Course Description		
Course title:	Material testing	
Neptun code:	MAKPOL227B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l + 2p	
Name and position of lecturer:	Prof. Dr. György CZÉL	
Contact of lecturer:	gyorgy.czel@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	1/autumn	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is to teach material testing of metallic and non-metallic materials. Another goal is to determine the mechanical properties and material characteristics of various materials	
Course structure:	**Week**	**Topic**
	1.	Purpose of material testing
	2.	Coexistence of elastic load and deformation
	3.	The historicity of the concept of hardness
	4.	Tensile testing of metals (tensile test)
	5.	Derivative determined by tear test material properties
	6.	Tensile testing of polymers
	7.	Fracture mechanics tests
	8.	Fatiguing tests
	9.	Technological tests, Material categories for fracture according to behavior
	10.	Non-destructive tests
	11.	Ultrasound examinations
	12.	Industrial practice of material testing
	13.	
Required readings:	William D. Callister,Jr.: Fundamentals of Materials Science and Engineering (ISBN: 0-471-47014-7)	
Recommended readings:	Berg, McGarry, Elliot: Composite materials testing and design (anerican Society for testing Materials, 1974)	
Evaluation method:	midterm test and 10 reports	

Course Description		
Course title:	Basics of Physics	
Neptun code:	GEFIT051B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2p	
Name and position of lecturer:	Dr. Gábor Pszota, associate professor	
Contact of lecturer:	gabor.pszota@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	1/autumn	
Number of credits:	2	
Requirements (exam/practical mark/signature/report, essay):	practial mark	
Course objectives (50-100 words):	Getting to know the most important basic concepts of Physics, repeating what you learned in high school. In the classes, we mainly deal with the concepts of Mechanics, and we perform tasks related to the mechanics of the point of mass and simple systems. A prominent role is given to measurements and mathematics clarifying the relationships between methods and model creation, as well as showing solutions to tasks from multiple perspectives.	
Course structure:	**Week**	**Topic**
	1.	Basic concepts of kinematics. Newton's laws, Momentum and its conservation, Work, energy, power.
	2.	Conservative fields and potential energy. Torque.
	3.	Equilibrium of rigid bodies. Free and forced linear oscillations.
	4.	Hydrostatics.
	5.	First law of thermodynamics. Thermodynamics of gases, solids, and liquids.
	6.	Heat propagation. Electric charge, field, potential.
	7.	Conductors in electrostatic field. The flow of electric charges.
	8.	The concept of current, current density, voltage. Voltage sources, electromotive force.
	9.	DC circuits. Joule's law.
	10.	The concept of magnetic induction. Forces in a magnetic field.
	11.	Dia-, para-, and ferromagnetism. Ampere's law.
	12.	Electromagnetic induction. Neumann's law. Faraday's law of induction.
	13.	AC circuits. Ampere-Maxwell law. EM waves.

Required readings:	R.A. Serway and Chris Vuille: Essentials of College Physics, 2007, ISBN: 0-495-10619-4 P.A. Tipler and Gene Mosca: Physics for Scientists and Engineers, 2004, ISBN: 0-7167-0809-4, 0-7167-0810-8
Recommended readings:	M. Alonso – E. J. Finn: Fundamental University Physics, Volume I., II., Addison-Wesley Publishing Company, 1979 D. Halliday – R. Resnick: Fundamentals of Physics, John Wiley & Sons, 1981
Evaluation method:	

Course Description		
Course title:	Materials Science	
Neptun code:	MAKFKT120B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l + 2p	
Name and position of lecturer:	Prof. Peter Baumli	
Contact of lecturer:	peter.baumli@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	1/autumn	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	In the course, students will learn about the structure of materials, from atomic composition to the molecular level. The aim is to understand the description of structures in condensed materials, exploring both order and disorder and how these can be characterized.	
Course structure:	**Week**	**Topic**
	1.	Chemical Bonds
	2.	Amorphous Materials
	3.	Lattice Types of Crystalline Materials
	4.	Characterization of Crystalline Lattices, Miller Indexing
	5.	Lattice Defects
	6.	Introduction to Phase Diagrams, Their Physico-Chemical Background
	7.	Introduction to Phase Diagrams, Their Physico-Chemical Background II
	8.	Interpretation of Magnetic and Electrical Properties

	9.	Interfaces and Interfacial Phenomena
	10.	Characterization of Ceramic Materials
	11.	Introduction to Polymers
	12.	Examination of Molecular Structure
	13.	Presentation of Semester Project
Required readings:	1. Materials Science and Engineering: An Introduction" by William D. Callister and David G. Rethwisch; 2. De Graef, M., & McHenry, M. E. (2012). The Structure of Materials (2nd ed.). Cambridge University Press.	
Recommended readings:	Gaskell, D. R. (2017). Introduction to the Thermodynamics of Materials (6th ed.). CRC Press.	
Evaluation method:	The students prepare a semester project work. After the submission of the semester work, the teacher evaluates it. Accepted the semester work, the students can start the Oral examination.	

Course Description		
Course title:	Scientific work technics for engineers	
Neptun code:	MAKETT120B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2p	
Name and position of lecturer:	Helga Kovacs, PhD, associate professor	
Contact of lecturer:	helga.kovacs@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	1/autumn	
Number of credits:	2	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	Providing the IT knowledge necessary for the professional preparation of scientific data processing, documents, and presentations. Setting up and learning to use individual student Microsoft accounts.	
Course structure:	**Week**	**Topic**
	1.	A comprehensive presentation on the installation and use of the Microsoft 365 software package.
	2.	E-learning system of University of Miskolc
	3.	The art of editing scientific documents and presentations.

	4.	The theory of literature research and the application of related software, including database management.
	5.	The theory of literature research and the application of related software, including database management
	6.	Microsoft Word
	7.	Microsoft Word
	8.	Microsoft Excel
	9.	Microsoft Excel
	10.	Microsoft Excel
	11.	Microsoft Power Point
	12.	Test, 1st appointment, Student presentation of semester assigments
	13.	Test second appointment, Student presentation of semester assigments
Required readings:	"Educational videos in e-learning system, •https://support.microsoft.com/hu-hu/training •Naveed Saleh: The complete Guide to article writing, Writer's Digest Books, 2014 •Liam Lusk: Presentation Skills: How To Make A Great Presentation, Amazon Digital Services LLC, 2012 Michael Alexander, Richard Kusleika, John Walkenbach: Excel 2019 Bible, Wiley, 2018"	
Recommended readings:	"•Nick Moore: How to Do Research: A Practical Guide to Designing and Managing Research Projects, Facet, 2006"	
Evaluation method:	practical grade	

Course Description	
Course title:	Everyday's material knowledge
Neptun code:	MAKFKT121B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2l
Name and position of lecturer:	Klara Hernadi, full professor
Contact of lecturer:	klara.hernadi@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	1/autumn
Number of credits:	2

Requirements (exam/practical mark/signature/report, essay):	report	
Course objectives (50-100 words):	Practical learning about the materials we use in our everyday lives. Critically processing the (online) knowledge that comes our way. Developing an appropriate attitude, recognising unscientific misconceptions and criticising them with a system of arguments. Knowledge and insights that can be applied in everyday life developing practical knowledge and insight.	
Course structure:	**Week**	**Topic**
	1.	Atoms: the origin of the atoms' names, their occurrence in the world, in our everyday life, in biological systems and their role in them
	2.	A "hit list" of compounds: the fifty most produced chemicals in the world, their usage
	3.	Fuels for vehicles: characterization of the basic types; alternative (environmentally friendly) fuels; automotive catalytic converters
	4.	Our medicines: home pharmacy - most important everyday medicines; pharmaceutical manufacturing
	5.	Our food products: carbohydrates, proteins, lipids, vitamins, colours; food preservation; drinks
	6.	Our cleansing products: chemicals in our environment, their possible dangers
	7.	Natural and artificial objects in our environment: building materials, glass-ceramics, metal objects, etc.
	8.	Plastics: natural and synthetic plastics most commonly found in our environment
	9.	Lightweight yet strong structural materials for the 21st century: composite materials in architecture, automotive design, sports equipment, etc.
	10.	Environment in everyday life: air, water, soil: general exercises to reduce environmental pressures (recycled paper making new paper), household "hazardous waste"
	11.	
	12.	
	13.	

Required readings:	https://iupac.org/what-we-do/periodic-table-of-elements/ https://en.wikipedia.org/wiki/Motor_fuel and related pages https://en.wikipedia.org/wiki/Environmental_science
Recommended readings:	https://en.wikipedia.org/wiki/Pharmaceutical_industry https://wellnessatnih.ors.od.nih.gov/Nutrition/Pages/Nutrition-Basics.aspx and related pages
Evaluation method:	Completion of a 25-question test or giving your own presentation at the end of the semester

Course Description		
Course title:	Descriptive Geometry	
Neptun code:	GEAGT104-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	3p	
Name and position of lecturer:	József Túri, associate professor	
Contact of lecturer:	jozsef.turi@uni-miskolc,hu, room: 325 (A/4 building),	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	1/autumn	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	The main goal of the subject is constructive geometric sense, practical spatial perception and editorial work developing your skills. When choosing the study material, we include it in a system for the engineering practice basic geometric knowledge is essential, and the independent application by discussing the comprehensive principles we strive to develop the ability. The method of negotiation is adapted to construction subjects needs in order for the student to successfully recognize the geometrical content of the engineering tasks, successfully cope with the precise geometric formulation of the question and for a constructive solution come on.	
Course structure:	**Week**	**Topic**
	1.	Euclidean edits. axonometry, Monge projection. Representation of spatial elements.

	2.	Alignment and parallelism of space elements.
	3.	Punching a plane and a straight line, cutting two planes.
	4.	Introduction of a new image plane, target transformations.
	5.	Representation and thrusting of logs and gules with a straight line, its intersection with a plane.
	6.	Perpendicularity, plane parallel to image plane turning it into position. Distance, angle
	7.	Representation of a circle, properties of the ellipse image of the circle.
	8.	Representing a sphere, stabbing it with a straight line, intersection with a plane.
	9.	Representation and punching of a cylinder of rotation, a cone of rotation with a straight line. Intersection of a cylinder of revolution with a plane.
	10.	Plane sections of a cone of rotation. Cone slices.
	11.	Effect of rotation cone, rotation cylinder, sequencing, slicing.
	12.	Interaction of a cone of rotation with an intersecting axis and a cylinder for engineering tasks, auxiliary sphere method.
	13.	Interaction between cylinder and cylinder.
Required readings:	Kenson, Ervin (2009): Descriptive Geometry. University of Michigan Library Smith, William Grisworld (2023): Practical Descriptive Geometry. Legare Street Pr. Woolf, Solomon (2007): Elementary Course In Descriptive Geometry. Merchant Books	
Recommended readings:	Watts, Earle F. (2008): Desciptive Geometry. Watts Press	
Evaluation method:	Evaluation is done by written and oral assessment.	

Course Description	
Course title:	Mechanical Drawing-Machine Elements
Neptun code:	GEGET224B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2l + 2p
Name and position of lecturer:	Dr. Sarka Ferenc, associate professor
Contact of lecturer:	ferenc.sarka@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English

Suggested semester: autumn /spring, 1-6	2/spring	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is to introduce materials engineering students to the basic rules of mechanical drawing and the characteristics and operation of the most important machine components. Knowledge of mechanical drawing is essential for an engineer, because it is the basis of engineering communication. Those who complete the course will be able to communicate with others, even mechanical engineers, with technical drawings, and they will be able to perform simple sizing tasks.	
Course structure:	**Week**	**Topic**
	1.	Description of semester requirements. Apply drawing pages, text boxes, drawing types, projections, sections, cut-out. General description of drawing techniques. Preparation of the drawing sheet, entering and filling in the text field. Description of drawing tools. Basic editing techniques (parallel, perpendicular, etc.)
	2.	Construction of dimensions, specification of dimensional tolerances, positional tolerances, and surface qualities. Task 1: Drawing a simple part. Edited, pencil drawing on paper
	3.	Representation of bolted connections. Representation and specification of different joints. Submission of task 1
	4.	Specifying shafts, shaft-hub connections. Task 2: Representation of a screw connection. Component drawing of hexagon head screw, hexagonal nut, spring washer.
	5.	Representation of toothed machine elements. Gear, Sprocket. Task 2 - creating an assembly drawing
	6.	Properties of assembly drawings, applied markings, other accessories. Submission of task 2 - making an assembly drawing.
	7.	Design process and its steps. Basic concepts of sizing. Task 3: Making a drawing of the shaft end bearing unit
	8.	Shafts, shaft-hub connections, bearings. Task 3: Making a drawing of the shaft end bearing unit.
	9.	Bearings, bearing units, seals and gaskets. Task 3: Service life calculation of bearing.
	10.	Couplings, shafts. Task 4: Making a sleve clutch report.

	11.	Fasteners, toothed machine elements, gear drives. Sleve clutch editing, pencil drawing, on drawing sheet
	12.	Manufacturing processes of gear elements, special gears, failures. Sleve clutch editing, pencil drawing, on drawing sheet
	13.	Correcting and replacing faulty tasks.
Required readings:		•Stefano Tornincasa: Technical Drawing for Product Design, 2024, Springer, ISBN 978-3-031-51186-8. •Joseph E. Shigley - Charles R. Mischke – Richard G. Budynas: Mechanical Engineering Design. McGrawHill 2004, ISBN 007-252036-1
Recommended readings:		Bernard J. Hamrock – Bo Jacobson – Steven R. Schmid – Fundamentals of Machine Elements. McGraw-Hill, 1999, ISBN 0-25-19069-0
Evaluation method:		The subject is completed by teacher's signatute and taking an exam. In order to obtain a signature, the mid-year tasks must be submitted by the deadline, and must be prepared at least to a sufficient level (they must not contain calculation errors, free of drawing errors). You have to be there for 70% of the practical lessons and 60% of the lectures. Attendance is checked each time by the instructors. The written exam is mandatory. The exam is evaluated on a five grade scale. The oral part can be taken in case of a doubtful mark or at the request of the student, if the written part is at least of a sufficient level. The rounded value of the average of the grades received for the four mid-year tasks is counted in the exam grade with one third of the weight. The exam is passed if at least 50% of the obtainable points are obtained. Grades: average from 65%, good from 80%, excellent from 90%.

Course Description	
Course title:	Energy production and transformation
Neptun code:	MAKETT301B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2l
Name and position of lecturer:	Helga Kovacs, PhD, associate professor
Contact of lecturer:	helga.kovacs@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	2/spring
Number of credits:	2

Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is to introduce students to the concept of energy and its production possibilities. It provides a brief overview of energy carriers and, focusing on the main energy production and conversion technologies (combustion, gasification, pyrolysis), presents the processes, advantages, and disadvantages of each technology, taking into account environmental and economic aspects. The course primarily concentrates on technologies related to materials engineering. In addition to the currently used technologies, it also provides insight into the world of innovative methods.	
Course structure:	**Week**	**Topic**
	1.	Energy sources, statistics
	2.	Energy sources, statistics
	3.	Raction kinetics
	4.	Theory of combustion
	5.	Theory of combustion
	6.	Theory of combustion
	7.	Theory of gasification
	8.	Theory of pyrolysis
	9.	Electric systems and grids
	10.	Energy related calculations
	11.	Energy related calculations
	12.	Test, 1st appointment
	13.	Test, 2nd appointment
Required readings:	Energy from Waste, ISBN 978-0-08-101042-6, Combsution, ISBN 978-0-12-407913-7	
Recommended readings:	Waste-to-Energy, ISBN: 9780128160800	
Evaluation method:	Exam grading	

Course Description	
Course title:	Heat transfer calculations
Neptun code:	MAKETT121B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2p
Name and position of lecturer:	Dr. Kállay Andraás Arnold, senior researcher
Contact of lecturer:	andras.kallay@uni-miskolc.hu
Prerequisite course(s):	

Language of the course:	English	
Suggested semester: autumn /spring, 1-6	2/spring	
Number of credits:	2	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	In the lectures, students will learn about the theoretical description (differential equations) of heat conduction, convection and radiative heat transfer processes. In the practical exercises, they will learn about the methods of calculating these processes under time-steady and time-varying conditions, with special emphasis on modern computational solutions.	
Course structure:	**Week**	**Topic**
	1.	Description of requirements. Review of the semester's syllabus.
	2.	Mathematical foundations of transport equations
	3.	The heat flow transport equation
	4.	Stationary problems I.
	5.	Stationary problems II.
	6.	Transient problems
	7.	1st. midterm exam
	8.	Radiative heat transfer
	9.	Spectrum of radiation, radiometry
	10.	Radiative subfactors
	11.	Numerical methods
	12.	Coupled problems
	13.	2nd. midterm exam
Required readings:	Frank P. Incropera, David P. DeWitt: Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 2002. Franz Beneke, Bernhard Nacke, Herbert Pfeifer: Handbook of thermoprocessing technologies, Vulkan Verlag Gmbh, 2012.	
Recommended readings:	C. E. Baukal, Jr.: Heat Transfer in Industrial Combustion, CRC Press LLC, 2000Franz Beneke, Yeshvant V. Deshmukh: Industrial Heating: Principles, Techniques, Materials, Applications, and Design, CRC Press, 2005. Bird, R.B., Stewart, W.E. and Lightfoot, E.N.: Transport Phenomena, John Wiley & Sons, 2007	

Evaluation method:	Signature requirements during the semester: - min 70% of lectures and min. Active participation in 70% of the lectures and 70% of the practicals, - Successful completion (at least 50%) of 2 final exams, The course is completed by: signature + exam Evaluation: grading from 1 to 5.

Course Description		
Course title:	Investigation of Material Structure	
Neptun code:	MAKFKT101-22-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l + 2p	
Name and position of lecturer:	Dr. Márton Benke, professor	
Contact of lecturer:	marton.benke@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	2/spring	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is the education of fundamental examination methods and the theoretical basics and application fields of the most relevant micro-, macro- and crystal structure examination methods of solid materials.	
Course structure:	**Week**	**Topic**
	1.	Outline, objectice and equipment park of material structure examinations
	2.	Lightl microscopy I.
	3.	Light microscopy II.
	4.	Principles of X-ray diffraction
	5.	X-ray diffraction qualitative phase analysis
	6.	X-ray diffraction residual stress measurements
	7.	Scanning electron microscopy I.
	8.	Scanning electron microscopy II.
	9.	Transmission electron microscopy I.
	10.	Transmission electron microscopy II.
	11.	Cumpoted tomography

	12.	Midterm test
	13.	Consultation
Required readings:	A. D. Krawitz, Introduction to Diffraction in Materials Science and Engineering, Wiley & Sons, Hoboken, 2001.	
Recommended readings:		
Evaluation method:		

Course Description		
Course title:	CAD	
Neptun code:	MAKÖNT120B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	3p	
Name and position of lecturer:	Janos Erdelyi, Phd associate professor	
Contact of lecturer:	janos.erdelyi@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	3/autumn	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	Presentation of CAD technologies. Learning about three-dimensional parametric modeling. Three-dimensional parametric modeling is presented within the framework of the course. The students they gain insight into the application possibilities of a market-leading software. The body modeling function is detailed by presenting them, they acquire knowledge for creating the geometry of parts. The different material through addition and removal options, tailoring patterns, holes, ribs, chamfers, etc. geometric we present the preparation of features. Models created in the component module, 2D representation, technical preparation of documentation. Getting to know assemblies, simpler forcing methods, complex construction of virtual models	
Course structure:	**Week**	**Topic**
	1.	Familiarization with the use of a 3D CAD software (Solid Edge).
	2.	material addition commands (protrusion, revolved protrusion, helical protrusion, swept protrusion)

	3.	material removal commands (cutout, revolved cutout, helical cutout, swept cutout)
	4.	hole making command (threaded, tapered, countersunk)
	5.	Distribution (round and rectangular distributions)
	6.	roundings, chamfers, lateral bevels
	7.	mirroring, moving, copying (between bodies)
	8.	other operations
	9.	Assemblies (Assembly module)
	10.	Assemblies (Assembly module)
	11.	Different types of VEM analysis
	12.	Getting to know the Drawing/Draft module
	13.	Test (drawing)
Required readings:	1. Solid Edge tutorial module (electronic, part of the software) 2. Solid Edge online manual (electronic, software part)	
Recommended readings:	Siemens Solid Edge Youtube chanel	
Evaluation method:	Test (60% for succes)	

Course Description	
Course title:	Physical metallurgy
Neptun code:	MAKFKT225-22-B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	3l + 3p
Name and position of lecturer:	Prof. Dr. Valeria Mertinger
Contact of lecturer:	valeria.mertinger@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	3/autumn
Number of credits:	6
Requirements (exam/practical mark/signature/report, essay):	exam

Course objectives (50-100 words):	The aim of the subject is to provide a general and alloy-specific understanding of the metallurgical processes involved in the production of a metal component (crystallisation, heat treatment, deformation) and to apply these processes in a conscious manner. To learn about new developments and scientific results in the field of iron, aluminium, copper and the most important metal alloys. To provide theoretical and practical knowledge of the basic metallic disciplines.	
Course structure:	**Week**	**Topic**
	1.	Crystallization, solid state transformations
	2.	Equilibrium conditions of ferrous alloys. Binary ferrous alloys, Ternary alloys.
	3.	Equilibrium and non-equilibrium transformations, Transformation diagrams, factors influencing them.
	4.	Effect of heating below A1
	5.	Mechanical properties of steels (mechanical properties of materials). Mechanisms of plastic deformation. Contaminants in steels
	6.	Cast steel. Main alloy steel types,
	7.	Heat treatment of steels
	8.	Cast irons.
	9.	Summary of the mechanisms of strength increase, forming chemistry.Grain structure, solid solution hardening, precipitation hardening. Comparison of strain hardening in steel and aluminium alloys.
	10.	Aluminium alloys equilibrium diagrams, industrial Al alloys csop.
	11.	Light metals. Titanium and its alloys Beryllium, Magnesium
	12.	Copper alloys. Copper and its properties. Copper and its alloys. Equilibrium diagrams. Major alloys
	13.	Zn, tin, lead and precious metals
Required readings:	[1] H.K.D.H. Bhadeshia: Steels Microsructure and properties, Elsevier, 2006	
Recommended readings:	[1] Otsuka Shape Memory Materials, Cambridge University Press, 1998 [2] Krauss Principles of Heat treatment of Steel [3]Askeland: The science and engineering of materials, PWS Publishing Company, 1989 [4]W.D. Callister Materials science and engineering an introduction, John Wiley&Sons 2007 [5]Van Vlack: Materials for engineering, Addison Wesley Publishing Company, 1982 [6]Van Vlack: Elements of Materials Science and Engineering, Addison Wesley Publishing Company, 1982	

Evaluation method:	Mid-term examination and assessment: final examination. Practical reports and multiple-choice test after the practical. Semester mark: At least satisfactory final examination and completion of all exercises. The final examination may be substituted 1 time! One make-up is possible in the last week of the semester. In other words, more than 1 absence of practice will result in an automatic REFUSAL of the signature. A test will be uploaded via the university Moodle system after the exercises. After completing the internship, you will be asked to upload the documents proving the completion of the internship and to complete a multiple-choice test. Method of completion and assessment: oral examination, preceded by a minimum knowledge test in the form of a written test (pop-up). The oral test is taken during the pre-examination period. The mark will depend on the performance on the day.

Course Description		
Course title:	Theory of Ceramics	
Neptun code:	MAKKSZ218-22-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	3l + 3p	
Name and position of lecturer:	Kocserha István, associate professor	
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	3/autumn	
Number of credits:	6	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	Overview and brief history of traditional silicate-based and technical ceramics. Structure and properties of ceramic materials and their characterisation. Introduction to the raw materials and their characteristics of traditional and technical ceramics. Acquiring a basic knowledge of engineering of the ceramics used today and their related technologies, understanding the mechanisms of action of the factors influencing their physical, chemical and mechanical properties. Acquisition of testing and evaluation methods at BSc level.	
Course structure:	**Week**	**Topic**
	1.	Introduction, subject requirements. Concept of ceramics, applications of traditional and technical ceramics.

	2.	History of ceramic materials. Structural principles of ceramics.
	3.	Basic materials of traditional ceramic materials. Two and three component phase diagrams and their interpretation.
	4.	Properties of traditional and technical ceramic materials I.
	5.	Properties of traditional and technical ceramics II.
	6.	Shaping technologies of traditional and technical ceramics I.
	7.	Shaping technologies of traditional and technical ceramics II.
	8.	Production technology of traditional and technical ceramics I.
	9.	Production technology of traditional and technical ceramics II.
	10.	Heat treatment of ceramics.
	11.	Refractory ceramic materials.
	12.	Glasses and glazes. Production technologies.
	13.	Cement and concrete. Production technologies.
	14.	Brick and tile manufacturing technology.
Required readings:	M V Barsoum. Fundamentals of Ceramics, CRC Press, (2003)	
Recommended readings:	Philippe Boch, Jean-Claude Niepce: Ceramic Materials, Wiley-ISTE, (2006)	
Evaluation method:	Written and oral exam. Students will be given a series of tests on the topics of the lectures, which they must complete on paper. Time allowed: 2 hours. After correction of the written test, the student will receive a mark, which he/she may either accept or correct by oral examination. Written test, graded from 1 to 5 marks. Grading :<60%: unsatisfactory; 60-70%: satisfactory; 70-80%: average; 80-90%: good; >90%: excellent	

Course Description	
Course title:	Polymer study
Neptun code:	MAKPOL228-22-B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	3l + 3p
Name and position of lecturer:	Dr. Tamas J. Szabo, associate professor
Contact of lecturer:	tamas.szabo@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	3/autumn
Number of credits:	6

Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	Definition of the concept of polymers and plastics. Creation of polymer molecules. Characterization of polymers, molecular weight, polydispersity. Spatial structure, tacticity. Polymer molecular mobility, properties. Polymers, industries based on polymers. Production of macromolecules, polymerization, copolymerization, polyaddition, polycondensation. Plastics. The most important concepts, the components of plastics (polymers, plasticizers, fillers), plastic types. Mass plastics (PE, PP, PS, PVC), technical plastics (POM, PA, PES). Processing of plastic materials. Basic concepts of melt rheology, flow models, calendering, extrusion, injection molding, pressing, casting, special processes. Properties of plastics and investigation. Viscoelastic models, definitions, mechanical properties, modulus of elasticity, large deformations, tensile impact tests, orientation, creep, shrinkage, relaxation phenomena, models, time-temperature superposition, electrical properties, dielectric conduction, insulating capacity, dielectric strenght, melt rheology.	
Course structure:	**Week**	**Topic**
	1.	1. Chemistry quiz. Macromolecules characteristics. Concept definitions. History of polymer technology and polymer science.
	2.	2. Reactions leading to the formation of polymers. Polymerization, polycondensation, polyaddition. Main chain structure and properties relationship between (Heteroatoms, rings).
	3.	3. Molecular weight of the polymer. Interpretation of number and mass averages. Polydispersity. Isomerism in polymers.Tacticity. Cross-linked polymers.
	4.	4. Physical states of the polymer. The glass transition, the highly elastic state. Segment interpretation. Relaxation time. Viscoelastic models I.
	5.	5. The principle of time-temperature superposition. Polystyrene, PVC, PMMA, polyacrylonitrile.
	6.	6. Additive systems for plastics. Plasticizers, stabilizers, fillers.
	7.	7. Polymer analogue transformations. Copolymers types, their production. Structure property connections.

	8.	8. Polyolefins. Production, properties. THE crystallinity of polymers, crystallinity effect on properties.
	9.	9. Polycondensation plastics. Linear and cross-linked condensation products. Polyesters, polyamides, phenolic resins, aminoplasts.
	10.	10. Viscosity of polymer solutions. The relative- a the concept of specific and limiting viscosity, relationship between the molecular weight and the between viscosity.
	11.	11. Viscoelastic models II. Polymer basics of rheology of melts.
	12.	12. Mixing polymers, polymer blends. Lifetime of plastics. Recycling (recycling) issues
	13.	
Required readings:	1. Pukánszky Béla: Műanyagok BME Műanyag-és Gumiipari Tanszék, Budapest, 2003. 2. Rodriguez, F.: Principles of polymer sytems, McGraw-Hill, 1987	
Recommended readings:	1. Cvikovszky Tibor, Nagy P., Gaál J.: A polimertechnika alapjai, Műegyetemi Könyvkiadó, Budapest 2000. 2. Bodor Géza: A polimerek szerkezete, Műszaki Könyvkiadó, 1982. 3. Ritche,P.D.: Lágyítók, stabilizátorok, töltőanyagok, Műszaki Könyvkiadó, 1976. 4. Hedvig Péter: Elektromos vezetés és polarizáció műanyagokban, Akadémiai Kiadó, Budapest, 1969. 5. Hedvig Péter: Dielectric spectroscopy of polymers, Akadémiai Kiadó, Budapest, 1977	
Evaluation method:	Grading on a scale of 1-5, written exam with the possibility of oral correction	

Course Description	
Course title:	Furnances and Burners
Neptun code:	MAKETT302-22-B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2l + 2p

Name and position of lecturer:	Csaba Póliska PhD, associate professor	
Contact of lecturer:	csaba.poliska@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	3/autumn	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of teaching the subject is to learn the structure and operating conditions of modern silicate and ceramic, refractory and chemical industry furnaces and melting equipment.	
Course structure:	**Week**	**Topic**
	1.	Heat transfer of furnaces, types of furnaces.
	2.	Types and characteristics of chamber furnaces.
	3.	The structure, operation, refractory materials, firing and flow system of glass melting furnaces.
	4.	Structure, operation, firing, flow system, temperature distribution of pusher type and walking beam furnaces.
	5.	Structure, operation, firing, flow system, temperature distribution of carousel furnaces.
	6.	Structure, operation, firing, flow system, temperature distribution of tunnel kilns.
	7.	Structure, operation, firing and flow system of cement industry and waste incineration rotary kiln, temperature field of the equipment.
	8.	Structural design, operation, firing and flow system of shaft and double shaft furnaces, characteristic temperature distribution, feasible technologies.
	9.	Purpose and operation of tube furnaces.
	10.	Resistance heating and electric arc furnaces.
	11.	Energy balance and efficiency of furnaces.
	12.	Special furnaces
	13.	Written test

Required readings:	B. G. Miller, D. A. Tillman: Combustion Engineering Issues for solid Fuel Systems, Elsevier, 2008. P. Mullinger, B. Jenkins: Industrial and process furnaces, Elsevier Ltd. 2008. M. Lackner, F. Winter, A. K. Agarwal: Handbook of Combustion, 5 Volume Set, Wiley VCH Verlag GmbH, 2010.
Recommended readings:	M. Lackner, Á. B. Palotás, F. Winter: Combustion (From basics to applications), Wiley-VCH, Weinheim, 2013.
Evaluation method:	Written test, grade 1-5. Grading scale: >90 %: excellent, 80-89 %: good, 65-79 %: medium, 50-64 %: satisfactory, <50 %: unsatisfactory.

Course Description		
Course title:	Quality affair	
Neptun code:	MAKMKT214-17-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l	
Name and position of lecturer:	Eva Stumpf	
Contact of lecturer:	eva.stumpf@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	4/spring	
Number of credits:	2	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	Students get to know the theoretical background of quality (mainly quality management, quality assurance and quality control) and the most common quality tools in the production of raw materials and components. The aim of the course is for the students to recognize and understand the practical methods of quality when they enter the industry, thereby being able to effectively support the operation of quality systems and the production of consistent product quality.	
Course structure:	**Week**	**Topic**
	1.	Concept of quality. Structure of customer needs.
	2.	Historical development of quality matters, presentation of the branches of quality matters.
	3.	Basic principles of quality management. Use of quality management systems.

	4.	Identification and classification of company processes.
	5.	Measurement and monitoring of processes.
	6.	Quality management system documents. System certification principles.
	7.	Basic principles of quality control. Means of declaring customer requirements.
	8.	Machine drawing and standard theory.
	9.	Quality control design tools. Place of quality control in the product production process.
	10.	Test methods. Principles of selection of measuring and testing devices.
	11.	Principle and necessity of calibration and authentication. Quality certification practice. The essence of CE marking, prerequisites for logo usage rights.
	12.	Methods of artificial authentication of metal products. Legal institutions for standing up for quality
	13.	Importance of quality costs. classification and types of quality costs.
Required readings:	lesson notes MSZ EN ISO 9000:2015	
Recommended readings:	Decision 768/2008/EC of the European Parliament and the Council (July 9, 2008) on the marketing of products on the common framework of its adoption	
Evaluation method:	midterm test, written exam (1 - 5 grade scale)	

Course Description	
Course title:	Engineering Calculations
Neptun code:	MAKFKT105B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	1l + 2p
Name and position of lecturer:	Dr. Máté Szűcs
Contact of lecturer:	mate.szucs@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	4/spring
Number of credits:	3
Requirements (exam/practical mark/signature/report, essay):	practical mark

Course objectives (50-100 words):	General description and classification of computer algebra systems and teaching of a general-purpose computer algebra system (Maple) suitable for performing numerical and symbolic calculations related to engineering tasks. The student who has mastered the subject is able to solve equations and systems of equations symbolically and numerically, to apply integral and differential calculus, including differential equations. The student understands the basic questions of the mathematization of engineering problems, the need to analyze, check, and evaluate computer results.	
Course structure:	**Week**	**Topic**
	1.	Programming technical, mathematical, theoretical background
	2.	Programming technical, mathematical, theoretical background
	3.	Programming technical, mathematical, theoretical background
	4.	Programming technical, mathematical, theoretical background
	5.	Maple calculation exercises
	6.	Maple calculation exercises
	7.	Maple calculation exercises
	8.	Maple calculation exercises
	9.	Maple calculation exercises
	10.	Individual engineering-mathematical tasks presenting his background.
	11.	Individual consultation, special tasks programming
	12.	Individual consultation, special tasks programming
	13.	Individual consultation, special tasks programming
Required readings:	Gergó Lajos - Horváth András - Kallós Gábor - Molnárka Győző - Wettl Ferenc B.: A Maple V és alkal mazásai, Springer Hungarica Kiadó Kft., 1996;	
Recommended readings:	FRANK GARVAN : The MAPLE BOOK	
Evaluation method:	Completion of an individual simulation task until the (last) week before the end of the study period of the semester, the student's performance for the semester will be evaluated based on the completed task.	

Course Description		
Course title:	Powder technology	
Neptun code:	MAKKSZ219-22-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l + 1p	
Name and position of lecturer:	Kocserha István, associate professor	
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	4/spring	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	General properties of powders. Particle size, grain shape, surface "roughness", hardness, mechanical strength, micro- and macro-structure, porosity, moisture content. Different interpretations of grain diameter, determination and calculation of specific surface area and grain sizes. Preparation of powders: comminution and grinding. Theory and machinery of grinding and milling. Pulverized drying of powders. Separation of powders by particle size and composition; design and principle of operation of separation equipment. Transport and storage of powders. Separation and filtration of powders from air - process equipment. Equipment for mixing and homogenising powders.	
Course structure:	**Week**	**Topic**
	1.	Materials, types and characteristics of powders. The most typical operational steps of powder technologies. Morphology of powders - importance of grain shape, grain size and grain structure.
	2.	Theoretical principles of grinding and milling of materials. Evolution of grinding theories to the present day. Production of powders by comminution. Working principle and design of mechanical crushers.
	3.	Production of powders by grinding. Equipment for fine grinding - working principle and construction of mills.
	4.	Specific powder production processes. Technologies for the production of natural and synthetic ceramic powders. Spray drying.
	5.	Production of powders by spray drying, mechanical equipment for the technology.

	6.	Construction, characteristics and design aspects of powder storage silos. Silo filling and emptying procedures. Screw transport of powders.
	7.	Pneumatic transport of powders, types. Separation and classification of powders from air. Air separators.
	8.	Classification, separation of powders. Principle of operation of industrial flat sieves, drum sieves and wind classifiers; construction design.
	9.	Dosing of powders, principle of operation of vibrating, disc, cabinet, auger and cellular feeders; construction.
	10.	Separation of powders from air. Gravity separators. Determination of limiting particle diameter.
	11.	Separation of dusts from air. Operation of cyclones. Determination of boundary particle diameter.
	12.	Filtration of dusts from gases.
	13.	Filters, electrostatic precipitation.
	14.	Mixing and homogenisation of powders.
Required readings:	C.R.Woodcock, J.S.Mason: Bulk Solids Handling. Chapmanand Hall	
Recommended readings:		
Evaluation method:	Written and oral exam. Students will be given a series of tests on the topics of the lectures, which they must complete on paper. Time allowed: 2 hours. After correction of the written test, the student will receive a mark, which he/she may either accept or correct by oral examination. Written test, graded from 1 to 5 marks. Grading :<60%: unsatisfactory; 60-70%: satisfactory; 70-80%: average; 80-90%: good; >90%: excellent	

Course Description	
Course title:	Introduction to electronics
Neptun code:	MAKKSZ241B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2l + 2p
Name and position of lecturer:	Kocserha István, associate professor
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	5/autumn

Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	Within the framework of the course, students will get acquainted with the basics and basic phenomena of electrical engineering. In exercises following the lectures, students will acquire basic knowledge and measurement skills through the assembly, calculation and measurement of simple circuits.	
Course structure:	**Week**	**Topic**
	1.	Introduction. Structure of the electricity network in Hungary. Direct current networks. Voltage, current, Ohm's law. Elements of electrical networks.
	2.	Common active and passive networks. Network laws. Network calculation theorems.
	3.	Basics of measurement. Wheastone bridge operation.
	4.	Types and operation of sensors used in metrology.
	5.	Alternating current networks. Sinusoidal voltage generation and sinusoidal networks.
	6.	Alternating current networks. RLC circuits.
	7.	Three phase systems. Star and delta circuits. Capacities.
	8.	Transformers. Construction working principle. Substitution switching.
	9.	Transformers. Three-phase transformers. Special transformers.
	10.	Construction and working principle of electrical machines.
	11.	Asynchronous motors. Construction, working principle, circuit model. Load conditions. Power relations
	12.	Asynchronous motors. Torque slip characteristic curve. Starting, braking, reversing. Speed variation
	13.	Synchronous generators. Construction, operating principle, circuit model.
	14.	DC machines. Construction, operating principle, circuit model. Excitation modes, motor and generator operation. Model curves
Required readings:	1. Published presentation materials in pdf format 2. Uray-Szabó: Electrotechnics textbook, Technical Publisher, Budapest, 1994	
Recommended readings:	Electrical engineering guides on the web.	

Evaluation method:	Condition of signature: Passing 2 tests at a satisfactory level (satisfactory level: 50%), Attendance of at least 50% of the lectures and at least 100% of the practical course. Written and oral exam. Candidates will be given 20 items from a pre-assigned list of 200 minimum questions, which they must complete on paper. Time allowed: 40 minutes. To obtain a pass mark, the candidate must answer at least 12 questions (60%) correctly. To achieve a better mark (3, 4, 5), the exam must be continued with oral questions and answers.

Course Description		
Course title:	Special Materials	
Neptun code:	MAKFKT104B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l	
Name and position of lecturer:	Mende Tamás, associate professor	
Contact of lecturer:	tamas.mende@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	5/autumn	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	report	
Course objectives (50-100 words):	During lectures presented by invited speakers, the students get to know a wide variety of special materials, which are as follows: metal matrix composites, block nanostructured materials, amorphous materials, eutectics, special steels and shape memory alloys, historical metals and technology, special composites, materials for electric transmission lines, high-entropy alloys , welding technology materials.	
Course structure:	**Week**	**Topic**
	1.	Introduction
	2.	Historical metals and their technologies
	3.	Special steels and shape memory alloys
	4.	Materials containing eutectic
	5.	Special materials and their production
	6.	Amorphous materials
	7.	Metal matrix composites
	8.	Materials of electric transmission lines

	9.	Study break
	10.	Materials used in space
	11.	Presentations
	12.	Compensation for missed hours
	13.	
Required readings:	Metals Handbook, Vol 20, Materials Selection and Design,1997 W.D. Callister Materials Science and Engineering an Introduction, John Wiley&Sons 2007	
Recommended readings:	-	
Evaluation method:	Making ppt presentation	

Course Description		
Course title:	Additive technologies	
Neptun code:	MAKÖNT126-22-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l + 2p	
Name and position of lecturer:	Laszló Varga, Phd, Associate Professor	
Contact of lecturer:	laszlo.varga1@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	5/autumn	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	AM technology allows the designer to work with only a small number of restrictions, thereby having the freedom to place the chosen according to the function of the design materials in space, exactly where needed. This significantly reduces the material used quantity, reduces the weight, so in combination with the digitally available design units, it is perfect can provide topological optimization to the manufactured product. The procedure essentially provides complete freedom for the designer, thus the geometry to be manufactured its complexity does not mean additional costs when using AM technology, as it is not required to make / put into operation additional tools. No need to recalibrate the tools, that is for further training of operators, and there is no significant additional time requirement either.	
Course structure:	**Week**	**Topic**

	1.	History of the development of AM technologies.
	2.	Presentation of the advantages of using AM technologies, areas of application.
	3.	General production process of AM technologies, additional processes.
	4.	Grouping of AM technologies: material extrusion, directed energy deposition (DED), material jetting, binder jetting, sheet lamination (LOM, UAM),
	5.	Vat polymerisation, Powder bed fusion (PBF).
	6.	Presentation of the metallic additive technologies used today: Nanoparticle jetting, Binder jetting, DMLS (direct metal laser sintering),
	7.	DMLM (direct metal laser melting), SLM (selective laser melting),
	8.	SLS (selective laser sintering), EBM (electron beam melting),
	9.	LENS (laser engineering net shape), EBAM (electron beam additive manufacturing).
	10.	Aspects of the choice of additive technologies.
	11.	Application case studies for different AM technologies.
	12.	Development guidelines, business benefits
	13.	Test
Required readings:		Roche Industry – The Ultimate Guide: Everything need to know about 3D printing services https://www.rocheindustry.com/3d-printing-ultimate-guide
Recommended readings:		Additive Manufacturing Technologies: Current Status and Future Perspectives Amirah Alammar DDS, John C. Kois DMD, MSD, Marta Revilla-León DDS, MSD, PhD, Wael Att DDS, Dr Med Dent, PhD, 21 March 2022, https://doi.org/10.1111/jopr.13477
Evaluation method:		semester technology complex task, test

Course Description	
Course title:	Waste utilization
Neptun code:	MAKETT304-22-B
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	1l + 2p
Name and position of lecturer:	Dr. Gábor Nagy
Contact of lecturer:	gabor.nagy2@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English

Suggested semester: autumn /spring, 1-6	5/autumn	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	Within the framework of the subject, students will learn about the types of waste and their sources of generation. In addition to these, the utilization or disposal options of waste are also presented.	
Course structure:	**Week**	**Topic**
	1.	Overview of basic concepts related to waste and the relevant legal regulations
	2.	Wood waste
	3.	Paper waste
	4.	Food waste and other biodegradable wastes
	5.	Metal waste
	6.	Glass waste
	7.	Construction and demolition waste
	8.	Battery waste
	9.	Electronic waste
	10.	End-of-life vehicles
	11.	Waste tires
	12.	Other industrial wastes
	13.	Test
Required readings:	Letcher, Trevor M.; Vallero, Daniel A.: Waste : a handbook for management. Academic Press, 2011. Information Reso Management Association: Waste Management: Concepts, Methodologies, Tools, and Applications, 3 volume. Engineering Science Reference, 2019.	
Recommended readings:	Stefan Scheuer: EU Environmental Policy Handbook. Commission Communication, Brussels, 2005. Vera Weghmann: Waste Management in Europa. EPSU, 2023.	
Evaluation method:	Test results	

Course Description	
Course title:	Management and Business studies
Neptun code:	MAKMKT215VB
Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2l
Name and position of lecturer:	Prof. Dr. Csaba Deák, University Professor

Contact of lecturer:	csaba.deak@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	6/spring	
Number of credits:	2	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is to acquire the fundamentals of business and management knowledge. Students will become familiar with the tools of entrepreneurship development methodology, which contribute to the correct interpretation of the operational foundations of enterprises. Examples from domestic and international corporate cases are also covered.	
Course structure:	**Week**	**Topic**
	1.	Introduction / Discussion of tasks
	2.	Leadership 1: The leader's personality
	3.	Leadership 2: Team development, Difficult conversations
	4.	The driving force of innovation: Basics, Types, Strategy
	5.	Leadership 3: How to motivate your team? Praise and criticism
	6.	Starting a business 1: Idea search, Creative techniques, Idea generation
	7.	Successful entrepreneur guest lecture
	8.	Business Model Canvas (Student presentations)
	9.	Starting a business 2: Project implementation, Mini Business Case task
	10.	Starting a business 3: Product and service development, Process development, Business model development
	11.	Business plan
	12.	Assessment: Presentations
	13.	Closing Remarks and Final Discussion
Required readings:	"Entrepreneurship: Theory, Process, and Practice" by Donald F. Kuratko ISBN: 978-1305576247	
Recommended readings:	"Leadership: Theory and Practice" by Peter G. Northouse ISBN: 978-1506362311	

Evaluation method:	Evaluation method: Mid-term assessment: Written test and group assignment (uploaded to Microsoft Teams). Components: Leadership e-learning (1+4 modules: 20%), Business Model Canvas and presentation (in pairs: 25%), Mini Business Case task (25%), Theory (final assessment in class: 30%), Active participation (10%).

Course Description		
Course title:	Environmental Protection	
Neptun code:	MAKETT124B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l	
Name and position of lecturer:	Dr. Gábor Nagy	
Contact of lecturer:	gabor.nagy2@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	6/spring	
Number of credits:	2	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is for students to acquire comprehensive knowledge about environmental protection. This includes the cycles of environmental elements and the effects of industrial activities affecting them. Furthermore, within the framework of the subject, students will learn about the basic means of protecting air, water and soil.	
Course structure:	**Week**	**Topic**
	1.	Basic concepts, legislation
	2.	Environmental cycles
	3.	Air pollution (characterization of pollutants, sources, air quality, solutions to reduce air pollutants)
	4.	
	5.	
	6.	
	7.	Water pollution (surface and groundwater pollutants, water quality characterization, pollution sources, wastewater treatment)
	8.	
	9.	Soil pollution (soil pollution types, remediation)
	10.	
	11.	Generation, utilization and disposal of waste

	12.	Generation, utilization and disposal of waste
	13.	Test
Required readings:	Anndrew Farmer: Handbook of Environmental Protection and Enforcement, Earthscan, 2007. Sven Erik Jørgensen: Principles of pollution abatement: pollution abatement for the 21st century. Elsevier, New York, 2000.	
Recommended readings:	Stefan Scheuer: EU Environmental Policy Handbook. Commission Communication, Brussels, 2005. Trust for Public Land and American Water Works Association: Source Protection Handbook. 2021.	
Evaluation method:	Written exam	

Course Description		
Course title:	Metallic materials	
Neptun code:	MAKFKT128-22-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l +2p	
Name and position of lecturer:	Prof. Dr. Valeria Mertinger	
Contact of lecturer:	valeria.mertinger@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	6/spring	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The course synthesizes the knowledge acquired in the heat treatment specialization and introduces students to metallic structural materials and the solution of metallurgical problems arising in their application through many practical examples. It specifically develops problem-solving skills.	
Course structure:	**Week**	**Topic**
	1.	Introduction, Technology. the triple role of structure and property with examples.
	2.	Crystallisation, crystallisation-related technologies and related structural and metallurgical problems.
	3.	An overview of the structural changes associated with ductile formation and related metallurgical problems.

	4.	Solid solution, solid solution + second phase type structures, their formation and properties.
	5.	Ferroalloys - Non-ferrous metal grades. Solid solution ferrous alloys- Cold suction steels, Materials with guaranteed expansion properties, Soft magnetic materials, Corrosion resistant steels, Heat resistant steels
	6.	Non-alloy ferrous alloys with ferrite+ carbide fabric structure.
	7.	Iron alloys with solid solution + carbide fabric structure: stainless, spring, hardenable from inserts, ball bearings, tool steels
	8.	Ferrous alloys with solid solution + carbide + other phase fabric structure: automatic steels, cast irons
	9.	Light metals, Al, Mg, Be alloys. Ti alloys, Low melting point alloys
	10.	Copper and its alloys.
	11.	Special alloys I: Superalloys, Shape memory alloys. Special alloys II: Amorphous materials,
	12.	Case studies. individual presentations
	13.	
Required readings:	ASM Spec,. Handbook, Aluminium and Aluminium Alloys, ASM International 1996[1] Otsuka Shape Memory Materials, Cambridge University Press, 1998 Krauss Principles of Heat treatment of Steel Askeland: The science and engineering of materials, PWS Publishing Company, 1989 W.D. Callister Materials science and engineering an introduction, John Wiley&Sons 2007 Van Vlack: Materials for engineering, Addison Wesley Publishing Company, 1982 Van Vlack: Elements of Materials Science and Engineering, Addison Wesley Publishing Company, 1982	
Recommended readings:	Wiedemann: Structural materials, Open University, 1990 Van Vlack: Materials for engineering, Addison Wesley Publishing Company, 1982 C.R. Brooks: Heat treatment, structure and properties of nonferrous alloys, American Society forMetals J. G. Kaufman, E.L.Rooy: Aluminium Alloys casting, ASM International 2005 ASM Spec,. Handbook, Coper and copper Alloys, ASM International 2001 ASM Spec. Handbook: Cast Irons, ASM International W. Callister: Materials science and engineering an introduction, John Wiley & Sons, Inc., USA,2007	

Evaluation method:	Mid-term assessment and evaluation: to check the follow-up of the lectures, you will be given an individual assignment after each lecture, which must be answered in writing by the time of the next lecture. A maximum of 1 mark will be awarded for each answer. A total of 6 points is required by the end of the semester. If you do not have 6 points by the end of the semester, you will have to solve a number of problems equal to three times the number of missing answers. The oral examination may be taken during the pre-examination period. The value of the mark depends on the performance on the day.

Course Description		
Course title:	Automatization	
Neptun code:	MAKÖNT121-22-B	
Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	1l + 2p	
Name and position of lecturer:	Janos Erdelyi, Phd associate professor	
Contact of lecturer:	janos.erdelyi@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	6/spring	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	The task of the Foundry Automation Knowledge course is to familiarize students with the basic concepts of automation technology and to demonstrate their application through foundry examples. The structure and principle of control and regulation, showing their operation through practical examples. Comparison of control and regulation. Construction of pneumatic systems, practical examples. Construction of hydraulic systems, practical examples. The basic structure of the PLC, practical examples. Basics of measurement technology, sensors, measurement practices. The aim of the training is for the materials engineering students to learn about the automation solutions used in casting technologies. They should be able to recognize the given elements and systems in the given place, as well as be able to plan automation processes and diagnose errors.	
Course structure:	**Week**	**Topic**
	1.	Basic concepts and scope of automation. The control and controlled system.

	2.	Effect, effect chain, signal carriers, signs. Grouping and types of signs. Concepts related to impact design.
	3.	Block diagram, elements and operation of the control. Practical examples of casting controls.
	4.	Block diagram, elements and operation of the regulation. Practical examples of casting regulations.
	5.	Comparison of control and regulation, significant differences and similarities. Practical examples.
	6.	Division of automation. Division of regulation, regulatory bodies, regulations.
	7.	Sensors. Perception and measurement of physical characteristics, types, practical examples.
	8.	Structure, elements and operation of pneumatic systems. Standard symbols, circuit diagrams.
	9.	Structure, elements and operation of hydraulic systems. Standard symbols, circuit diagrams.
	10.	PLC structure, operation, types. Programming options, programming, practical examples
	11.	Basics of measurement technology, measurement amplifiers, measurement technology practice.
	12.	Test
	13.	
Required readings:		
Recommended readings:		Richard L. Shell - Ernest L. Hall: Handbook of Industrial Automation, Marcel Dekker, 2000. Srinivas Medida: Pocket Guide on Industrial Automation For Engineers, IDC Technologies, 2007. (https://www.pacontrol.com/download/Industrial-Automation-Pocket-Guide.pdf
Evaluation method:		test (evaluation on a five-point scale: 1-5) the subject can be signed by the student who completes the test at a level of (2) completed, and was absent from the course lessons a maximum of two times.

Course Description	
Course title:	Engineering communication
Neptun code:	MAKMET124B

Type (core, specialization, optional, dissertation, other):	core
Lecture/ Seminar (practical); hours per week:	2l + 2p
Name and position of lecturer:	Dr. Béla TÖRÖK, associate professor
Contact of lecturer:	bela.torok@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	7/autumn
Number of credits:	2
Requirements (exam/practical mark/signature/report, essay):	practical mark
Course objectives (50-100 words):	The basic task of the course is to develop students' communication skills and to familiarise them with the functions and forms of communication used in engineering and business practice. The course will provide a complex knowledge of general and specific (engineering and business) communication requirements, characteristics and functions in a generalised formulation and through the presentation of model examples. The course aims to equip students not only with professional knowledge, but also with the ability to express, convey and apply it in appropriate situations. Be aware of the basic ethical, strategic and communicative situations, verbal and visual expectations of business, the basic rules of business and workplace protocol and the specific rules of engineering culture. They should be able to use communication tools effectively, to express themselves in motivational situations, conflict management or advocacy situations.

Course structure:	**Week**	**Topic**
	1.	Concept, functions, types and general model of communication. Processes, dynamics and channels of direct human communication.
	2.	Organisational communication. Types and basic rules of oral and written business communication.
	3.	Prescriptive functions of engineering communication: product and process documentation, product design, technical specifications, process specifications, instructions for use, etc.
	4.	Mediating and fact-finding functions of engineering communication: discussion, conducting meetings, minutes. Archiving aspects. Written communication: business letter, e-mail, request, order, contract.
	5.	Basic situations in business communication. Negotiation strategies and tactics. Proposals, argumentation, persuasion, resistance management. Communication with partners, clients, customers, customers, official organisations.

	6.	Concepts and principles of business ethics. Ethics and protocol in domestic and international business. Effects of behavioural culture, appearance and non-verbal communication.
	7.	Basic and specific aspects of verbal communication. Characteristics and styles of speech. Questioning techniques, active listening, accurate understanding. Appropriate and topical expression, vocabulary, intelligibility.
	8.	Basic concepts of visual communication. Visual language in reception and creation.
	9.	Aspects of making and presenting a professional presentation. Presentation techniques. Preparing professional and scientific communications and publications.
	10.	Personality traits and basic leadership theories. The role of communication in motivation. Conflict management and conflict management.
	11.	Communication at the university. Key learning competences and their development with a focus on communication in the university's master's and doctoral programmes.
	12.	Writing a multiple-choice test .
	13.	Presentation of the homework assignments (PPT for a case study).
Required readings:	David Ingre, Robert Basil: Engineering Communication: A Practical Guide to Workplace Communications for Engineers. Cengage Learning, 2016. ISBN 978-1-305-63510-4 Robert Irish, Peter Weiss: Engineering Communication: From Principles to Practice. Oxford University Press, 2013. ISBN 978-0-195-44692-0	
Recommended readings:	Charles W. Knisely, Karin I. Knisely: Engineering Communication. Cengage Learning, 2015, ISBN 978-1-133-11470-3 Heather Silyn-Roberts: Professional Communications: A Handbook for Civil Engineers. American Society of Civil Engineers, 2004. ISBN 978-0-784-40732-5	
Evaluation method:	Writing a multiple-choice test: 20 questions - 1 point/good answer + presentation of the homework assignment: 20 points = 40 points. Excellent: 35-40, Good: 30-34, Average: 25-29, Satisfactory: 21-24, Failed: 0-20.	

Course Description	
Course title:	Conformity of Measurements
Neptun code:	MAKFKT112-22-B

Type (core, specialization, optional, dissertation, other):	core	
Lecture/ Seminar (practical); hours per week:	2l + 3p	
Name and position of lecturer:	Dr. Mikó Tamás, senior research fellow	
Contact of lecturer:	tamas.miko@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	7/autumn	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	The main goal of the course is for students to become familiar with the uncertainty of basic measurements related to material testing. In the world of material science and engineering, the correct planning and execution of the measurements, as well as the processing and evaluation of the data obtained as a result, and finally the communication protocol, are of particular importance. The purpose of the "Conformity of measurements" subject is a thorough overview of the steps of this process, during which students develop the practical application of various material testing methods and expand their measurement knowledge.	
Course structure:	**Week**	**Topic**
	1.	Development and use of units of measure other than SI and Si.
	2.	Method of determining and communicating measurement results (mean, standard deviation, median, mode, variance, normal distribution, measurement uncertainty).
	3.	Content and form requirements of measurement reports.
	4.	Calibration and use of the most important engineering tools for length measurement (caliper, micrometer).
	5.	Calibration and use of analytical balances.
	6.	Density measurement using the geometric and Archimedes method.
	7.	Standard hardness measurement, calibration of hardness tester.
	8.	Presentation and calibration of the fine strain measuring devices of a tearing machine.
	9.	Carrying out a standard tensile test, evaluating tensile curves (methods of determining yield strength, Young's modulus).
	10.	Temperature measurement using different methods, making and calibrating thermocouples.

	11.	Determination of thermal expansion coefficients of metals using dilatometer measurements.
	12.	Measuring the electrical resistance of different metals.
	13.	substitution of practices
Required readings:		H. T. Castrup; W. G. Eicke; J. L. Hayes; A. Mark; R. E, Martin: J. L. Taylor Metrology —Calibration and Measurement Processes Guidelines, Jet Propulsion Laboratory California Institute of Technology, Pasadena, California 1994 Forbes, A.B.: Measurement uncertainty and optimized conformance assessment. Measurement 39. 2006.
Recommended readings:		
Evaluation method:		exam

Course Description		
Course title:		Energy storage
Neptun code:		MAKETT293B
Type (core, specialization, optional, dissertation, other):		core
Lecture/ Seminar (practical); hours per week:		2l
Name and position of lecturer:		Dr. Zsolt Dobó, senior research fellow
Contact of lecturer:		zsolt.dobo@uni-miskolc.hu
Prerequisite course(s):		
Language of the course:		English
Suggested semester: autumn /spring, 1-6		7/autumn
Number of credits:		2
Requirements (exam/practical mark/signature/report, essay):		exam
Course objectives (50-100 words):		The course intends to give an overview of various energy storage methods focusing on the theoretical background, storage properties and characteristics, implementation of different energy storages into systems, and practical considerations. Examples of the most up-to-date storage solutions are included along with possible and promising directions.
Course structure:	**Week**	**Topic**
	1.	Introduction, classification, energy conversion, semester overview.
	2.	Batteries - Lithium ion batteries I. Introduction, working principle, characteristics, materials, cell setup.

	3.	Batteries - Lithium ion batteries II. BMS, interconnection, implementation, recycling, research trends.
	4.	Batteries - Other batteries. Overview of lead acid batteries, vanadium redox flow batteries, NaS batteries.
	5.	Capacitors - Theoretical background, setup, properties, utilization. Introduction of supercapacitors.
	6.	Pump hydro - Overview of pump hydro energy storage as the largest installed capacity energy storage solution worldwide.
	7.	Chemical energy storage I. - Hydrogen production methods, focus on green hydrogen, electrolysis, hydrogen properties and characteristics. Power-to-gas and power-to-liquid, power-to-X concepts.
	8.	Chemical energy storage II. - Conversion of hydrogen into various feedstocks.
	9.	Thermal energy storage - Sensible, latent, thermo-chemical. Heat exchangers. Phase-change materials.
	10.	Other energy storage methods.
	11.	Summary, comparison, integration, development.
	12.	Test
	13.	Retake test
Required readings:	Michael Sterner, Ingo Stadler: Handbook of Energy Storage: Demand, Technologies, Integration. Springer, 2019. ISBN 978-3-662-55503-3.	
Recommended readings:	Armin U. Schmiegel: Energystorage systems. Oxford University Press, 2023, ISBN 978–0–19–285800–9.	
Evaluation method:	Signiture upon successful test. Exam.	

Course Description	
Course title:	Energy sources
Neptun code:	MAKETT101-22-B
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)
Lecture/ Seminar (practical); hours per week:	2l +2p
Name and position of lecturer:	Csaba Póliska PhD, associate professor
Contact of lecturer:	csaba.poliska@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	4/spring

Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	EXAM	
Course objectives (50-100 words):	The purpose of teaching the subject is to introduce the students to the world's energy production possibilities based on fossil and renewable energy sources, the main characteristics of their use and their expected future development, the methods of production, transportation, transformation and storage of energy sources.	
Course structure:	**Week**	**Topic**
	1.	Energy sources, energy demand, basic concepts.
	2.	The source, extraction and use of coal for the production of heat and electricity.
	3.	The source, extraction and use of crude oil for the production of heat and electricity.
	4.	The source, extraction and use of natural gas for the production of heat and electricity.
	5.	Nuclear energy production.
	6.	Written test
	7.	Use of solar energy for heat and electricity production.
	8.	Source and use of wind energy.
	9.	Source and use of hydropower.
	10.	Source and use of geothermal energy.
	11.	Energy trends in the world.
	12.	Presentation of a complex task.
	13.	Written test
Required readings:	Bent Sorensen: Renewable Energy, 3rd edition, Elsevier Inc., 2004. T. K. Ghosh, M. A. Prelas: Energy Resources and Systems Volume 2: Renewable Resources, Springer Science+Business Media B.V. 2011 R. L. Evans: Fueling Our Future, An Introduction to Sustainable Energy, Cambridge University Press, 2007.	
Recommended readings:	Ralph E.H. Sims (New Zealand), Robert N. Schock (USA): Energy Supply, http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter4.pdf K. W. Ragland, K. M. Bryden: Combustion Engineering, CRC PressTaylor & Francis Group, 2011.	
Evaluation method:	Written test, grade 1-5. Grading scale: >90 %: excellent, 80-89 %: good, 65-79 %: medium, 50-64 %: satisfactory, <50 %: unsatisfactory.	

Course Description		
Course title:	Energetic calculations	
Neptun code:	MAKETT125B	
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)	
Lecture/ Seminar (practical); hours per week:	3P	
Name and position of lecturer:	Helga Kovacs, PhD, associate professor	
Contact of lecturer:	helga.kovacs@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	4/spring	
Number of credits:	3	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	The aim of the course is for students to independently perform basic calculations related to energy production, building on the theoretical knowledge they have already acquired. During laboratory exercises, students are expected to prepare reports.	
Course structure:	**Week**	**Topic**
	1.	Basics for energy prodution related calculations
	2.	Calculation, practical class
	3.	Calculation, practical class
	4.	Calculation, practical class
	5.	Calculation, practical class
	6.	Laboratory practice for energetic measurements
	7.	Laboratory practice for energetic measurements
	8.	Laboratory practice for energetic measurements
	9.	Laboratory practice for energetic measurements
	10.	Preparetion of assignments
	11.	Preparetion of assignments
	12.	Preparetion of assignments
	13.	Laboratory practice for energetic measurements - extra appointment
Required readings:	Combsution, ISBN 978-0-12-407913-7, Simple Solutions to Energy Calculations, Fifth Edition - ISBN 978-1-48-2217810	
Recommended readings:		
Evaluation method:	Practical grading	

Course Description	
Course title:	Industrial Polymerization Technologies
Neptun code:	MAKPOL101-22-B
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)
Lecture/ Seminar (practical); hours per week:	2l + 2p
Name and position of lecturer:	Dr. Tamas J. Szabo, associate professor
Contact of lecturer:	tamas.szabo@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	4/spring
Number of credits:	4
Requirements (exam/practical mark/signature/report, essay):	practical mark
Course objectives (50-100 words):	Getting to know the production of polymers at an industrial-technological level. Technology of the production of polymers problems: purity, energy, thermal issues, the reduction of monomers, raw

Course structure:	**Week**	**Topic**
	1.	1. Natural and naturally based plastics. The production of polymers ways. (Repeat.) The most important thing raw material bases.
	2.	2. Production of olefins. The polyolefins history of its production. Low density polyethylene, radical polymerization. The ionic polymerization of olefins. The structure regulation.
	3.	3. Olefin-based monomers. Vinyl monomers production. Epoxy ring monomers and polymers. The production technology of PVC and questions.
	4.	4. Styrene monomer and different styrene production of polymers. The foamable polystyrene.
	5.	5. Six-carbon starting materials. Adipic acid, hexamethylenediamine. Condensation polyamides. Special polyamides.
	6.	6. Production of caprolactam and lacdid, ring-opening polymerization. Polyamide 6, polylactic acid
	7.	7. Production of isocyanates, polyurethanes. Thermoplastic and cross-linked PUR systems. Polyurethane foams.
	8.	8. Polycondensation processes. PET, polycarbonates. "Exotic" technologies, polysulfide rubber, polyphenylene sulfide
	9.	9. Polycondensation procedures. Phenolic resins, aminoplasts. Thermoset resins further processing.

	10.	10. Natural based polymers. The main thing technical produced by polymer-analog reaction polymers.
	11.	11. Synthetic rubber manufacturing processes. Epoxy production of resins, polyester resins.
	12.	12. Report, presentation of the mid-year thesis and its protection
	13.	
Required readings:		1. Borda Jenő: Műanyagok gyártása és feldolgozása: (egyetemi jegyzet) Debrecen: Kossuth Lajos Tudományegyetem Alkalmazott Kémiai Tanszék, 1994 2. Borda Jenő: Műanyagok gyártása és feldolgozása Debrecen: Kossuth Egyetemi Kiadó, 2001 3. Fred W. Billmeyer, Jr.: Textbook of Polymer Science (John Wiley and Sons Inc.) 1984.
Recommended readings:		1. George Odean: Principles of Polymerization, Wiley-Interscience 2004
Evaluation method:		Presentation evaluation. After the presentation, the examiner and the audience ask the student questions to check your readiness. Five-level rating.

Course Description	
Course title:	Glass Technology
Neptun code:	MAKKSZ106-22-B
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)
Lecture/ Seminar (practical); hours per week:	3l + 1p
Name and position of lecturer:	Róbert Géber, associate professor
Contact of lecturer:	robert.geber@uni-miskolc.hu
Prerequisite course(s):	MAKKSZ218-22-B Theory of ceramics
Language of the course:	English
Suggested semester: autumn /spring, 1-6	4/spring
Number of credits:	4
Requirements (exam/practical mark/signature/report, essay):	exam

Course objectives (50-100 words):	Introduction to the raw materials used in the glass industry. A detailed overview of the different glass manufacturing technologies. Full and complete presentation of the technological equipment to the students.	
Course structure:	**Week**	**Topic**
	1.	Introduction - History and applications of glass. General description of glass, its structure, types of glass (1,2,3,4-part glass)
	2.	Properties of glass I. (mechanical, thermal, acoustic, photometric, electrical)
	3.	Properties of glass II. ((resistance to acid, resistance to alkali, effects of gases on glass)
	4.	A general introduction to glass production. Raw materials, additives, mixtures.
	5.	Melting of glass - phenomena and transformations during glass melting processes. Crystallisation of glass.
	6.	Melting techniques - furnaces
	7.	Written test #1
	8.	Shaping of glass - flat glass manufacturing processes.
	9.	Shaping of glass - bottle glass manufacturing processes and technologies.
	10.	Other glass manufacturing technologies (tubes, glass wool, glass fibre...)
	11.	The refinement of glass. Stresses in glass. Stress generation, analysis and reduction.
	12.	Types of glass defects, causes of their occurrence, types of their occurrence, reduction methods.
	13.	Written test #2
Required readings:	https://op.europa.eu/hu/publication-detail/-/publication/ff8a3955-d0d0-46f5-8a15-4b638896cb56 J. E. Shelby: Introduction to Glass Science and Technology, The Royal Society of Chemistry, 2005	
Recommended readings:	Eric Le Bourhis: Glass Mechanics and Technology, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2008 Properties of Glass-Forming Melts, Edited by L. David Pye, Angelo Montenero, Innocent Joseph, CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 33487-2742, 2005	

Evaluation method:	Written and oral exam. Students will be given a series of tests on the topics of the lectures, which they must complete on paper. Time allowed: 2 hours. After correction of the written test, the student will receive a mark, which he/she may either accept or correct by oral examination. Written test, graded from 1 to 5 marks. Grading :<60%: unsatisfactory; 60-70%: satisfactory; 70-80%: average; 80-90%: good; >90%: excellent

Course Description		
Course title:	Elastomers	
Neptun code:	MAKPOL105-22-B	
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)	
Lecture/ Seminar (practical); hours per week:	2l + 2p	
Name and position of lecturer:	Dr Mariann Szabóné Kollár , associate professor	
Contact of lecturer:	mariann.kollar@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	5/autumn	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	This course imparts basic knowledge about elastomer (and other crosslinked materials) material making and their use. Influences are pointed out which can be decisive for the function of the components in practical use. An introduction to the most important test methods followed by a laboratory tour concludes the seminar.	
Course structure:	**Week**	**Topic**
	1.	Introduction, Description of requirements
	2.	The history of rubber, the history of rubber processing, pneumatic tyre history
	3.	Rubber as a structural material
	4.	Natural rubber
	5.	Artificial rubbers
	6.	Additives I.
	7.	Additives II.
	8.	Rubber processing machines
	9.	Tyre prosecing
	10.	Rubbert tests

	11.	Thermoplastic elastomers, and croslinked polymers
	12.	Final test
	13.	Rubber mixture processing
Required readings:	J.R. White S.K. De: Rubber Technologist's Handbook, Rapra Robert C. Klingender: Gandbook of Speciality elastomers, CRC Press Anil K. Bhowmick, Howard Stephens: Handbook of Elastomers	
Recommended readings:	Kanthappu S.:Fundamentals of rubber technology 2002	
Evaluation method:	Completion of at least a sufficient level of the Final test(minimum 60 %) and 60% participation in classes.The test is evaluated with a 1-5 digit rating. Scoring - (0-19p – insufficient, 20-24p – sufficient, 25-29p – medium, 30-34p – good, 35-40p excellent).	

Course Description		
Course title:	Shaping of Ceramics	
Neptun code:	MAKKSZ121B	
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)	
Lecture/ Seminar (practical); hours per week:	2l + 2p	
Name and position of lecturer:	Kocserha István, associate professor	
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	5/autumn	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is to provide students with a theoretical and practical introduction to the most common forming technologies used in the ceramics industry, to familiarise them with the related equipment, its construction and operation, and to provide examples of basic and auxiliary materials used in the production of ceramics.	
Course structure:	**Week**	**Topic**
	1.	Introduction, subject requirements. The place of shaping in ceramic technologies. Most common forming processes in ceramic technologies.
	2.	Shaping preparation operations, recipe calculation
	3.	Ceramic powder production processes and equipment

	4.	Additives in the different processes
	5.	Rheology and shaping
	6.	Casting of ceramic products, non-pressure and low, medium and high pressure casting processes
	7.	Injection moulding of ceramics
	8.	Shaping of ductile ceramic bodies - extrusion, discing
	9.	Ceramics powder pressing process and equipment
	10.	Ceramic powder pressing process and equipment
	11.	Foil casting technology
	12.	3D printing technologies for ceramics
	13.	Post-forming operations
	14.	Post-forming operations
Required readings:	Philippe Boch, Jean-Claude Niepce: Ceramic Materials, Wiley-ISTE, (2006)	
Recommended readings:	M V Barsoum. Fundamentals of Ceramics, CRC Press, (2003)	
Evaluation method:	Written and oral exam. Students will be given a series of tests on the topics of the lectures, which they must complete on paper. Time allowed: 2 hours. After correction of the written test, the student will receive a mark, which he/she may either accept or correct by oral examination. Written test, graded from 1 to 5 marks. Grading :<60%: unsatisfactory; 60-70%: satisfactory; 70-80%: average; 80-90%: good; >90%: excellent	

Course Description	
Course title:	Silicate Technology
Neptun code:	MAKKSZ120-22-B
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)
Lecture/ Seminar (practical); hours per week:	2l + 2p
Name and position of lecturer:	Róbert Géber, associate professor
Contact of lecturer:	robert.geber@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	5/autumn
Number of credits:	2
Requirements (exam/practical mark/signature/report, essay):	practical mark

Course objectives (50-100 words):	The aim of the course is to provide an overview of the raw materials and production technology of weakly hydraulic and non-hydraulic as well as hydraulic binders, in particular Portland cements and normal concretes made from these binders. The aim of the course is to enable students to understand the basic relationships between the materials, technologies and the composition and properties of the product selected, and to interpret and solve the professional problems encountered.	
Course structure:	**Week**	**Topic**
	1.	A general introduction to binders. Characteristic differences between hydraulic and non-hydraulic binders. Bonding and setting of lime and gypsum.
	2.	Cement raw materials operations: extraction, preparation, storage. Raw meal production operations and equipment, Mills, classifiers. Raw meal storage, transport.
	3.	Preheater, calciner, cyclones. Clinker kiln, clinker cooler.
	4.	Chemical reactions in clinker burning. Main clinker products and their properties.
	5.	Hydration of cement, hydration products and their characteristics.
	6.	Cement production: grinding and mixing. Application of cement as a hydraulic binder for concrete and reinforced concrete products.
	7.	Raw materials and production technology of concrete, methods of mixing. Concrete design methods.
	8.	Classification of concrete, role of water/cement ratio on concrete properties.
	9.	Key characteristics of fresh concrete: air content, density, consistency.
	10.	Key characteristics of hardened concrete: density, compressive strength classes.
	11.	An introduction to environmental impacts, environmental classes.
	12.	Report on the individual mid-term project.
	13.	Writing test.
Required readings:	W. Kurdowski: Cement and Concrete Chemistry, Springer (2014) https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/CLM_Published_def_0.pdf https://www.iricen.gov.in/iricen/books_jquery/concrete_technology_2014.pdf	
Recommended readings:	https://www.thyssenkrupp-industrial-solutions.com/en/industries/cement/	

Evaluation method:	Written test, graded from 1 to 5 marks. Grading :<60%: unsatisfactory; 60-70%: satisfactory; 70-80%: average; 80-90%: good; >90%: excellent Mid-term project: completion of an individual research project. Literature review on the chosen topic, followed by independent experimental work, evaluation of results, drawing conclusions. Presentation of the mid-term project in a written report of 15-20 pages and a presentation. Presentation and evaluation of the exercises.

Course Description		
Course title:	Energy rationalization	
Neptun code:	MAKETT103-22-B	
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)	
Lecture/ Seminar (practical); hours per week:	3l + 1p	
Name and position of lecturer:	Dr. Attila Garami, senior lecturer	
Contact of lecturer:	attila.garami@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	6/spring	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is to provide detailed and concrete knowledge of energy management in metallurgical, mechanical, silicate, chemical, light industry companies, energy production and service companies, or for materials engineers employed at public institutions.	
Course structure:	**Week**	**Topic**
	1.	Basics of energy management
	2.	Analysis of energy processes
	3.	Analysis of energy consumption
	4.	Material, energy and cost balance
	5.	Metrics for energy efficiency
	6.	Energy demand management
	7.	Investigation of energy loss
	8.	Energy recovery
	9.	Enterprise energy management

	10.	Basic economics
	11.	Techno-economic analysis
	12.	Risk assessment and uncertainty
	13.	
Required readings:	Wayne C. Turner: Energy Management Handbook, 2007	
Recommended readings:		
Evaluation method:		

Course Description		
Course title:	Fine Ceramic Technology	
Neptun code:	MAKKSZ105-22-B	
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)	
Lecture/ Seminar (practical); hours per week:	2l + 2p	
Name and position of lecturer:	Kocserha István, associate professor	
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	6/spring	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	In this course, students will learn in detail about the structure of the fine ceramics industry. The different mixtures of materials used in the production of porcelain, tableware, sanitary ware, tiles, porcelain insulators and various technical ceramic products will be discussed. It will cover the minerals that make up the bodies, equipment for body preparation and homogenisation, different technologies for the production of pressing powders, drying and heat treatment of ceramics and structural transformation processes.	
Course structure:	**Week**	**Topic**
	1.	Introduction to the fine ceramics industry, main products. Overview of classical and technical fine ceramic manufacturing processes.
	2.	Raw materials of the fine ceramics industry. Mineral compositions and modifications. Requirements for raw materials
	3.	Fine ceramic bodies and the technological process of body production.

	4.	Raw material preparation machines in the fine ceramics industry. Ball mills. Drum mills. Mixing equipment for suspensions.
	5.	Magnetic filtration. Vibro-screening. Filtration equipment.
	6.	Theory of filtration. Production of porcelain and sanitary ware by casting. Gravitational and pressure casting technology.
	7.	Theory of casting. Ancillary equipment for casting
	8.	Discing. Conventional and spray drying powder production. Powder pressing. Types of presses.
	9.	Processes during pressing. Production of vessels. Isostatic pressing.
	10.	Firing aids for the fine ceramics industry
	11.	Overview of ceramic injection moulding technology.
	12.	Overview of technical ceramics I. Electrical insulators. Electronic ceramics. Ferroelectric materials. Dielectrics
	13.	Burning processes for different products I.
	14.	Burning processes in different products II.
Required readings:	Robert B. Heimann: Classic and Advanced Ceramics Charles A. Harper: Handbook of Ceramics, Glasses and Diamonds Robert B. Heimann: Classic and Advanced Ceramics Charles A. Harper: Handbook of Ceramics, Glasses and Diamonds	
Recommended readings:	Jens Helbig, Urs Schönholczer: Grundzüge der Keramik	
Evaluation method:	The exam is written and oral. The students have to complete the 5 topics assigned in the 2 hours available. The examination papers will be marked and the students will be asked to defend the written papers orally if necessary. In the case of oral examinations, it is possible to improve or reduce the mark of the written paper.	

Course Description	
Course title:	Ceramics in Construction
Neptun code:	MAKKSZ123B
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)
Lecture/ Seminar (practical); hours per week:	2l +2p
Name and position of lecturer:	Kocserha István, associate professor
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English

Suggested semester: autumn /spring, 1-6	6/spring	
Number of credits:	4	
Requirements (exam/practical mark/signature/report, essay):	practical mark	
Course objectives (50-100 words):	The course introduces students to the products used in the construction industry based on ceramics and silicates, their raw materials and production technologies. The requirements for each building element, product parameters, testing techniques and standards will be reviewed.	
Course structure:	**Week**	**Topic**
	1.	Overview of building ceramics. Technical requirements for building materials, energy requirements.
	2.	Materials, properties and processing of traditional architectural ceramics.
	3.	Overview of brick and tile production technology. Preparation of raw materials.
	4.	Overview of brick and tile production technology. Laying technologies.
	5.	Overview of brick and tile production technology. Processes during drying and firing.
	6.	Production of tiles. Technology overview.
	7.	Production of tiles using conventional and fast firing technologies.
	8.	Production technologies for ceramic fibre insulating materials
	9.	Special glasses and coatings
	10.	Special glasses and coatings
	11.	Concrete building elements and their production.
	12.	Concrete building elements and their production.
	13.	Lightweight concrete building elements and their production technology.
	14.	Production technology of lightweight concrete building elements.
Required readings:	Robert B. Heimann: Classic and Advanced Ceramics Charles A. Harper: Handbook of Ceramics, Glasses and Diamonds	
Recommended readings:	Jens Helbig, Urs Schönholczer: Grundzüge der Keramik	
Evaluation method:	Written and oral exam. Students will be given a series of tests on the topics of the lectures, which they must complete on paper. Time allowed: 2 hours. After correction of the written test, the student will receive a mark, which he/she may either accept or correct by oral examination. Written test, graded from 1 to 5 marks. Grading :<60%: unsatisfactory; 60-70%: satisfactory; 70-80%: average; 80-90%: good; >90%: excellent	

Course Description		
Course title:	Safety in Industry	
Neptun code:	MAKÖNT256B	
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)	
Lecture/ Seminar (practical); hours per week:	2l	
Name and position of lecturer:	Ferenczi Tibor	
Contact of lecturer:	tibor.ferenczi@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	7/autumn	
Number of credits:	2	
Requirements (exam/practical mark/signature/report, essay):	exam	
Course objectives (50-100 words):	The aim of the course is for the students to acquire all occupational safety and environmental safety knowledge, which they can use to carry out and manage material engineering activities. Get to know the basic safety and fire protection rules, the technique of safe operation of machines, and introduce the rules for working with hazardous materials.	
Course structure:	**Week**	**Topic**
	1.	Presentation of the subject program, allocation of semester tasks, Occupational health and safety in history.
	2.	The concept, purpose and basic issues of occupational health and safety. Areas of labor protection. Sources of danger. The accident and the workplace accident and its administration. Occupational safety diary, Accident report. Related Legislation.
	3.	Safe design of workplaces. Heating, ventilation and air conditioning. Workplace lighting. Safety signs used in workplaces. Noise protection. Protection against vibration and radiation.
	4.	Safety technology of electricity. Overcurrent protection methods. Overload protection. Foreclosure protection. Voltage drop protection. Lightning and surge protection.
	5.	Transportation and storage of hazardous materials. Safety data sheet. Poisoning concept. Classification of toxic substances according to their effect.

	6.	Special requirements for work with pressure vessels. Pressure limiters, test pressure, danger indicator. Gas cylinders, storage record rules and work with them. Equipment operating at reduced pressure.
	7.	Material handling safety technology. Material handling machines. Warehousing, storage.
	8.	Basic knowledge of general fire protection. Burning, inflammation. Fire Protection Regulations. Fire alarm plan. Fire protection education. Fire hazard classes. Fire resistance grades.
	9.	Risk assessment. Concepts, methods. Personal protective equipment.
	10.	Ceramic and polymer technical supercilious safety technology
	11.	Computer workplaces, video projection
	12.	Closed task
	13.	Submission of individual tasks, additional closed room, Evaluation
Required readings:		
Recommended readings:		Jungsun PARK: Safety and Health at Work, Journal, Elsevier;
Evaluation method:		Attendance of at least 60% of the lectures, signature, practice ticket Completion of 1 indoor thesis at a sufficient level (sufficient level: 60%) five-point rating 0-60% insufficient, 61-70% sufficient, 71-80% medium, 81-90% good, 91-100% excellent

Course Description	
Course title:	Corporate Quality Management
Neptun code:	MAKMKT216B
Type (core, specialization, optional, dissertation, other):	specialization (Ceramics and polymer technologies)
Lecture/ Seminar (practical); hours per week:	2l
Name and position of lecturer:	Prof. Dr. Csaba Deák, Professor
Contact of lecturer:	csaba.deak@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	7/autumn
Number of credits:	2
Requirements (exam/practical mark/signature/report, essay):	exam

Course objectives (50-100 words):	The objective of the course is to introduce the concepts of quality management in production companies. Students will gain a comprehensive understanding of quality-related tasks at the management level and learn to organize their work processes with a focus on quality. Best practice case studies support the theoretical knowledge, and students will work on practice-oriented project tasks.	
Course structure:	**Week**	**Topic**
	1.	Introduction to Quality Management; What is quality?
	2.	The Total Quality Approach to Quality Management (History); Quality and Global Competitiveness Customer Satisfaction, Retention, and Loyalty
	3.	Strategic Management: Planning and Execution for Competitive Advantage
	4.	ISO 9000 and Total Quality: The Relationship; Audit
	5.	5 QMS in different industries 1. Automotive, IT, Food, Pharma)
	6.	Team presentations
	7.	Overview of Total Quality Tools; Problem Solving and Decision Making ISHIKAWA
	8.	Quality Function Deployment (QFD); Optimizing and Controlling Processes Through Statistical Process Control (SPC)
	9.	Continual Improvement Methods with Six Sigma, Lean, and Lean Six Sigma
	10.	Leadership and Change
	11.	The Goal; Film and game
	12.	Benchmarking; Just-in-Time Manufacturing (JIT)
	13.	
Required readings:	David L. Goetsch, Stanley Davis: *Quality Management for Organizational Excellence: Introduction to Total Quality*, 6th Edition, Pearson, 2010. ISBN: 9780135019672 Berényi L.: *Fundamental of Quality Management*, LAMBERT, 2013 David Hoyle: *ISO 9000 Quality Systems Handbook: Increasing the Quality of an Organization's Outputs*, Routledge, 7th Edition, 2017. ISBN: 9781315642192	
Recommended readings:	Luis R-L: *Building Quality Management Systems: Selecting the Right Methods and Tools*, CRC, 2013 Juqulum R.: *Design for Lean Six Sigma: A Holistic Approach to Design and Innovation*, Wiley, 2008 Chandupatla T.R.: *Quality and Reliability in Engineering*, Cambridge, 2009	

Evaluation method:	Evaluation method: - Active participation: 10% - Group assignment (case studies and presentation): 50% - Written exam: 40%