing the equality of means of two normal populations, case of known variances (the paired z-test), case of unknown but equal variances (the paired t-test), case of unknown and unequal variances (the Welch- test), Kolmogorov–Smirnov test. 5.) Linear models and linear regression: Simple Linear Regression; Least Squares Method of Estimation; Properties of Least-Square Estimators; Confidence Intervals for Regression Coefficients.

Assignment and requirements of signature (full time):

The semester ends with a signature and an exam mark. Exams and signature: The exams are written, consisting of 6 practical problems. The mark of the exam is the minimum of 5 and the number of fully well solved problems.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

The signature condition: 60 percents of the homework and 2 out of 6 practical problems of the mid-term exam must be successfully solved.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. V.K. Rohatgi, A.K. Saleh: An introduction to probability theory and statistics, Wiley, New York, 2001.
2. R. Bhattacharya, E.C. Waymire: A Basic Course in Probability Theory, Springer, New York, 2007.
3. A.O. Allen: Probability , Statistics and Queueing Theory, Academic Press, Boston, 1990.

Suggested readings:

1. Robert B. Ash: Basic propability theory, Dover ed., New York, 2008.
2. Richard J. Larsen, Morris L. Marx: AN INTRODUCTION TO
MATHEMATICAL STATISTICS
AND ITS APPLICATIONS, Prentice Hall, Boston 5th ed., 2012.

Subject name: **Mechanical Vibrations**	**Neptun code:** Full time: GEMET101-Ma Part time: **Organizational unit:** Mechanics
	Type of subject: TT4
Responsible Lecturer: Dr. László Péter Kiss, Senior Lecturer	
Co-Lecturer(s): -	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The subject covers the fundamental principles and methods necessary to understand, analyze and solve different vibration problems and to make correct modeling decisions in the finite element simulations of vibrational problems in mechanical engineering.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Knowledge of fundamental theories, relations, and the terminology used in the engineering field.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to enrich the knowledge base of mechanical engineering with original ideas.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Striving to continuously improve their own and their colleagues' knowledge through further and self-education. Striving to acquire a comprehensive knowledge.

Autonomy and responsibility: Sharing acquired knowledge and experience with representatives of the field communicating in formal, non-formal and informal ways. Ability to perform engineering tasks individually. Initiative to solve engineering problems.

Subject description:

Principles of modeling dynamical systems. Central and eccentric impact of rigid bodies, the Maxwell-diagram. Modeling of mechanical vibrations, methods for the derivation and solution of the equations of motion. Vibrating systems with one degree of freedom (free vibrations, forced vibrations, damped free- and damped forced vibrations). Vertical vibrations of machine foundations. Active systems of vibration protection. Vibration of discrete systems with more degrees of freedom (equations of motion, natural frequencies, vibration modes). Eigenvalue-problems and their solutions, properties of the eigenvalues and eigenvectors. Vibration of continuous systems. Longitudinal-, bending- and torsional vibrations of elastic beams. Rayleigh-damping. Critical angular velocity of rotating shafts. Laval problems. Bearing reactions of rotating shaft-bearing systems. Uniformity and stability of rotational motion. Dynamic analysis of slider-crank mechanisms. Balancing of a multi-cylinder engine. Introduction to the measurement of dynamical parameters.

Assignment and requirements of signature (full time):

Two midterm exams are to be taken during the semester. The maximum score attainable is 2 x 40 = 80. The minimum score is 32 for the signature at the end of the semester.

Assignment and requirements of signature (part time):

One midterm exam is to be taken during the semester. The maximum score attainable is 40. The minimum score is 16 for the signature at the end of the semester.

Requirement end evaluation of the practical mark/ exam (full time):
The written exam is 50 minutes long. The maximum score attainable is 40. One quarter of the score above 32 achieved in the term-time is added to the score of the exam. The mark is given according to a five grade scale and depends on the total score attained as follows: 0-19: fail(1); 20-23: pass(2); 24-27: fair(3); 28-31: good(4); 32-: excellent (5).

Requirement end evaluation of the practical mark/ exam (part time):
The written exam is 50 minutes long. The maximum score attainable is 40. One quarter of the score above 16 achieved in the term-time is added to the score of the exam. The mark is given according to a five grade scale and depends on the total score attained as follows: 0-19: fail(1); 20-23: pass(2); 24-27: fair(3); 28-31: good(4); 32-: excellent (5).

Required readings:
1. Szeidl, G. - Kiss, L.P.: Mechanical Vibrations. An Introduction, Springer-Verlag, 2020. ISBN 978-3-030-45074-8
2. Meirovitch, L.: Fundamentals of Vibrations, McGraw-Hill, New York, 2001. ISBN 0-072-88180-1
3. Geradin, M. – Rixen, D.: Mechanical Vibrations, Theory and Application to Structural Dynamics, Blackwell Publishers, Wiley, 2010. ISBN 0-470-84786-7

Suggested readings:
1.Meirovitch, L.: Elements of Vibration Analysis, McGraw-Hill, New York, 1975. ISBN 0-070-41340-12
2. Inman, D.J.: Engineering Vibrations, 4th Edition, Prentice Hall, 2013. ISBN 978-0-132-87169-3
3. Bathe, K.J.: Finite Element Procedures, Prentice Hall, Englewood Cliffs, 1996. ISBN 0-133-01458-4

Subject name: **Differential Equations**	**Neptun code:** Full time: GEMAN500-Ma Part time: **Organizational unit:** Mathematics
	Type of subject: TT1
Responsible Lecturer: Dr Péter Varga, Associate Professor	
Co-Lecturer(s): Dr Péter Varga	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The theory of differential equations is a basic tool of diverse fields of science. Students of this course should be able to understand the behaviors and to derive solutions of differential equations. The analysis of differential equations includes numerical, geometrical and analytical methods. The course covers linear and nonlinear, and also ordinary and partial differential equations. Nonlinear equations are studied by their linearization around the equilibrium solution. A short introduction to complex functions is presented. Laplace and Fourier methods are applied both to ordinary and partial equations.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Broad theoretical and practical background as well as methodological and practical knowledge of design, manufacture, operation and control of complex mechanical systems and processes.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to solve problems in a creative, and complex tasks in a flexible way, as well as to pursue life-long learning and to demonstrate a commitment to diversity and value-basedness.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Striving to comply with and enforce quality standards. Examining the possibilities of setting research, development and innovation objectives and striving to achieve them during their work.

Autonomy and responsibility: Encouraging colleagues and subordinates to practising engineering in a responsible and ethical way. Acting independently and initiatively to solve professional problems.

Subject description:

Topics: Geometric interpretation and numerical solution, Euler method. Error estimation of numerical methods. Solution by Taylor series. Solutions' qualitative behavior. Linearization. Solution of linear ODE. Eigensystems of matrices. Matrix exponentials, Jordan decomposition. Complex functions, Cauchy formula. Laplace transform. Inhomogeneous linear differential equations. Frequency and impulse responses. Numerical methods. Heat equation, conservation laws. Special solutions of partial differential equations. Plane waves. Wave equations. Laplace equation. Calculus of variations, finite elements. The order of the topics is tentative.

Assignment and requirements of signature (full time):

The grade is determined on the basis of two tests. Failed tests can be repeated at the end of the semester. As a final resort, the students can take a comrehensive exam in the examination period.

Assignment and requirements of signature (part time):

The grade is determined on the basis of two tests. Failed tests can be repeated at the end of the semester. As a final resort, the students can take a comrehensive exam in the examination period.

Requirement end evaluation of the practical mark/ exam (full time):
The grade is determined on the basis of two tests. Failed tests can be repeated at the end of the semester. As a final resort, the students can take a comrehensive exam in the examination period.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:
Lecture notes of the course, P. Dawkins: Paul's Online Math Notes: Differential Equations: http://tutorial.math.lamar.edu/Classes/DE/DE.aspx MIT OCW: Differential Equations 18.03, https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/

Suggested readings:
1.Dennis G. Zill: Differential Equations with Boundary-Value Problems, 8th Edition, ISBN-13: 978-1111827069. W. Trench: Elementary Differential Equations with Boundary Values Problems, (free textbook, http://digitalcommons.trinity.edu/mono/9/) Peter Olver: Introduction to Partial Differential Equations, Springer, 2013.

Subject name: **Materials Science**	**Neptun code:** Full time: GEMTT001-Ma Part time: **Organizational unit:** Materials Science and Technology
	Type of subject: TT3
Responsible Lecturer: Dr. Maria Berkes Maros, Full professor	
Co-Lecturer(s): no	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

A system-approach comparison of the structural features of different (metal, ceramic, polymer) material systems, presentation of the material science background of their mechanical behaviour. A review of the latest advances and development trends in materials science and technology for the conscious design and efficient use of the engineering materials.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Knowledge of fundamental theories, relations, and the terminology used in the engineering field. Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation. Knowledge and understanding of terminology, main regulations and aspects of other areas relating to and having a priority for practising engineering (primarily that of logistics, management, environmental protection, quality assurance, information technology, law, economics, occupational and fire safety, industrial safety). A detailed knowledge and understanding of mechanisms of knowledge acquisition and methods for data collection, their ethical barriers and problem-solving techniques related to the engineering field. A comprehensive understanding of the main properties and application fields of structural materials related to mechanical engineering. Have a detailed knowledge of the rules of preparing technical documentations. Knowledge of measurement techniques and theory related to mechanical engineering. Knowledge of the information and communication technologies related to mechanical engineering.

Skills: Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way. Ability to organise cooperation with experts from related fields to solve problems. Ability to solve specific engineering problems by applying modern knowledge acquisition and data collection methods. Ability to apply information and communication technologies and methods to solve engineering problems. Ability to publish research work, make presentations and hold discussions in their field in their mother tongue and at least in one foreign language. Ability to study and analyse the materials used in mechanical engineering in a laboratory, as well as to assess and document research results. Ability to process, systemise and analyse information gained through the operation of mechanical systems and processes, as well as to draw conclusions. Ability to solve problems in a creative, and complex tasks in a flexible way, as well as to pursue life-long learning and to demonstrate a commitment to diversity and value-basedness.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Striving to acquire a comprehensive knowledge. Striving to design and perform tasks individually or in a team at a professionally high level. Examining the possibilities of setting research, development and innovation objectives and striving to achieve them during their work. Commitment to do high-level, high quality work, setting an example to co-workers of how to adopt this

attitude.
Autonomy and responsibility: Sharing acquired knowledge and experience with representatives of the field communicating in formal, non-formal and informal ways. Assessing subordinates' work, sharing critical comments to improve their professional development. Ability to perform engineering tasks individually. Initiative to solve engineering problems. Taking responsibility for sub-processes under their control. Encouraging colleagues and subordinates to practising engineering in a responsible and ethical way. Acting independently and initiatively to solve professional problems.

Subject description:
Different levels of material structure and material properties determined by each level. Peculiarities of crystalline and amorphous materials and their description in case of the different groups of materials. Examination of the material structure at the microscopic and atomic levels. Transport phenomena, diffusion. Equilibrium of homogeneous and heterogeneous material systems. Types of interfaces and their role in thermodynamic equilibrium. Types and classification of phase transformations. Materials science background of the mechanical behaviour of basic materials. Deformation modes, constitutive equations for materials. Complex relationship-system and interactions between the elements of the material structure, the property/performance and the manufacturing technology. Typical damage and failure modes of metals, ceramics and polymers. Development directions of each material group. Environmental protection, recycling.

Assignment and requirements of signature (full time):
2 main tests, 1 project work in team (ppt presentation), 2 mini-tests, 2 reports on laboratory materials testings.
The condition of the signature is the min. 60% attendance of lectures, 100% completion of the mandatory laboratory lessons and a prescribed level of completion of the ellenőrzés due at the seminars, the min. 50% fulfilment of the main tests.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):
Written and oral exam. The condition for the oral exam is a min. 50% fulfilment of the written exam. A pre-suggested mark (PSM) substituting the written exam (WE) can be obtained on the basis of the mid-term performance (main test, teamwork, tests, measurement's reports, class attendance and class activity). The condition of getting a PSM is a minimum 70% completion of the average of the main tests, as well as the individual tasks issued during the laboratory seminars and at least ,75% completion of the lecture class attendance.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:
1. Marosné, B.M. Electronic notes of the lectures and exercises of the subject GEMTT0001M (ppt and doc. Or pdf format), ME,
http://edu.uni-miskolc.hu/moodle/course/view.php?id=63
2. Tisza M.: Physical Metallurgy, ASM International Publisher, Ohio Park, USA, 2001.
3. William D. Callister: Materials Science and Engineering, John Wiely & Sons, New York, 2004. p. 1-808.
4. Porter, D.A., Easterling, K.E. Phase Transformation in Metals and Alloys,Chapman & Hall, 1981, ISBN 0 412 45030 5

Suggested readings:

1. Ashby, M.F, Jones, D.R.H.: Engineering Materials 1-An introduction to Microstructures, Processing and Design 3rd ed., Elsevier Butterwoth-heinemann, Oxford, 2006. ISBN 0 7506 63804
2. Ashby, M.F, Jones, D.R.H.: Engineering Materials 2-An introduction to properties, Applications and Design 3rd ed., Elsevier Butterwoth-heinemann, Oxford, 2006. ISBN-13: 978-0-7506-6381-6
3. Somiya, W. et al.: Handbook of Advanced Ceramics, 2 Volume Set, Elsevier, 2003,
4. Crawford, J.: Plastics engineering, Pergamon Press, 1987, ISBN 0-08-032626-9, p.354

Subject name: **Engineering Fluid Mechanics and Heat Transfer**	**Neptun code:** Full time: GEAHT001-Ma Part time: **Organizational unit:** Energy Engineering and Chemical Machinery
	Type of subject: TT5
Responsible Lecturer: Dr. Norbert Szaszák, assistant professor	
Co-Lecturer(s): Dr. Norbert Szaszák	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The primary aim of the subject is to enhance the knowledge of the students in the fields of theoretical and applied Fluid Mechanics and Heat Transfer with special attention to heat conduction and heat convection.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Knowledge of fundamental theories, relations, and the terminology used in the engineering field. A detailed knowledge and understanding of mechanisms of knowledge acquisition and methods for data collection, their ethical barriers and problem-solving techniques related to the engineering field. Knowledge of measurement techniques and theory related to mechanical engineering. Knowledge and understanding of devices and methods of computer modelling and simulation related to mechanical engineering.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way. Ability to organise cooperation with experts from related fields to solve problems. Ability to apply information and communication technologies and methods to solve engineering problems. Ability to perform managerial tasks after gaining practical experience. Ability to enrich the knowledge base of mechanical engineering with original ideas. Ability to design complex systems using a system approach and process oriented way of thinking. Ability to provide quality assurance for mechanical systems, technologies and processes, and to solve tasks of measurement technique and process control.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Striving to participate in the development of new methods and equipment related to engineering. A deep sense of vocation. Striving to continuously improve their own and their colleagues' knowledge through further and self-education. Striving to comply with and enforce the ethical principles of work and organisational culture. Striving to comply with and enforce quality standards. Striving to design and perform tasks individually or in a team at a professionally high level. Striving to perform work in a complex, system based and process oriented way. Examining the possibilities of setting research, development and innovation objectives and striving to achieve them during their work. Striving to understand, describe and explain observable phenomena as thoroughly as possible applying the engineering knowledge acquired.

Autonomy and responsibility: Sharing acquired knowledge and experience with representatives of the field communicating in formal, non-formal and informal ways. Assessing subordinates' work, sharing critical comments to improve their professional development. Ability to perform engineering tasks individually. Taking responsibility for sub-processes under their control. Making professional decisions individually within the field. Encouraging colleagues and subordinates to practising engineering in a

responsible and ethical way. Acting independently and initiatively to solve professional problems.
Subject description: General properties of fluids, surface tension, capillarity, Newton's law of viscosity. Hydrostatics, pressure variation in a fluid at rest, accelerating or totating tank. Thrust on submerged plane and curved surfaces, line of action. Continuity. Eulerian equation of motion. Bernoulli equation. Momentum theorem. Navier-Stokes equations. Friction losses in pipes, minor losses. Introduction to Computational Fluid Dynamics (CFD). Forms of heat transfer: conduction, convection, radiation. One-dimensional steady-state conduction in a composite wall or in cylindrical shells. Variable thermal conductivity. Convective heat transfer. Energy equation.
Assignment and requirements of signature (full time): The condition for acquiring a signature from the subject is that you should reach at least 50% of the maximum attainable points on a written test. The conditions for writing the repetition test are contained in the current description of subject requirements. You have to attend at least 60% of the lectures and 70% of the tutorial classes.
Assignment and requirements of signature (part time): The condition for acquiring a signature from the subject is submitting an assignment (receiving a minimum of 70%). The conditions for trying again to get the signature are contained in the current description of subject requirements. You have to attend at least 60% of the lectures and 70% of the tutorial classes.
Requirement end evaluation of the practical mark/ exam (full time): Your performance during the semester does not influence your exam result. The exam can be oral or written (depending on the number of students taking the exam). Grades: fail (0-49%), pass (50-62%); satisfactory 63-74%); good (75-85%); excellent (86-100%). A grade of excellent can be obtained only after an oral exam following the written exam.
Requirement end evaluation of the practical mark/ exam (part time): exam: witten and/or oral: Grades: fail (0-49%), pass (50-62%); satisfactory 63-74%); good (75-85%); excellent (86-100%).
Required readings: 1. White, F.M.: Fluid Mechanics. 7th Edition, McGraw-Hill, Boston, 2011. 2. Özisik, M.N.: Heat Transfer. 3rd Edition, McGraw-Hill, New York, 1985.
Suggested readings: 1. Imberger, Jorg. Environmental fluid dynamics: flow processes, scaling, equations of motion, and solutions to environmental flows. Academic Press, 2012. 2. Serth, Robert W., and Thomas Lestina. Process heat transfer: Principles, applications and rules of thumb. Academic press, 2014.

Subject name: **Environmental Management**	**Neptun code:** Full time: GEVGT301-Ma Part time: **Organizational unit:** Energy Engineering and Chemical Machinery
	Type of subject: GH2
Responsible Lecturer: Dr. Zoltán Szamosi, associate professor	
Co-Lecturer(s): Dr. Zoltán Szamosi	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 1 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The aim is to present the energy problem of the Earth, and human being. During the course the students will introduced to renewable energy sources and the fossil fuel dependent society.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Comprehensive understanding of global social and economic processes. Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to process, systemise and analyse information gained through the operation of mechanical systems and processes, as well as to draw conclusions. Ability to design and manage the use of technical, economic, environmental and human resources in a complex way.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Commitment to professional and ethical values related to engineering. Striving to organise and perform tasks in accordance with environmentally and health conscious, as well as sustainability expectations. Striving to enforce the requirements of sustainability and energy efficiency.

Autonomy and responsibility: Responsibility for sustainability, health and safety culture at work, as well as environmental consciousness. Making informed decisions individually after consultations with representatives from diverse fields (primarily that of law, economics, energy management, environmental protection), taking responsibility for the decisions. Make decisions based on principles and applicability of environmental protection, quality assurance, consumer protection, product responsibility, equal rights to accessibility, as well as the basic principles of occupational health and safety, technological, economic and legal regulations, moreover basic requirements of engineering ethics.

Subject description:

The structure of the energy consumption, composition, energymix and the related problems. Energy sources and their usage and the distribution all around the globe. Possibilities of electricity production. The resources of energy sources and the possibility of the depletion time and their causes. The CO2 content in the atmosphere and the possible causes, possible ways to decreasing it. The alternatives of the fossil fuels. Nuclear energy. Hydro energy. Pump-storage hydro power plants: as an efficient way of energy storage. Biomass usage. Energy density increment technologies of biomass. Mechanical and thermal process. Possible biomass replacement of crude oil. Biomass as a plastic source.

Assignment and requirements of signature (full time):

The condition for obtaining the practical mark is the average of two written in-house papers written during

the semester, min. 50% fulfillment. On a five-point scale: 0-50%: insufficient, 51% -65%: sufficient, 66% - 80%: medium, 81% -92%: good, above 92%: excellent. If the requirements of a particular exam differ from this, this will be indicated on the exam sheet
Assignment and requirements of signature (part time): The condition for obtaining the practical mark is the average of two written in-house papers written during the semester, min. 50% fulfillment
Requirement end evaluation of the practical mark/ exam (full time): The condition for obtaining the practical mark is the average of two written in-house papers written during the semester, min. 50% fulfillment. On a five-point scale: 0-50%: insufficient, 51% -65%: sufficient, 66% - 80%: medium, 81% -92%: good, above 92%: excellent. If the requirements of a particular exam differ from this, this will be indicated on the exam sheet
Requirement end evaluation of the practical mark/ exam (part time): The condition for obtaining the practical mark is the average of two written in-house papers written during the semester, min. 50% fulfillment. On a five-point scale: 0-50%: insufficient, 51% -65%: sufficient, 66% - 80%: medium, 81% -92%: good, above 92%: excellent. If the requirements of a particular exam differ from this, this will be indicated on the exam sheet
Required readings: 1. David J Mackay: Sustainable energy without hot air, Cambridge, 2008 2. John Blewitt: Understanding Sustainable Development, Earthscan, 2008 3. Richard S. Stein, Joseph Power: Energy problem, World Scientific, USA 2011
Suggested readings: 1. Szamosi Zoltán: Mezőgazdasági melléktermékek energiasűrűség-növelésének vizsgálata, Miskolc, 2016 2. P.C.A Bergman: The TOP process, ECN, 2005 3. Ram B. Gupta: Gasoline, diesel and ethanol biofuels from grasses and plants, Cambridge University Press, 2010

Subject name: **Project Management**	**Neptun code:** Full time: GTVSM7003M Part time: **Organizational unit:** Fac. of Economics
	Type of subject: GH1
Responsible Lecturer: Veresné Dr. Somosi Mariann, Egyetemi tanár	
Co-Lecturer(s): Tóthné Kiss Anett, mesteroktató	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 1 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

This course aims to provide students with the basic tools and techniques of project management, to demonstrate the importance of project management knowledge for future career decision making, and to reinforce project management skills by means of experiential learning and lecture-based methodologies.

Knowledge: Having an English language proficiency sufficient to complete the programme, review English language literature, to comprehend and process texts of specific vocabulary and to perform professional tasks being qualified for as well as to continue professional self-education.

Skills: Ability to reveal and understand general rules and relationships. Ability to apply and use the acquired knowledge in practice. Expertise, analysis, design and implementation skills of their specialization. Ability to recognise and solve routine problems, as well as to come up with original ideas. Ability to cooperate with the experts in the application environment in a professional way.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility. Assessing their subordinates' and their own performance in a realistic and unbiased way. Working in a creative and flexible way, recognising and solving problems based on intuition and methodology.

Autonomy and responsibility: Responsibility for complying with and enforcing deadlines. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:

Lectures+ Seminars:

week1. Basic informations about the subject..

week2. Foundation Principles of Project Management. Basic definitions of PM. Type of projects. Project scope management.

week3. Project life cycle. Definig the Project. Project Documents.

week4. Project planing. Resource planning and costing.

week5. Stakeholder analysis. Project risk management. Teamwork during the project.

week6. Work breakdown structure. GANTT diagram.. Fulfilment of resource plan. Milestone events.

week7. Project metrics. Project fulfilment strategy. Feasibility study

week8 Project control. Project organisations. Management of R&D projects

week9.. Project Portfolio Management.

week10. Projekt management competency measurement with online software

week11. Project supporting softwares. (SAP, MS Project)

week12. Teamwork presentation

week13. Colsulation week14. Written-exam
Assignment and requirements of signature (full time): Instructor's signature and evaluation: Mid-semester tasks: case assignment and presentation (30% of term mark), competency test (30% of the term mark) Attendance and participation in lectures and seminars: 10%, Examination: Written examination (30% of term mark)
Assignment and requirements of signature (part time):
Requirement end evaluation of the practical mark/ exam (full time): Instructor's signature and evaluation: Mid-semester tasks: case assignment and presentation (30% of term mark), competency test (30% of the term mark) Attendance and participation in lectures and seminars: 10%, Examination: Written examination (30% of term mark)
Requirement end evaluation of the practical mark/ exam (part time):
Required readings: Essential Reading: 1. Course material (ppt slides; handouts) 2. E. Verzuh: Project Management, 2003. 3. PMI Standards Committee: Project Management Body of Knowledge, 2006.
Suggested readings: Recommended Additional Reading: 1. J. G. Monks: Operations Management, McGraw-Hill, 1982. Chapters 12, 13. 2. https://www.academia.edu/3438417/The_project_managers_leadership_style_as_a_success_factor_on_projects_a_literature_review

Subject name: **Innovation Management for Engineers**	**Neptun code:** Full time: MAKMKT530N Part time: **Organizational unit:** Fac. of Mat. Sci. & Eng.
	Type of subject: GH1
Responsible Lecturer: Dr. Csaba Deák (PhD), professor	
Co-Lecturer(s): Dr. Anett Leskó (PhD)	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 1 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
The aim of the course is to acquire knowledge related to the management and economic contexts of innovation, which are essential for the development, technical-economic foundation and implementation of competitive development strategies and tactics.
Knowledge: Understanding of the organizational tools and methods of management, relevant legislation necessary for practising engineering.
Skills: Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way. Ability to perform managerial tasks after gaining practical experience. Ability to enrich the knowledge base of mechanical engineering with original ideas. Ability to solve problems in a creative, and complex tasks in a flexible way, as well as to pursue life-long learning and to demonstrate a commitment to diversity and value-basedness.
Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Striving to participate in the development of new methods and equipment related to engineering. A deep sense of vocation. Examining the possibilities of setting research, development and innovation objectives and striving to achieve them during their work.
Autonomy and responsibility: Initiative to solve engineering problems. Taking responsibility for sub-processes under their control.

Subject description:
Types of innovation; The process of innovation; Creative techniques; Selection; Product innovation; Design Thinking; Utilization of results; Process innovation; Business model innovation; Startup world; Student presentation

Assignment and requirements of signature (full time):
Team assignments, presentation

Assignment and requirements of signature (part time):
Team assignments, presentation

Requirement end evaluation of the practical mark/ exam (full time):
Based on the tasks completed during the semester (50%), the quality of the presentations (10%), active participation (10%), theoretical preparation (40%), a five-level evaluation is performed in the case of the practical mark. (1: 0-50%,; 2: 51-66%; 3: 67-75%; 4: 76-86%; 5: 87-100%)

Requirement end evaluation of the practical mark/ exam (part time):
Based on the tasks completed during the semester (50%), the quality of the presentations (10%), active participation (10%), theoretical preparation (40%), a five-level evaluation is performed in the case of the practical mark. (1: 0-50%,; 2: 51-66%; 3: 67-75%; 4: 76-86%; 5: 87-100%)

Required readings:
1.Tidd,J- Bessant, J. - Pavitt, K: Managing Innovation: Integrating Technological, Market, and Organizational

Change. John Wiley & Sons, 2013 ISBN-10: 111836063
2.Wulfen, G. (2013) The Innovation Expedition: A Visual Toolkit to Start Innovation. Amsterdam: BIS Publishers.
3.Cooper, R.G. (2017) Winning at New Products: Creating Value Through Innovation. 5th edn. New York: Basic Books, Perseus Books Group.

Suggested readings:

1.OECD (2002), Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development [Online]. Available at: https://dx.doi.org/10.1787/9789264199040-en (Accessed: 11 Dec 2002).
2.OECD and EUROSTAT (2019) Oslo Manual: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th edn., The Measurement of Scientific, Technological and Innovation Activities [Online]. Available at: https://doi.org/10.1787/9789264304604-en (Accessed: 22 Oct 2019).
3.Mauborgne, René: Blue Ocean Strategy. Boston, Harvard Business School Press, 2005. ISBN: 1-59139-619-0.

Subject name: **Advanced Materials Processing**	**Neptun code:** Full time: GEMTT002-Ma Part time: **Organizational unit:** Materials Science and Technology
	Type of subject: SZT4
Responsible Lecturer: Dr. Gáspár Marcell Gyula, egyetemi docens	
Co-Lecturer(s): Raghawendra Sisodia	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
The aim of the subject is to acquaint the students with the basic principles, modern process variants and application areas of materials technologies of high importance for mechanical engineering practice.
Knowledge: Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation. Broad theoretical and practical background as well as methodological and practical knowledge of design, manufacture, operation and control of complex mechanical systems and processes.
Skills: Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way. Ability to process, systemise and analyse information gained through the operation of mechanical systems and processes, as well as to draw conclusions. Ability to apply integrated knowledge from the field of machines, mechanical engineering devices, systems and processes, engineering materials and technologies, as well as related electronics and informatics.
Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Striving to understand, describe and explain observable phenomena as thoroughly as possible applying the engineering knowledge acquired.
Autonomy and responsibility: Ability to perform engineering tasks individually.

Subject description:
Primary shaping technologies. Powder metallurgy (P/M) technology, typical metal, ceramic and composite products. Advanced casting processes used in component production. Properties and design guidelines for cast products. Theoretical bases of welding. The most important fusion and pressure welding processes with their advanced process variants. Thermal cutting and joining processes related to welding. Heat and surface treatments in mechanical engineering practice. Heat and material transport. Annealing processes. Strengthening and hardening. Toughning. Modification of properties of surface layers by thermal, physical and chemical processes. Theoretical principles of plastic formation. Cold and hot forming methods, innovative metal forming processes. Introduction to plastic injection molding.

Assignment and requirements of signature (full time):
Two written test papers + 1 individual task

Assignment and requirements of signature (part time):
N/A

Requirement end evaluation of the practical mark/ exam (full time):
signature and term mark based on the test papers, individual task and activity during the lectures and practical courses

Requirement end evaluation of the practical mark/ exam (part time):
N/A

Required readings:

1. ASM Metals Handbook, Vol. 4 Heat Treating
2. ASM Metals Handbook, Vol. 6 Welding, Brazing and Soldering
3. ASM Metals Handbook, Vol. 7 Powder Metal Technologies
4. ASM Metals Handbook, Vol. 14 Forming and Forging
5. ASM Metals Handbook, Vol. 15 Casting

Suggested readings:

1. Bhadesia, H. K. D. H, Honeycombe, R. W. K.: Steels Microstructure and Properties, Third Edition, Elsevier Linacre House, Hordan Hill, Oxford OX2 8DP, UK, 2006.
2. Porter, D. A., Easterling, K. E.: Phase Transformations in Metals and Alloys, Secondedition, Chapman and Hall, 2-6 Boundary Row, London SE1 8HN, UK 1996.

Subject name: **Automated Machine Tools**	**Neptun code:** Full time: GESGT001-Ma Part time: **Organizational unit:** Machine Tools and Mechatronics
	Type of subject: SZT5
Responsible Lecturer: Dr. Tomori Zoltán, associate professor	
Co-Lecturer(s):	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The fundamental concepts of CNC machine tools. Components of CNC machine tools and their morfology.The types of CNC cutting machine tools. After the course, the student has a wider knowledge of CNC machine tools - in addition to the structure of their main components - also in terms of their cooperation.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Comprehensive understanding of global social and economic processes.
Skills: Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to publish research work, make presentations and hold discussions in their field in their mother tongue and at least in one foreign language.
Attitude: Commitment to professional and ethical values related to engineering. Striving to perform work in a complex, system based and process oriented way.
Autonomy and responsibility: Initiative to solve engineering problems. Making informed decisions individually after consultations with representatives from diverse fields (primarily that of law, economics, energy management, environmental protection), taking responsibility for the decisions.

Subject description:

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Morphology of machine tools.
Powerspindles,
main electric controls.
Axisdrives, Beds frames.
Position measuring,
Controllers. Encoders,
studying the controllers.
Tool-and workpiece supply.

Chiphandlings, Housing.
Machine tools with parallel
kinematics. Morphology of
tradicional machine tools.
Additive machine tools.
Manual and CAM programming
of CNC machine tools.
Morphology and development levels
of CNC machine tools.

Assignment and requirements of signature (full time):

Participation in lectures + exercises to the
extent prescribed in the
"Study and Examination Regulations".
Successful completion of 1 pc
2-hour mid-year written test,
which is evaluated on a scale
of 1-5.
Score ranges:
0-50% - failed,
50.1% -62.5% - passed,
62.3% -75% - medium,
75.1% -87.5% - good,
87.6% -100% - excellent.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

A colloquium, the necessary condition of
which is to obtain a signature at the end
of the semester. The colloquium is written
test in 2 hours and is graded on a scale of 1-5.
Score ranges: 0-50% - failed,
50.1% -62.5% - passed, 62.3% -75% - medium,
75.1% -87.5% - good, 87.6% -100% -excellent.
If the student wants to improve on at least
a passed successful written exam, he / she
will be given an oral opportunity
to prove his / her higher level of
knowledge after the exam.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. T. Csáki & I. Mako: Fundamentals of Automation
2. http://www.szgt.uni-miskolc.hu/robot/Fundamentals%20.pdf
3. Lopez de Lacalle, L.J., Lamikez, A.: Machine tools for High Performance Machining, Springer, ISBN 978-1-84800-379-8
4.www.nct.hu/en

Suggested readings:

1.Harris and Creede.: Shock & Vibration Handbook, McGraw – Hill Book Co., Inc. 1961.
2.www.dmgmori.com
3.www.mazak.com

4.www.fanuc.com
5.www.haascnc.com

Subject name: **Machine Structures and Design**	**Neptun code:** Full time: GEGET501-Ma Part time: **Organizational unit:** Machine and Product Design
	Type of subject: SZT3
Responsible Lecturer: Ferenc Sarka, Associate prefessor	
Co-Lecturer(s): Géza Németh, assistant professor.	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

An overview of the typical ways of damage to mechanical components and the measures to be taken to prevent them. Presentation of the phenomenon of fatigue, control calculations to prevent it. Introducing the basic concepts of spatial connection, mastering the special design and sizing features of complex drive types at the skill level.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Knowledge of fundamental theories, relations, and the terminology used in the engineering field. Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation. A detailed knowledge and understanding of mechanisms of knowledge acquisition and methods for data collection, their ethical barriers and problem-solving techniques related to the engineering field. Broad theoretical and practical background as well as methodological and practical knowledge of design, manufacture, operation and control of complex mechanical systems and processes.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way. Ability to study and analyse the materials used in mechanical engineering in a laboratory, as well as to assess and document research results. Ability to process, systemise and analyse information gained through the operation of mechanical systems and processes, as well as to draw conclusions. Ability to enrich the knowledge base of mechanical engineering with original ideas. Ability to apply integrated knowledge from the field of machines, mechanical engineering devices, systems and processes, engineering materials and technologies, as well as related electronics and informatics.

Attitude: Striving to design and perform tasks individually or in a team at a professionally high level.

Autonomy and responsibility: Sharing acquired knowledge and experience with representatives of the field communicating in formal, non-formal and informal ways. Assessing subordinates' work, sharing critical comments to improve their professional development. Ability to perform engineering tasks individually. Initiative to solve engineering problems. Taking responsibility for sub-processes under their control. Making professional decisions individually within the field. Encouraging colleagues and subordinates to practising engineering in a responsible and ethical way. Acting independently and initiatively to solve professional problems. Responsibility for sustainability, health and safety culture at work, as well as environmental consciousness. Making informed decisions individually after consultations with representatives from diverse fields (primarily that of law, economics, energy management, environmental protection), taking responsibility for the decisions.

Subject description:

1. Types and causes of damage. Sizing, inspection, material selection, load capacity.
2. Sizing of machine elements for repeated use. Fatigue curves of constant amplitude stationary repeated stresses. Fatigue limit.
3. Factors influencing the fatigue limit. Impact of incisions, size, surface quality and technological factors. Determining fatigue safety. Sizing for service life.
4. Dimensioning for multi-axis stress state. The experiments of Gough and Pollard. Procedures of Muttnyánszky and Rohonyi.
5. Repeated loads of varying amplitude. Accumulation of damage. Palmgren-Miner theory.
6. Dimensioning of axes for fatigue. Axle stiffness. Deformation and angular rotation.
7. Calculation of linear sliding wear. Adhesive technology.
8. Theoretical foundations of the operation of spatial drives. Imaginary plane wheel. Typical dimensions of the wheel body and sprocket. Forces of curved gears. Sizing of bevel gears with curved teeth based on tooth surface strength.
9. Sizing of bevel gears with curved teeth based on tooth bending strength. Design considerations for the installation of bevel gears.
10. Drive transmission between spatially inclined axes cylindrical or with bevel gears. Screw drive. Hypoid shoot.
11. Types of worm drives, their geometric sizing, their manufacturing methods.
12. Strength sizing of worm gears: for heating, load capacity of tooth surfaces, gripping load capacity of worm gear.
13. Design features. The rigidity of the worm shaft. Choice of lubricant.
14. Preliminary examination.

Assignment and requirements of signature (full time):

During the semester, two independent planning tasks have to be solved, which mostly include calculations and to a lesser extent construction tasks. The two tasks are evaluated with a five-level qualification.

Assignment and requirements of signature (part time):

During the semester, two independent planning tasks have to be solved, which mostly include calculations and to a lesser extent construction tasks. The two tasks are evaluated with a five-level qualification.

Requirement end evaluation of the practical mark/ exam (full time):

To obtain an instructor's signature, both tasks must be at least of a sufficient level. The mid-year performance is included in the exam mark with the rounded average of the grades given for the tasks, in the ratio of 1/3. For the credit to be taken into account, the result of the examination alone must be at least sufficient. Exams are evaluated with a five-level qualification

Requirement end evaluation of the practical mark/ exam (part time):

To obtain an instructor's signature, both tasks must be at least of a sufficient level. The mid-year performance is included in the exam mark with the rounded average of the grades given for the tasks, in the ratio of 1/3. For the credit to be taken into account, the result of the examination alone must be at least sufficient. Exams are evaluated with a five-level qualification

Required readings:

1. Joseph E. Shigley - Charles R. Mischke, Richard G. Budynas: Mechanical Engineering Design. McGraw Hill, ISBN 007-123270-2
2. Robert L Mott: Machine Elements in Mechanical Design, Perason Prentice Hall. ISBN0-13-191129-5
3. Bernard J Hamrock - Bo Jacobson - Steven R. Schmid: Fundamentals of Machine Elements, McGraw Hill. ISBN 0-256-19069-0

Suggested readings:

1.Robert C. Juvinal: Fundamentals of Machine Component Design, John Wiley & Sons Inc. ISBN 0-471-24448-1
2. Tyler G. Hicks: Standard Handbook of Engineering Calculations, McGraw-Hill, ISBN0-07-142793-7, (only Section 3)

Subject name: **Manufacturing Processes and Systems**	**Neptun code:** Full time: GEGTT800-Ma Part time: **Organizational unit:** Manufacturing Science
	Type of subject: SZT2
Responsible Lecturer: Dr. Csaba Felhő, associate professor	
Co-Lecturer(s): N/A	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The main goal of the subject is to acquaint students with the main production processes, their characteristics, methods and tools, as well as the characteristics and types of production systems. This is an integral part of students 'MSc studies in mechanical engineering, as knowledge of manufacturing technology is essential for mechanical engineers.

Knowledge: Comprehensive understanding of global social and economic processes. Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation. Broad theoretical and practical background as well as methodological and practical knowledge of design, manufacture, operation and control of complex mechanical systems and processes.

Skills: Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to apply integrated knowledge from the field of machines, mechanical engineering devices, systems and processes, engineering materials and technologies, as well as related electronics and informatics.

Attitude: Striving to design and perform tasks individually or in a team at a professionally high level. Participation in mechanical engineering R&D projects, applying theoretical and practical knowledge and skills in collaboration with members of the development team.

Autonomy and responsibility: Sharing acquired knowledge and experience with representatives of the field communicating in formal, non-formal and informal ways. Ability to perform engineering tasks individually.

Subject description:

Basic concepts and main characteristics of manufacturing processes and systems. The main tasks of technological design and production planning, and the relationship between them. The theoretical basis for technological design, regularities and methodology. Process and information background of technology pre-planning, operation sequence, operation and operation-element planning. Impact of the manufacturing environment to the technology planning. The modern technological procedures, tools and techniques of machinery. Types and structure of manufacturing systems. Technological, organizational and methodological fundamentals of manufacturing system design. Systems of the flexible automated manufacturing. Optimization and simulation in design of manufacturing processes and systems.

Assignment and requirements of signature (full time):

Presentation, submission

Assignment and requirements of signature (part time):

N/A

Requirement end evaluation of the practical mark/ exam (full time):

Oral exam

evaluation on a five-point scale:

satisfactory (2) from 50%
mediocre (3) from 60 %
good (4) from 70 %
excellent (5) from 85%

Requirement end evaluation of the practical mark/ exam (part time):
N/A

Required readings:
1. George Chryssolouris: Manufacturing Systems: Theory and Practice, 2nd Edition, Springer (USA), 2006, ISBN 0-387-25683-0
2. Mikell G.Groover: Fundamentals of Modern Manufacturing: Materials, Processes and Systems, John Wiley & Sons (USA), 2007, ISBN-13: 978-0-471-74485-6, ISBN-10: 0-471-74485-9
3. Peter Scallan: Process Planning:
The design/manufacture interface, Elsevier Science & Technology Books, December 2002, ISBN: 0750651296

Suggested readings:
1. Heiko Meyer, Franz Fuchs, Klaus Thiel: Manufacturing
Execution Systems: Optimal Design, Planning,
and Deployment, McGraw-Hill, 2009, ISBN: 978-0-07-162602-6
2. Myer Kutz: Mechanical Engineer's Handbook Volume 3: Manufacturing and Management. John Wiley & Sons (USA), 2006, ISBN-13: 978-0-471-44990-4, ISBN-10: 0-471-44990-3

Subject name: **Measurement, Signal Processing and Electronics**	**Neptun code:** Full time: GEVEE201-Ma Part time: **Organizational unit:** Physics and Electronic Engineering
	Type of subject: SZT1
Responsible Lecturer: MATUSZ-KALÁSZ DÁVID, tanársegéd	
Co-Lecturer(s):	
Suggested semester: 4S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
Megismertetni az méréstechnikában használatos eszközöket, elsősorban az multimétereket, különös tekintettel az elektromos szenzorok működésére. Megismertetni a számítógéppel vezérelt méréstechnika alapvető ismereteit, a jelfeldolgozás metodikáját és elektromos jelek átalítását. Rávilágítani a villamos mérőrendszerek fejlődési történetére és fejlesztési lehetőségeire.
Knowledge: Knowledge of measurement techniques and theory related to mechanical engineering.
Skills: Ability to process, systemise and analyse information gained through the operation of mechanical systems and processes, as well as to draw conclusions.
Attitude: Striving to design and perform tasks individually or in a team at a professionally high level.
Autonomy and responsibility: Ability to perform engineering tasks individually.

Subject description:
Electrical Safety Training, International system of units,
Analog Instruments, Voltage – current- and power meters,
Digital multimeters, Measurement error,
Digital measurement methods, Sampling,
Quantization, Quantization error,
Sensors, Temperature measurement,
A/D and D/A conversion,
Electrotechnics basics,
Diodes, Zener diodes,
Bipolar Junction Transistors,
Field effect transistor, JFET, MOSFET,
Amplifiers, Operational amplifier

Assignment and requirements of signature (full time):
A gyakorlati órák során elvégezendő mérésekről készült beszámolók és jegyzőkönyvek leadása. A mérési gyakorlatok az intézel által biztosított eszközökkel és készülékekkel zajlanak.

Assignment and requirements of signature (part time):
A gyakorlati órák során elvégezendő mérésekről készült beszámolók és jegyzőkönyvek leadása. A mérési gyakorlatok az intézel által biztosított eszközökkel és készülékekkel zajlanak.

Requirement end evaluation of the practical mark/ exam (full time):
Gyakorlati jegy megszerzése írásbeli zárthyelyi dolgozat megírásával. Osztályozás ötfokozatú skálán.
Osztályozás:

0% - 49%	Elégtelen	(1)
50% - 59%	Elégséges	(2)
60% - 69%	Közepes	(3)
70% - 84%	Jó	(4)

85% fölött	Jeles	(5)

Requirement end evaluation of the practical mark/ exam (part time):

Gyakorlati jegy megszerzése írásbeli zárthyelyi dolgozat megírásával. Osztályozás ötfokozatú skálán.

Osztályozás:

0% - 49%	Elégtelen	(1)
50% - 59%	Elégséges	(2)
60% - 69%	Közepes	(3)
70% - 84%	Jó	(4)
85% fölött	Jeles	(5)

Required readings:

1. Doeblin, E.O.: Measurement Systems, McGraw-Hill, 1990. ISBN 0-07-017338-9
2. Webster, J.G.: The Measurement, Instrumentation, and Sensors Handbook, CRC Press LLC, 1999. ISBN 3-540-64830-5
3. Lang, T.T.: Computerized Instrumentation, John Wiley &Sons Ltd., England 1991.
4.
5.

Suggested readings:

1. Tumanski, S.: Principles of electrical measurement, Taylor & Francis Group (USA), 2006, ISBN 0-7503-1038-3
2. Purkait, P., Biswas, B., Das, S., Koley, C.: Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education (India), 2013, ISBN (13): 978-1-25-902959-2
3.Regtien, P.P.L.: Electronic instrumentation,VSSD (The Netherlands) 2005, ISBN 90-71301-43-5
4.
5.

Subject name: **iCAD Systems 1**	**Neptun code:** Full time: GESGT002-Ma Part time: **Organizational unit:** Machine Tools and Mechatronics
	Type of subject: DSZ1
Responsible Lecturer: Dr Attila Szilágyi, associate professor	
Co-Lecturer(s): Dr György Hegedűs associate professor Sándor Gergő Tóth assistant lecturer	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
Describe the modules of computer-aided integrated design systems and master their practical application. Modeling of complex parts, compilation of construction models and preparation of their technical documentation. Preparation of kinematic tests within a CAD system.
Knowledge: Knowledge of fundamental theories, relations, and the terminology used in the engineering field.
Skills: Ability to apply integrated knowledge from the field of machines, mechanical engineering devices, systems and processes, engineering materials and technologies, as well as related electronics and informatics.
Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering.
Autonomy and responsibility: Ability to perform engineering tasks individually. Initiative to solve engineering problems. Making professional decisions individually within the field.

Subject description:
Development and integration characteristics of CAx systems. Data exchange between CAx systems. Geometric modeling, set theory approach to model history, CSG tree. Interpretation of shape features, characteristics of geometry modeling based on shape features. Possibilities of plane and spatial distribution of shape features. Sketching options. Defining control curves with equations. Modeling of parametric components. Steps for modeling typical machine elements (shaft, spring, gear). Definition of assembly constraints, peculiarities of geometric and kinematic constraints. Basics of surface modeling, typical surface operations in CAD systems. Creating a technical drawing in a CAD environment. Preparation of kinematic tests on CAD interface.

Assignment and requirements of signature (full time):
Participation in lectures + exercises to the extent prescribed in the "Study and Examination Regulations".
Successful completion of 1 3-hour mid-year test, which is evaluated on a scale of 1-5.
Grades: 0-50% - fail,
50.1% -62.5% - pass,
62.6% -75% - satisfactory,
75.1% -87.5% - good,
87.6% -100% - excellent.

Assignment and requirements of signature (part time):
Participation in lectures + exercises to the extent prescribed in the "Study and Examination Regulations".
Successful completion of 1 3-hour mid-year test, which is evaluated on a scale of 1-5.
Grades: 0-50% - fail,

50.1% -62.5% - pass,
62.6% -75% - satisfactory,
75.1% -87.5% - good,
87.6% -100% - excellent.

Requirement end evaluation of the practical mark/ exam (full time):
Successful completion of 1 3-hour exam test, which is evaluated on a scale of 1-5.
Grades: 0-50% - fail,
50.1% -62.5% - pass,
62.6% -75% - satisfactory,
75.1% -87.5% - good,
87.6% -100% - excellent.

Requirement end evaluation of the practical mark/ exam (part time):
Successful completion of 1 3-hour exam test, which is evaluated on a scale of 1-5.
Grades: 0-50% - fail,
50.1% -62.5% - pass,
62.6% -75% - satisfactory,
75.1% -87.5% - good,
87.6% -100% - excellent.

Required readings:
1. M. Hzirz, W. Dietrich, A. Gfrerrer and J. Lang, Integrated Computer-Aided Design in Automotive Development, Berlin: Springer-Verlag, 2013.
2. Max K. Agoston: Computer graphics and geometric modeling, Implementation and algorithms, Springer, 2005, ISBN 1-85233-818-0
3. Christoph M. Hoffmann: Geometric and solid modeling, Morgan Kaufmann, 1989, ISBN 1-55860-067-1

Suggested readings:
1. Ian Stroud: Boundary Representation Modelling Techniques, Springer, 2006, ISBN 978-1-84628-616-2
2. Jean Gallier: Curves and Surfaces in Geometric Modeling: Theory and Algorithms, Morgan Kaufmann, 1999, ISBN 978-1-55860-599-2

Subject name: **iCAD Systems 2**	**Neptun code:** Full time: GEMTT071-Ma Part time: **Organizational unit:** Materials Science and Technology
	Type of subject: DSZ2
Responsible Lecturer: Zsolt Lukács, associate professor	
Co-Lecturer(s): Péter Zoltán Kovács, Viktor Gál	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
The basic objective of the course is to acquaint the student with the logical structure and workflow of the integrated modules of today's advanced CAD system (Siemens NX). With the special regard to design of progressive die tools and plastic injection molding tools
Knowledge: Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation. Broad theoretical and practical background as well as methodological and practical knowledge of design, manufacture, operation and control of complex mechanical systems and processes.
Skills: Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to publish research work, make presentations and hold discussions in their field in their mother tongue and at least in one foreign language.
Attitude: Commitment to professional and ethical values related to engineering. Striving to design and perform tasks individually or in a team at a professionally high level.
Autonomy and responsibility: Ability to perform engineering tasks individually.

Subject description:
Introduction of workflow of NX Sheet Metal Features module. Theoretical background of Technological Process Planning of Sheet Metal Forming. Workflow in NX Progressive Die Wizard module (working together until 4 week step by step). Theoretical background of Die Design of Plastic Injection Mould Tool. Workflow in NX Mould Wizard module (working together until 4 week step by step).

Assignment and requirements of signature (full time):
Successful completion of NX Sheet Metal test (better than 50%)

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):
Signature and 70% project work (NX PWD or NX MW) mark + 30% mark of written test result

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:
1. Vukota Boljanovic, J. R. Paquin: Die Desingn Fundamentals, ISBN-13: 9780831131197
2. Vukota Boljanovic: Sheet Metal Stamping Dies, Die Design and Die-Making Practise,

Suggested readings:

Subject name: **Methodical Design**	**Neptun code:** Full time: GESGT003-Ma Part time: **Organizational unit:** Machine Tools and Mechatronics
	Type of subject: DSZ3
Responsible Lecturer: Dr. György Hegedűs, associate professor	
Co-Lecturer(s): Sándor Gergő Tóth assistant lecturer	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

To get acquainted with the different design methods used in design engineering practice and their theoretical background for CAD / CAM students.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Have a detailed knowledge of the rules of preparing technical documentations.

Skills: Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to apply information and communication technologies and methods to solve engineering problems. Ability to solve problems in a creative, and complex tasks in a flexible way, as well as to pursue life-long learning and to demonstrate a commitment to diversity and value-basedness.

Attitude: Commitment to professional and ethical values related to engineering. Striving to design and perform tasks individually or in a team at a professionally high level.

Autonomy and responsibility: Sharing acquired knowledge and experience with representatives of the field communicating in formal, non-formal and informal ways. Acting independently and initiatively to solve professional problems.

Subject description:

The mission of the design engineer, decimal rule. Various design approaches and engineering schools. Synthesis of different design approaches. Intuitive design and techniques that encourage intuition. Outline of cognitive planning. The concept and sketches of discursive design. Application of design catalogs in design. Basics of functional analysis. Function structures. Methods of producing solution variants, knowledge tree and knowledge matrix. Combinatorial design in conceptual design. The concept and treatment of combinatorial explosion. Methods for accelerating design, sample designs, batch designs, cabinet systems. Selection of solution variants, error criticism, value analyzes, basics of technical value analysis. Satisfying the aspects of production, assembly, recycling, economy and maintenance during the design. DF (x) techniques and their application. Development of CAD and its impact on design processes. The concept and significance of RPT in design processes, 3DP rapid prototyping procedure and equipment. SLS rapid prototyping procedure and equipment, LOM rapid prototyping procedure and equipment. SLA rapid prototyping procedure and equipment, FDM rapid prototyping procedure and equipment. The concept and practical application of reverse engineering. Safe design of machines, standards, legislation.

Assignment and requirements of signature (full time):

1 mid-term test

1 parctical test

Signature is conditional on participation in lectures and exercises. Anyone who does not attend more than 30% of the practice hours will be permanently refused to sign.

Successful completion of mid-term test, which is evaluated on a scale of 1-5.

Grades: 0-50% - fail,
50.1% -62.5% - pass,
62.6% -75% - satisfactory,
75.1% -87.5% - good,
87.6% -100% - excellent.

Assignment and requirements of signature (part time):

1 mid-term test
1 parctical test
Signature is conditional on participation in lectures and exercises. Anyone who does not attend more than 30% of the practice hours will be permanently refused to sign.
Successful completion of mid-term test, which is evaluated on a scale of 1-5.
Grades: 0-50% - fail,
50.1% -62.5% - pass,
62.6% -75% - satisfactory,
75.1% -87.5% - good,
87.6% -100% - excellent.

Requirement end evaluation of the practical mark/ exam (full time):

The practical mark is determined on the basis of the submitted task and the mid-term test 1-5. rated on a scale.
Grades:
0-60%: fail;
<60-70%: pass;
<70-80%: satisfactory;
<80-90%: good;
<90-100%: excellent.

Requirement end evaluation of the practical mark/ exam (part time):

The practical mark is determined on the basis of the submitted task and the mid-term test 1-5. rated on a scale.
Grades:
0-60%: fail;
<60-70%: pass;
<70-80%: satisfactory;
<80-90%: good;
<90-100%: excellent.

Required readings:

1. M. Hzirz, W. Dietrich, A. Gfrerrer and J. Lang: Integrated Computer-Aided Design in Automotive Development, Berlin: Springer-Verlag, 2013, ISBN 978-3-642-11939-2
2. N. Cross, Engineering Design Methods - Strategies for Product Design (Third Edition), London: John Wiley 2005, ISB 978-0-47187-250-4.

Suggested readings:

1. G. Pahl, W. Beitz, J. Feldhusen and Karl-Heinrich Grote, Engineering Design - A Systematic Approach, London: Springer-Verlag 2007, ISBN 978-1-84628-3185.

Subject name: **Computer Aided Process Planning**	**Neptun code:** Full time: GEMTT114-Ma Part time: **Organizational unit:** Materials Science and Technology
	Type of subject: DSZ5
Responsible Lecturer: Zsolt Lukács, associate professor	
Co-Lecturer(s): Péter Zoltán Kovács, Viktor Gál	
Suggested semester: 4S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 4	**Program:** Full time

Objective and purpose of the subject:

The basic objective of the course is to acquaint the student with the logical structure and workflow of the numerical simulation of Metal Forming processes and the most popular software in this special areas (AutoForm, DEFORM, Moldex 3D).

Knowledge: Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation. Knowledge and understanding of devices and methods of computer modelling and simulation related to mechanical engineering.

Skills: Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to publish research work, make presentations and hold discussions in their field in their mother tongue and at least in one foreign language.

Attitude: Commitment to professional and ethical values related to engineering. Striving to design and perform tasks individually or in a team at a professionally high level.

Autonomy and responsibility: Ability to perform engineering tasks individually.

Subject description:

During the semester, the student gets acquainted with today's advanced computer-aided technology and tool design software and their workflow. First with the AutoForm software that supporting the technological and tool design of automotive sheet metal parts. You will then become familiar with the DEFORM software that supports the design of Bulk Metal Forming operations. Finally, Moldex3D software to support tool and technology design of plastic injection molded parts.

Assignment and requirements of signature (full time):

Successful completion of written test (better than 50%)

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

Signature and 33% AutoForm test result and 33% DEFORM test result and 33% Moldex3D test result

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. Dorel Banabic: Constitutive Modelling and Numerical Simulation, ISBN13: 9783642445101
2. Miklos Tisza: Metal Forming

Suggested readings:

Subject name: **NC programming**	**Neptun code:** Full time: GESGT004-Ma Part time: **Organizational unit:** Machine Tools and Mechatronics
	Type of subject: DSZ4
Responsible Lecturer: Dr. György Hegedűs, associate professor PhD.	
Co-Lecturer(s): Dániel Kiss assistant lecturer	
Suggested semester: 4S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

During the course the students gain knowledge using CAM software. Through the course they learn how to select tools for different machining operations, select parameters, import or create geometries and program modern CNC machines using integrated CAD software.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Knowledge and understanding of terminology, main regulations and aspects of other areas relating to and having a priority for practising engineering (primarily that of logistics, management, environmental protection, quality assurance, information technology, law, economics, occupational and fire safety, industrial safety). Knowledge and understanding of devices and methods of computer modelling and simulation related to mechanical engineering.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to solve problems using engineering theories and related terminology in an innovative way. Ability to solve specific engineering problems by applying modern knowledge acquisition and data collection methods.

Attitude: Striving to comply with and enforce quality standards. Striving to design and perform tasks individually or in a team at a professionally high level.

Autonomy and responsibility: Taking responsibility for sub-processes under their control. Responsibility for sustainability, health and safety culture at work, as well as environmental consciousness.

Subject description:

Programming methods of NC
machine tools: manual programming, WOP, computer aided programming. Advantages and disadvantages of methods. Process of computer aided NC programming. Introduction to Topsolid program. Menus, windows, bars. Machine and control definition. File handling. Importing and drawing the geometry. Editing the geometry. Coordinate systems, views. Solids, solid operations. Technological operations, handling of operation manager. Tool choice. Machining parameters, setup of work piece. Toolpathes in milling machines. Checking the NC program. Postprocessing, editing the NC program. Documentation, setup sheets. Examples.

Assignment and requirements of signature (full time):

The condition for signing is to attend 60% of the lectures and 70% of the exercises, to submit 1 semester assignment at a sufficient level.
Assessment of the task: on a five-point scale.
Point limits:

0 - 50% fail
51 - 65% pass
66 - 77% satisfactory
78 - 89% good
90 - 100% excellent

Assignment and requirements of signature (part time):

The condition for signing is to attend 60% of the lectures and 70% of the exercises, to submit 1 semester assignment at a sufficient level.
Assessment of the task: on a five-point scale.
Point limits:
0 - 50% fail
51 - 65% pass
66 - 77% satisfactory
78 - 89% good
90 - 100% excellent

Requirement end evaluation of the practical mark/ exam (full time):

The condition for signing is to attend 60% of the lectures and 70% of the exercises, to submit 1 semester assignment at a sufficient level.
Assessment of the task: on a five-point scale.
Point limits:
0 - 50% fail
51 - 65% pass
66 - 77% satisfactory
78 - 89% good
90 - 100% excellent

Requirement end evaluation of the practical mark/ exam (part time):

The condition for signing is to attend 60% of the lectures and 70% of the exercises, to submit 1 semester assignment at a sufficient level.
Assessment of the task: on a five-point scale.
Point limits:
0 - 50% fail
51 - 65% pass
66 - 77% satisfactory
78 - 89% good
90 - 100% excellent

Required readings:

1. Topsolid User's Guide and Help
2. Helmi A. Youssef, Hassan El-Hofy: Machining Technology – Machine tools and operations, 2008.
3. J. Paulo Davim: Machining of Complex Sculptured Surfaces, 2012.

Suggested readings:

Subject name: **Hydraulic Units and Systems**	**Neptun code:** Full time: GESGT005-Ma Part time: **Organizational unit:** Machine Tools and Mechatronics
	Type of subject: VT
Responsible Lecturer: Dr György Hegedűs, associate professor	
Co-Lecturer(s): Sándor Gergő Tóth assistant lecturer	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

Description of the most important elements of hydraulic circuits and hydraulic systems suitable for performing basic tasks, providing the knowledge necessary for the planning and operation of hydraulic circuits for the performance of a given task. Presentation of energy saving circuits and controllable energy converters.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Knowledge of fundamental theories, relations, and the terminology used in the engineering field.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Commitment to professional and ethical values related to engineering.

Autonomy and responsibility: Sharing acquired knowledge and experience with representatives of the field communicating in formal, non-formal and informal ways. Ability to perform engineering tasks individually.

Subject description:

Themes of lectures:

Assembly systems, characteristics and application areas of hydraulic elements. Classification of hydraulic circuits according to the nature and method of installation and the continuity of the working fluid. Structure, properties and characteristics of stable, mobile and installed hydraulic systems. Structure, properties and characteristic areas of application of closed, semi-closed and open hydraulic circuits. Hydraulic circuit working fluids. Main tasks, classification, characteristic properties, marking of working fluid. Performance fluid classes by performance level. Effect of oil viscosity on efficiency and equipment life, optimal viscosity range, viscosity metrics, viscosity classes. The effect of pollution on the service life of structural elements and operational safety. Pollution measures. Structural design and placement of filters in the circuit. Select a filter to ensure the desired filtration fineness, the degree of separation. Signs of oil aging, need for oil change. Elements of the hydraulic power supply, aspects of tank design. Changing the speed / speed of hydraulic motors. Speed control by current distribution. Throttle placement in the circuit, analysis of choke speed control. Determination of drive operating point by characteristic method. Effect of load change on the operating point of the drive. Increase drive stiffness. Motion control with variable specific volume energy converters. Primary, secondary, primary-secondary controlled hydraulic drives. Pressure, volume flow, power regulated energy converters. Operating principle of the current stabilizing valve, arrangement with chokes arranged in series and in parallel. Pressure differential stabilizing

operating principle, linear structural sketch, symbol. Structural design, characteristics, static characteristics, symbols and application of primary and secondary controlled two-way current stabilizers. Choke resp. load-time, pressure-time, and volume-flow-time diagrams of a primary-controlled drive comprising a primary and secondary controlled two-way current stabilizer. Structural design, characteristics, symbols and application of a three-way current stabilizer. Characteristics of current distribution with choke and volume flow stabilizer. Operating principle of current distribution. Pressure ratio stabilizing operating principle, line sketch, symbol. Line distribution sketch, structural design, operation, characteristics, symbol. Power failure. Line summary, structural design, operation, characteristics, symbol of the current summary. The task, symbol, marking, systematic derivation of reversing valves. Operation of derailleurs. Aspects of selection of diverter valves, quality characteristics of derailleurs. Tolerance forces. Structural design, detailed and consolidated drawing of pre-controlled switches. Control modes. Spring-centered and pressure-centered pre-controlled derailleur. The function, structural design, characteristic properties, symbols and characteristics of non-return valves. The function, structural design, characteristic properties and symbols of controlled non-return valves. Requirements for the installation of a controlled non - return valve. Use of a slotted oil non-return and a slotted oil return controlled non-return valve for load lowering. Dual controlled non-return valve. The function, structural design, characteristic properties and symbols of fall arrest valves. The function, structural design, characteristic properties and symbols of automatic deaeration valves. Operating principle, grouping, structural designs and symbols of hydraulic accumulators. Battery function in the hydraulic circuit, typical application examples. Change in the absorbed liquid volume of a battery as a function of the nature of the change in condition and pressure. Typical pressure values. Battery capacity, the working capacity of the fluid stored in the battery. Determine the nominal size of the battery and the gas filling pressure for the required absorbed / supplied liquid volume requirement. Safety requirements for the installation of a hydraulic accumulator, elements of the accumulator safety block. Example number: Selecting a battery to provide intermittent extra volume demand. Serial and parallel connection of energy converters. Circuits for solving typical basic hydraulic tasks. Overload protection, speed control in case of negative load, load holding, braking circuits. Pump relief, high-speed switching, multi-speed systems. Losses of hydraulic circuits, heating of working fluid. Tank sizing for working fluid heating. Energy saving circuits. Synchronous movement of hydraulic motors / cylinders. Synchronous movement with mechanical coupling, synchronous movement with current controllers. Pseudo-synchronous and true synchronous controls. Proportional operated hydraulic components. Structural design and characteristics of the proportional magnet. Displacement controlled and force controlled proportional magnet. Reducing the hysteresis of the proportional magnet. Structural design, characteristic feature and symbol of proportional magnet-operated hydraulic elements (direct and pre-controlled transducers, direct and pre-controlled pressure limiters, throttle and current stabilizing valve). Hydraulic functions of servo valves, their grouping. Electromechanical transducer for use in servo valves. Hydraulic booster stages with piston and nozzle. Typical characteristics of servo valves: idling and load characteristics. Structural design, operation, characteristics, symbol of a two-stage, non-rigid feedback servo valve. Comparison of proportional and servo valves.
Noise caused by hydraulics. Noise reduction options. Primary and secondary noise reduction solutions.
Lab topics:
Laboratory practice: hydraulic for measuring the static and dynamic characteristics of direct and pre - controlled pressure relief devices. Laboratory practice: Assembling a hydraulic circuit for speed control with choke and current stabilizer, measuring the characteristic parameters of the circuit under varying loads. Hydraulic circuit design steps. Example number: Designing a hydraulic circuit for a given task, sizing and selecting elements. Laboratory Practice: Assembling a hydraulic circuit to operate a cylinder in high-speed switching and to operate hydraulic motors in series and in parallel. Recording of idle and load characteristics of a servo valve.

Assignment and requirements of signature (full time):
2 mid-term test
Participation in lectures + exercises to the extent prescribed in the "Study and Examination Regulations".

Prerequisite for sign: at least a sufficient level of results achieved in test, participation in labs, submission of protocols prepared for laboratory measurements.

Assignment and requirements of signature (part time):

1 mid-term test

Participation in lectures + exercises to the extent prescribed in the "Study and Examination Regulations".

Prerequisite for sign: at least a sufficient level of results achieved in test, participation in labs, submission of protocols prepared for laboratory measurements.

Requirement end evaluation of the practical mark/ exam (full time):

The practical mark is determined on the basis of the submitted task and the mid-term test 1-5. rated on a scale.

Grades:

0-60%: fail;

<60-70%: pass;

<70-80%: satisfactory;

<80-90%: good;

<90-100%: excellent.

Requirement end evaluation of the practical mark/ exam (part time):

The practical mark is determined on the basis of the mid-term test 1-5. rated on a scale.

Grades:

0-60%: fail;

<60-70%: pass;

<70-80%: satisfactory;

<80-90%: good;

<90-100%: excellent.

Required readings:

1. Rabie, M. G.: Fluid Power Engineering, McGraw-Hill, 2009, ISBN 978-00-716-2246-2

2. On/off hydraulics –Electrical operation, Publisher:Bosch Rexroth AGDrive & Control Academy, 2016

3. Walters, R.B: Hydraulic and Electric-Hydraulic Control Systems, Springer, 2000, ISBN 978-94-015-9427-1

Suggested readings:

1. Jelali, M., Kroll, A.: Hydraulic Servo-systems, Springer, 2003, ISBN 978-1-4471-0099-7

2. Vyas, J. J., Gopalsamy, B., Joshi, H.: Electro-Hydraulic Actuation Systems, Springer, 2019, ISBN 978-981-13-2547-2

Subject name: **Simulation of Manufacturing Devices**	**Neptun code:** Full time: GESGT006-Ma Part time: **Organizational unit:** Machine Tools and Mechatronics
	Type of subject: VT
Responsible Lecturer: Dr Attila Szilágyi, associate professor	
Co-Lecturer(s): -	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The simulation analysis of vibrations may occur during the operation of manufacturing devices.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Knowledge of fundamental theories, relations, and the terminology used in the engineering field. Broad theoretical and practical background as well as methodological and practical knowledge of design, manufacture, operation and control of complex mechanical systems and processes.

Skills: Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way. Ability to apply integrated knowledge from the field of machines, mechanical engineering devices, systems and processes, engineering materials and technologies, as well as related electronics and informatics. Ability to process, systemise and analyse information gained through the operation of mechanical systems and processes, as well as to draw conclusions.

Attitude: Striving to participate in the development of new methods and equipment related to engineering. A deep sense of vocation. Striving to acquire a comprehensive knowledge. Striving to design and perform tasks individually or in a team at a professionally high level. Commitment to enrich the field of mechanical engineering with new findings and scientific results.

Autonomy and responsibility: Ability to perform engineering tasks individually. Initiative to solve engineering problems. Making professional decisions individually within the field.

Subject description:

Construction analysis of machine tools units. The finite element analysis of structures composed of these units: structural, thermal, and vibrational analysis of the cover plates of devices, vibration analysis of machine beds and the cutting process, balancing problems.

Assignment and requirements of signature (full time):

a 10-week tailored project work that should be completed by the last week of the term.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

Exam, qualified by a 1-5 scale.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. Harris and Piersol.: Shock & Vibration Handbook, McGraw – Hill Book Co., Inc. 2002.;;
2. W., Bottega: Engineering vibrations, Taylor and francis, 2009.;
3. Den Hartogh, J.P.: Mechanical Vibrations, McGraw – Hill Book Co., Inc. 1956.;

Suggested readings:

1. Den Hartogh, J.P.: Advanced strength of materials, Dover Publications, 1987

Subject name: **Materials Selection**	**Neptun code:** Full time: GEMTT074-Ma Part time: **Organizational unit:** Materials Science and Technology
	Type of subject: VT
Responsible Lecturer: Zsuzsanna Koncsik, associate professor	
Co-Lecturer(s): László Kuzsella	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
To choose the best material required by a particular application or for particular properties.
Knowledge: A comprehensive understanding of the main properties and application fields of structural materials related to mechanical engineering. Have a detailed knowledge of the rules of preparing technical documentations. Knowledge of measurement techniques and theory related to mechanical engineering. Knowledge of the information and communication technologies related to mechanical engineering.
Skills: Ability to approach and solve special problems arising in engineering in a versatile, interdisciplinary way. Ability to solve specific engineering problems by applying modern knowledge acquisition and data collection methods. Ability to apply information and communication technologies and methods to solve engineering problems. Ability to publish research work, make presentations and hold discussions in their field in their mother tongue and at least in one foreign language.
Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Commitment to professional and ethical values related to engineering. Striving to comply with and enforce quality standards. Striving to organise and perform tasks in accordance with environmentally and health conscious, as well as sustainability expectations. Striving to design and perform tasks individually or in a team at a professionally high level.
Autonomy and responsibility: Ability to perform engineering tasks individually. Responsibility for sustainability, health and safety culture at work, as well as environmental consciousness.

Subject description:
Descrition and application of different types of materials. Selection of the optimal material in function of the required mechanical and/or physical properties.

Assignment and requirements of signature (full time):
Successful completion of one test (minimum 50%), and elaborating one project work on acceptable level.

Assignment and requirements of signature (part time):
Successful completion of one test (minimum 50%), and elaborating one project work on acceptable level.

Requirement end evaluation of the practical mark/ exam (full time):
0.3* prejct work mark + 0.7*test mark

Requirement end evaluation of the practical mark/ exam (part time):
0.3* prejct work mark + 0.7*test mark

Required readings:
1. William D. Callister, Jr.: Materials Science and Engineering an Introduction, John Wiley&Sons, Inc. 2007.
2.Ashby, F. M.: Materials Selection in Mechanical Design, Cambridge University Press, Cambridge, 2004. p. 1-246.
3. Farag, M. M.: Selection of Materials for Engineering Design, Prentice Hall, New York, 1989. p. 1- 533.
4. ASM Handbook, Volume 20: Materials Selection and Design, ASM International, London, 1997. ISBN 0-

87170-386-6, p. 1-900.
5.

Suggested readings:

1. P.L. Mangonon: The Principles of Materials Selection for Engineerig Design, Prentice Hall, 1999.
2. Sabar D. Hutagalung: Materials Science and Technology, InTech, 2012.
3. N.P. Cheremisinoff, P. N. Cheremisinoff: Handbook of Advanced Materials Testing, Marcel dekker, 1995.