Course Description		
Course title:	Strength of materials	
Neptun code:	GEMET268M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	2l. 1p.	
Number of credits; hours per week	6; 3	
Name and position of lecturer:	Dr. Balázs Tóth, assistant professor	
Contact of lecturer:	mechtb@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 1	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):		
Course content:	**Week**	**Topic**
An introduction to tensor algebra. Fundamental concepts. Displacements in a small neighbourhood of a given point: displacement gradient, rotation tensor and strain tensor. Stress tensor. General equations: equilibrium equations for the stresses, kinematic equations, generalized Hook's law. Mohr's circle, principal stresses and strains. Basic principles in engineering design. The governing equations of elasticity in primal systems: field equations, boundary conditions, basic equations. Principle of virtual work. Variational principles: principle of minimum potential energy. Reciprocal theorems of Betti and Rayleigh. The Ritz method and its application to trusses and frames. Fundamentals of the finite element method. Theory of plasticity: Mises and Tresca- St.Venant's yielding criteria.	**1.**	
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Required readings:	Beer F. P., Johnston, E. R.: Mechanics of Materials, McGraw-Hill Education, 2007. ISBN 0073107956, 9780073107950 Chou, P.C., Pagano, N. J.: Elasticity. Tensor, Dyadic, and Engineering Approches, Dover, New York, 1992. ISBN 0-486-66958-0 - Bathe, K. J.: Finite Element Procedures, Prentice-Hall, Englewood Cliffs, 1996. ISBN 0-133-	
Recommended readings:		
Assessment methods and criteria:		

Course Description		
Course title:	Microstructure investigations II.	
Neptun code:	MAKFKT346M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	1l. 2p.	
Number of credits; hours per week	6; 3	
Name and position of lecturer:	Dr. Gréta Gergely, assistant professor	
Contact of lecturer:	femgreta@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 1	
Requirements (exam/practical mark/signature/report, essay)	practical mark	
Course objectives (50-100 words):	Students acquire knowledge about special microstructure investigation techniques.	
Course content:	**Week**	**Topic**
Morphological classification of single and multi-phase materials. Characterization of grains and particles, interpretation of grain size distribution. Fractal modell of the structure. Structural anisotropy and orderliness. Classification of two dimensioned grains by shape. Stereology of fracture surfaces and projections. Using image analysis method to characterize multi-phase structural.	**1.**	Basic of stereology
	2.	Morphological classification of single and multi-phase materials
	3.	Characterization of grains and particles, interpretation of grain size distribution
	4.	Anisotropy
	5.	Basic of image analysis
	6.	Basic of image analysis
	7.	Basic image analysis measurements
	8.	Basic image analysis measurements
	9.	Grain size distribution
	10.	Special investigation methods
	11.	Special investigation methods
	12.	X-ray Fluoressence
	13.	Computer tomgraphy

Required readings:	Microstructural Investigation and analysis, Volume 4, B. Jouffrey, Online ISBN: 9783527606160, Print ISBN: 9783527301218, DOI: 10.1002/3527606165 ASM Metals Handbook, Ninth Edition, v. 9, "Metallography and Microstructures", American Society for Metals, Metals Park, OH, 1985, p. 1 Underwood E. E.: Quantitative Stereology. Menlo Park, California. Addison-Wesley Publishing Company. (1970) p. 23.
Recommended readings:	Serra J.: Image Analysis and Mathematical Morphology. London. Academic Press. (1987) DeHoff R. T., Rhines F. N.: Quantitative Metallography. New York. McGraw-Hill. (1968)
Assessment methods and criteria:	Teaching method: oral, using a blackboard and computer. Submit appropriate reports, writen exam.

Course Description		
Course title:	Interfacial phenomena	
Neptun code:	MAKFKT347-17-M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	3l.	
Number of credits; hours per week	4; 3	
Name and position of lecturer:	Dr. György Kaptay, professor	
Contact of lecturer:	gyorgy.kaptay@bayzoltan.hu	
Prerequisite course(s):	Materials equilibria	
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 3	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):	The objective of the course is to teach the student to the science of interfacial phenomena, applied to nanosciences and nanotechnologies, mostly using the extended equilibrium approach of Gibbs.	
Course content:	**Week**	**Topic**
The course describes interfacial phenomena, applied to nanosciences and nanotechnologies, mostly using the extended equilibrium approach of Gibbs (as such, this course is an extension of the course “Materials Equilibria”). In addition of basic definitions (molar surface area, surface tension, contact angle, segregation, etc..) the course describes equilibrium of nano-materials (vapor pressure, solubility, melting point, phase equilibria), including super-hydophobicity, nucleation and interfacial forces in details.	**1.**	The definitions and the physical limits of macro, micro, nano, pico and femto regions. Classification of nano-technologies. Specific surface area: definition, sphere, cube, comparison.
	2.	Molar volume: definition, connection with density and atomic radius. Molar surface area: definition, connection with atomic radius and molar volume. The ratio of surface atoms.
	3.	The size dependence of the properties of nano-materials. The macroscopic usage of the molar Gibbs energy of phases. The size dependence of the Gibbs energy and molar Gibbs energy of nano-phases
	4.	The formal derivation of a model equation for surface tension. Equilibrium shape and size of independent liquid droplets. The Gibbs energy change accompanying coarsening and attrition of particles. The equilibrium shape and size of crystals.
	5.	The equilibrium contact angle, the Young equation. The adhesion energy, the Young-Dupré equation. Characteristic surface tension values of different liquids. Characteristic adhesion energy and contact angle values of solid/liquid couples.
	6.	Behavior of liquids if a cylindrical capillary is immersed into them. The capillary pressure. The equilibrium height of capillary rise or capillary depression.
	7.	Contact angle on nano-structured surfaces. Introduction / immersion of particles into liquids
	8.	Segregation of components to the surface of a liquid solution. Concentration dependence of surface tension of solutions.
	9.	Size dependence of the melting point of nano-crystals. The size dependence of the solubility of nano-crystals in solutions. The size dependence of the liquidus line of ideal A-B liquid solutions if there is no mixing between solid A and B. The size dependence of the equilibrium vapor pressure. The size dependence of the equilibrium one-component phase diagrams.
	10.	The size dependence of the equilibrium vapor pressure. The size dependence of the equilibrium one-component phase diagrams.
	11.	Homogeneous nucleation. The connection between the properties, the grain size, the probability of nucleation, and the critical Gibbs energy of nucleation. Heterogeneous nucleation. Different driving forces for nucleation: change in temperature, pressure, composition, or a chemical/electrochemical reaction
	12.	Interfacial forces. General definition, sign, the direction of the vector. Interfacial forces due to Young and Laplace.
	13.	Other interfacial forces (capillary, adhesional, gradient, meniscus)
Required readings:	A.W.Adamson: Physical Chemistry of Surfaces, 5th ed., John Wiley and Sons Inc., NY, 1990. / G.A.Somorjai: Introduction to Surface Chemistry and Catalysis. A Wiley-Interscience Publication, 1994, 667 pp. / J.N.Israelachvili: Intermolacular and surface forces, Academic Press, London, 1992.	

Recommended readings:	G. Kaptay: Modeling equilibrium grain boundary segregation, grain boundary energy and grain boundary segregation transition by the extended Butler equation. J. Mater. Sci., 2016, vol.51, pp. 1738-1755. G. Kaptay: On the partial surface tension of components of a solution. Langmuir, 2015, vol.31, No.21, pp. 5796-5804. Z. Weltsch, et al. Measurement and Modelling of the Wettability of Graphite by a Silver-Tin (Ag-Sn) Liquid Alloy – Applied Surface Science, 2013, vol.268, pp.52-60. G.Kaptay: Nano-Calphad: extension of the Calphad method to systems with nano-phases and complexions - J Mater Sci, 2012, vol.47, pp.8320-8335. G.Kaptay: Interfacial Forces in Dispersion Science and Technology - Journal of Dispersion Science and Technology, 2012, vol.33, pp.130-140 G.Kaptay: A unified model for the cohesive enthalpy, critical temperature, surface tension and volume thermal expansion coefficient of liquid metals of bcc, fcc and hcp crystals. Mater Sci Eng A, 2008, vol.495, pp.19-26.
Assessment methods and criteria:	Requirements during the semester: Two tests for maximum 100 points. Extra points can be gained during classes. On exam: oral presentation on two questions for maximum 100 points. Total maximum 200+ points. Teaching method: oral, using a blackboard (no computer during classes). Evaluation: At the end of semester: below 10 points: not allowed to exam; above 50 points: allowed to exam. Final mark: 100 – 119 points: satisfactory; 120 – 139 points: medium; 140 – 159 points: good; 160 and above: excellent.

Course Description

Course title:	Metal technologies	
Neptun code:	MAKMÖT311M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	2l. 1p.	
Number of credits; hours per week	6; 3	
Name and position of lecturer:	Dr. Tamár Kékesi, professor	
Contact of lecturer:	kekesi@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 1	
Requirements (exam/practical mark/signature/report, essay)		
Course objectives (50-100 words):	Initially, the course aims at delivering the general knowledge of the properties, the significance of metals. Further, the staple processes used for the extraction, refining, casting and shaping of metals are discussed on an introductory level. The theoretical fundamentals are outlined and the typical technologies are introduced. The scope is more general and compehensive than detailed and specific.	
Course content:	**Week**	**Topic**
The significance of primary and secondary raw materials for producing and processing metals. The importance of physic-chemical equilibrium conditions in the standard pyro- and hydrometallurgical processes. The implementation of roasting, smelting, leaching, solution purification and electrolytical technologies. Refining of metal melts and metal containing solutions to produce special purity metals. The main processes of melt refining, casting and solidification. Moulding materials and mould design. Gravity, centrifugal and pressure casting technologies. Testing methods and properties of castings. The main mechanical characteristics of plastic deformation. Materials and equipment of metal forming. The technology of hot and cold rolling, forging, extruding and wire drawing. The principles and practice of heat treatment.	**1.**	Orientation. The common and the specific chemical and physical characteristics of metals. The history of metals extraction and the relationship with civilization. The main types and beneficiating techniques of metal containing raw materials.
	2.	Thermodynamic principles of extractive metallurgy and metal refining. Reduction of oxides. Selective oxidation. Reaction kinetics.
	3.	The main processes of pyrometallurgy. Roasting, sintering, smelting, converting, fire refining and electrorefining. Virtual steel making.
	4.	The principle steps of hydrometallurgical processing, leaching, solution purification, electrowinning. Laboratory demonstration.
	5.	The crystallization of alloys. The significance of cast structure in determining the properties. Typical cast alloys.
	6.	Foundry equipmet. Moulding.
	7.	Casting methods and errors.
	8.	Simulation of mould filling and solidification.
	9.	Characterisation of workable alloys. The effect of crystal structure on properties. The major processes and products of metal shaping.
	10.	Characteristics of hot and cold working. Recrystallization.
	11.	The major methods, processes and equipment of metal working.
	12.	Simulation of plastic deformation.
	13.	Test paper.
Required readings:	http://web.iitd.ac.in/~pmpandey/MEL120_html/Metal%20Forming%20Processes.pdf Technology of metal forming processes, Surender Kumar, Published by Asoke K. Gosh, Prentice-Hall of India Private Limited, M-97, Connaught Circus, New Delhi-110001, ISBN: 978-81-203-3425-0 Handbook of metalforming processes, Henry E. Theis, New York, 1999., ISBN: 0-8247-9317-X	

Recommended readings:	
Assessment methods and criteria:	

Course Description		
Course title:	Differential equations	
Neptun code:	GEMAN015M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	2p.	
Number of credits; hours per week	4; 2	
Name and position of lecturer:	Dr. Péter Varga, associate professor	
Contact of lecturer:	matvarga@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 2	
Requirements (exam/practical mark/signature/report, essay)	practical mark	
Course objectives (50-100 words):	The theory of differential equations is a basic tool of diverse fields of science. Students of this course should be able to understand the behaviors and to derive solutions of differential equations. The analysis of differential equations includes numerical, geometrical and analytical methods. The course covers linear and nonlinear, and also ordinary and partial differential equations. Nonlinear equations are studied by their linearization around the equilibrium solution. A short introduction to complex functions is presented. Laplace and Fourier methods are applied both to ordinary and partial equations.	
Course content:	**Week**	**Topic**
By studying the exponential functions, and picking a convenient base, we have inadvertantly stumbled on a relationship satisfied by the function and its derivative. That relationship is called a differential equation . The topic of differential equations is an extremely important one in mathematics and science, as well as many other branches of studies (economics, commerce) in which changes occur and in which predictions are desirable. In most such circumstances, the systems studied come with some kind of "Natural Laws", or observations that, when translated into the language of mathematics, become differential equations. It is then the job of the mathematician to try to figure out what are the predictions, i.e. to find the functions that satisfy those equations.	**1.**	Geometric interpretation and numerical solution, Euler method.
	2.	Error estimation of numerical methods. Solution by Taylor series.
	3.	Solutions' qualitative behavior. Linearization.
	4.	Solution of linear ODE. Eigensystems of matrices.
	5.	Matrix exponentials, Jordan decomposition.
	6.	Complex functions, Cauchy formula.
	7.	Laplace transform.
	8.	Inhomogeneous linear differential equations. Frequency and impulse responses.
	9.	Heat equation, conservation laws.
	10.	Special solutions of partial differential equations. Plane waves.
	11.	Wave equation.
	12.	Laplace equation.
	13.	Calculus of variations, finite element methods.
Required readings:	A. D. Polyanin and V. F. Zaitsev, Handbook of Exact Solutions for Ordinary Differential Equations (2nd edition), Chapman & Hall/CRC Press, Boca Raton, 2003. ISBN 1-58488-297-2. E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, McGraw-Hill, 1955 Teschl, Gerald (2012). Ordinary Differential Equations and Dynamical Systems. Providence: American Mathematical Society. ISBN 978-0-8218-8328-0.	
Recommended readings:	Peter Olver: Introduction to Partial Differential Equations, Springer, 2013.	
Assessment methods and criteria:	Tests, quizzes, final exam. A 40% overall score is required to pass the course.	

Course Description		
Course title:	Applied chemistry and transport processes	
Neptun code:	MAKKEM272M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	2l. 1p.	
Number of credits; hours per week	6; 3	
Name and position of lecturer:	Dr. Ferenc Mogyoródy, assistant professor	
Contact of lecturer:	fkmmf@ui-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 2	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):		
Course content:	**Week**	**Topic**
Type and influence of the chemical reactions, the chemical speciality of the materials used in engineering. Quantity of the technological waters, chemical	**1.**	Reapeating physical chemistry
	2.	Green Chemistry

principles of technological water treatment. The chemistry of the natural gas, oil, mineral coal used for energy production. Green chemistry. C1-chemistry, Transport processes, viscosity, diffusion, heat transport, electric conductance, basics of hydrodynamics.	3.	Type of chemical reactions and influence
	4.	C1-chemistry
	5.	Appliead chemistry connected to chemical industry
	6.	The water
	7.	Raw materials of the chemical industry
	8.	Energy production
	9.	Viscosity
	10.	Diffusion
	11.	Heat transport
	12.	Conductivity
	13.	Practice
Required readings:	Plawsky, Joel L. (April 2001). Transport phenomena fundamentals (Chemical Industries Series). CRC Press. pp. 1, 2, 3. ISBN 978-0-8247-0500-8. Transport Phenomena (1 ed.). Nirali Prakashan. 2006. p. 15-3. ISBN 81-85790-86-8.,Chapter 15, p. 15-3 Alonso & Finn. "Physics." Addison Wesley,1992. Chapter 18	
Recommended readings:		
Assessment methods and criteria:	Teaching method: oral, using projector. Written exam at the end of semester.	

Course Description		
Course title:	Materials equilibria	
Neptun code:	MAKFKT345M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	2l.	
Number of credits; hours per week	4; 2	
Name and position of lecturer:	Dr. György Kaptay, professor	
Contact of lecturer:	gyorgy.kaptay@bayzoltan.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 2	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):	The objective of the course is to teach the student to the science of equilibrium of materials, based on the classical approach of Gibbs and based on the current state of the art of the Calphad method (= Calculation of Phase Diagrams).	
Course content:	**Week**	**Topic**
Basics (system, phases, components, mole fraction, phase fraction, materials balance, state and its characterization, state parameters, Gibbs energy, 1st, 2nd and 3rd laws, the condition of homogeneous and heterogeneous equilibria, phase rule). Calculation and understanding of one-component phase diagrams. The Gibbs energy of two-component solutions and mixtures; ideal solutions and possible phase diagram types. Different solution models (including the 4th law for the T-dependence of excess Gibbs energy) and models for compound phases. Derivation, calculation, understanding and classification of different phase diagram types for binary systems. Multi-component phase equilibria. Chemical equilibria. Electrochemical equilibria.	1.	Phases. Isolated systems. Components. The average mole fractions of components in a system. The phase fractions of phases in a system. The mole fractions of components within a phase. The connection between the average mole fraction of a component in a system, the phase fractions and the mole fractions of the same component in different phases.
	2.	The list of parameters dictated by the engineer (the state parameters). The list of parameters dependent on Nature (the characteristics of the equilibrium state). The number of experiments needed to connect the state parameters with the characteristics of the equilibrium state vs. the number of experiments performed so far. The Gibbs energy the system. The general condition of equilibrium. The integral Gibbs energy of phases and the partial Gibbs energy of the components. The condition of heterogeneous equilibrium.
	3.	The general algorithm of equilibrium calculations. The phase rule. Constitutents of the Gibbs energy. The inner energy, the volume work and the entropy term. The relative inner energy, molar volume and entropy values for solid, liquid and gaseous phases. The story-like derivation of the one-component phase diagram.
	4.	Standard Gibss energies as function of temperature and pressure. Graphical derivation of one-component phase diagrams. The EXCEL algorithm to calculate one-component phase diagrams.
	5.	The phase equilibria of two-component systems. The preferred section of two-component phase diagrams. The average integral Gibbs energy of mechanical mixtures. The integral Gibbs energy of solutions. Constructing partial Gibbs energies from the integral Gibbs energy of a solution: the tangent method. The Gibbs energy of an ideal solution and the cost of purified materials.
	6.	Construction of a binary phase diagram if a liquid solution is ideal, and if the solid phases have no mutual solubility (no allotropes, no compounds, different solid structures). Interpretation of the eutectic phase diagram: how to find the characteristics of equilibrium state in different areas of the phase diagram?

	7.	The equation for the liquidus line, which keeps equilibrium between pure solid phase alpha and the ideal liquid A-B solution. The equation for the liquidus line, which keeps equilibrium between pure solid phase betha and the ideal liquid A-B solution. The excel algorithm to construct the eutectic phase diagram: if a liquid solution is ideal, and if the solid phases have no mutual solubility (no allotropes, no compounds, different solid structures).
	8.	Construction of a binary phase diagram if both solid and liquid solutions are ideal (no allotropes, no compounds, identical solid structures): the solid solution type phase diagram. Equations for the equilibrium solidus and liquidus lines for a solid ideal A-B solution and a liquid ideal A-B solution. Construction of the phase ratio diagrams.
	9.	The excel algorithm to construct the solid solution type phase diagram (if both solid and liquid solutions are ideal (no allotropes, no compounds, identical solid structures). The excel algorithm to construct the phase ratio diagram for a given section of the solid solution type phase diagram.
	10.	Concentration dependence of the excess Gibbs energy of solutions. Temperature dependence of the excess Gibbs energy of solutions (the 4th law). Construction of solid phase separation line on phase diagrams, due to the repulsion of components within a solid solution phase.
	11.	The equilibrium between two solid solutions of the same structure but different compositions, if the components repulse each other in the solid solution. The critical temperature of phase separation / mutual solubility for repulsing components.The excel algorithm to create phase separation in solid solutions.
	12.	The equilibrium between a real solid solution and the ideal liquid solution. The excel algorithm to calculate solidus and liquidus lines for the equilibrium of a real solid solution and an ideal liquid solution. The condition when a minimum azeotropic point appears. The topological diagram of possible phase diagrams as function of melting point difference between the components and their interaction energy in the solid state if the liquid solution is ideal.
	13.	Eutectic and peritectic phase diagrams. Strong repulsion in the liquid state: the monotectic phase diagram. Compound formation: the dissociation temperature of different compounds. Compounds of different stability (weak, medium, strong) on the phase diagrams.

Required readings:	O.Kubaschewski, C.B.Alcock: Metallurgical Thermochemistry, Pergamon Press, Oxford, 1979 / N.Saunders, AP Miodownik: CALPHAD, a Comprehensive Guide, Pergamon, 1998, 479 pp. / Lukas HL, Fries SG, Sundman B: Computational Thermodynamics. The Calphad method. Cambridge University Press, 2007, Cambridge, UK, 313 pp.
Recommended readings:	G.Kaptay: On the abilities and limitations of the linear, exponential and combined models to describe the temperature dependence of the excess Gibbs energy of solutions. Calphad, 2014, vol.44, pp.81-94. / G.Kaptay: The essence of equilibrium of materials in 17 short statements – Mater Sci Eng, 2012, vol.37, No.2, pp.37-42 / G.Kaptay: Nano-Calphad: extension of the Calphad method to systems with nano-phases and complexions . J Mater Sci, 2012, vol.47, pp.8320-8335 / G.Kaptay: The conversion of phase diagrams of solid solution type into electrochemical synthesis diagrams for binary metallic systems on inert cathodes - Electrochimica Acta, 2012, vol.60, pp.401-409. / G.Kaptay: On the tendency of solutions to tend toward ideal solutions at high temperatures. Metall Mater Trans A, 2012, vol.43, pp. 531-543. / G.Kaptay: A method to calculate equilibrium surface phase transition lines in monotectic systems. Calphad, 2005, vol.29, pp.56-67 / G.Kaptay: A new equation for the temperature dependence of the excess Gibbs energy of solution phases. Calphad, 2004, vol.28, pp.115-124. / A.Roósz, J.Farkas, G.Kaptay: Thermodynamics-based semi-empirical description of the liquidus surface and partition coefficients in ternary Al-Mg-Si alloy. Mater Sci Forum, 2003, Vols. 414-415., pp.323-328
Assessment methods and criteria:	Requirements during the semester: Personal home works for maximum 100 points (calculation of phase diagrams using EXCEL). Extra points can be gained during classes. On exam: oral presentation on two questions for maximum 100 points. Total maximum 200+ points. Teaching method: oral, using a blackboard (no computer during classes). Evaluation: At the end of semester: below 10 points: not allowed to exam; above 50 points: allowed to exam. Final mark: 100 – 119 points: satisfactory; 120 – 139 points: medium; 140 – 159 points: good; 160 and above: excellent.

Course Description	
Course title:	Composites
Neptun code:	MAKFKT305M
Status: core, specialization, optional, other:	core
Type : lecture/seminar (practical)	2l. 1p.
Number of credits; hours per week	6; 3
Name and position of lecturer:	Dr. Gréta Gergely, assistant professor
Contact of lecturer:	femgreta@uni-miskolc.hu

Prerequisite course(s):			
Language of the course:	English		
Suggested semester: autumn /spring, 1-6	a, 1		
Requirements (exam/practical mark/signature/report, essay)	exam		
Course objectives (50-100 words):			
Course content:	**Week**	**Topic**	
Classification, evolution and importance of the engineering materials. Definition of composites, classification of composites based on matrix materials, reinforcement types and materials characteristics. Price of engineering materials, the material cycle. Materials of composite matrices: metals, polymers and ceramics. Reinforcements of composites: continuous fibers and their characteristics, processing of fibers, fabrics and preforms; discontinuous reinforcements and their characteristics; reinforcements of nano-composites. Engineering mechanics of composites: strength of continuous and short fiber reinforced composites; strength of discontinuous reinforced composites; macromechanics analysis of laminate properties, special laminates and their characteristics. Failure analysis and types of different composite structures. Manufacturing processes of metal, polymer and ceramic matrix composites. Requirements and methodology of composites, the building-block approach. Speciality of mechanical examinations of composite materials and structures.	**1.**		
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Required readings:	ASM Handbook, Vol. 21: Composites. ASM International, Materials Park, Ohio, 2001. (ISBN: 0-87170-703-9) Metal Matrix Composites. Custom-made Materials for Automotive and Aerospace Engineering. Ed.: KAINER, K. U. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim. (ISBN-13: 978-3-527-31360-0, ISBN-10: 3-527-31360-5) BUNSELL, A. R.; RENARD, J.: Fundamentals of Fibre Reinforced Composite Materials. IOP Publishing Ltd., London, 2005. (ISBN 0 7503 0689 0)		
Recommended readings:	AGARWAL, B. D.; BROUTMAN, L. J.; CHANDRASHEKHARA, K.: Analysis and Performance of Fiber Composites. John Wiley and Sons, Inc., Hoboken, New Jersey, 2006. (ISBN-13: 978-0-471-26891-8, ISBN-10: 0-471-26891-7)		
Assessment methods and criteria:			

Course Description		
Course title:	Solidification	
Neptun code:	MAKFKT357M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	2l. 1p.	
Number of credits; hours per week	6; 3	
Name and position of lecturer:	Dr. Tamás Mende, assistant professor	
Contact of lecturer:	tamas.mende@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 1	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):	The aim of the course to understand the solidification processes, nucleation and growth of grains, diffusion, micro- and macrosegregation, thermodynamic principles, state of equilibrium. The students will be able to use thermodynamic equiations to make their solidification calculations, and they will can handle binary and ternary phase diagrams.	
Course content:	**Week**	**Topic**
Understanding of solidification processes, nucleation and growth of grains, diffusion, micro- and macrosegregation, thermodynamic principles, state of equilibrium. Students can study about pure metals, alloys, phase diagrams, liquid and solid phases, cooling curves, cooling rate, undercooling, homogeneous and heterogeneous nucleation, growth of columnar or dendrite structure.	**1.**	Basic, terms of solidifcation processes, thermodynamics
	2.	Phase diagrams I. - binary systems
	3.	Phase diagrams II. - binary and ternary systems
	4.	Practice 1.
	5.	Nucleation of grains I. - Driving forces, thermodynamic principles, equilibrium
	6.	Nucleation of grains II. - Homogeneous and heterogeneous nucleation
	7.	Practice 2.
	8.	Solidification of α solid solution phase - in equilibrium
	9.	Solidification of α solid solution phase - in non equilibrium
	10.	Practice 3.
	11.	Solidifcation of eutectic phases - in equilibrium
	12.	Solidification of eutectic phases - in non equilibrium
	13.	Micro- and macrosegregation
Required readings:	Kurz W.: Fundamentals of Solidification Stefanescu D.M. : Science and Engineering of Casting Solidification ASM Handbook, Volume 3, Alloy Phase Diagrams	

Recommended readings:	Glicksman M. E. : Principles of Solidification Fredriksson H., Akerlind U.: Materials Processing during Casting Flemings M.C.: Solidification processing
Assessment methods and criteria:	Teaching method: oral, using a blackboard. Written exam at the end of semester.

Course Description

Course title:	Project management
Neptun code:	MAKFKT300M
Status: core, specialization, optional, other:	core
Type : lecture/seminar (practical)	2l.
Number of credits; hours per week	4; 2
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	s, 2
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	The course aims at helping students to be familiar with project management concepts, terms, roles and processes. They will learn: How projects are defined. How the structure of an organization impacts project management. How project management roles and responsibilities are defined. How all projects can be mapped to the same basic life cycle structure. How project management can be organized into functional areas.

Course content:	**Week**	**Topic**
Introduction to project management; Factors for project success or failure; Defining the project; Estimating project costs; First steps in planning the timescale; Financial appraisal and the business plan; Managing project risk; Project authorization; Special fields of project planning: brainstorming, SWOT-analysis, stakeholder-analysis, logframe matrix, established sets of requirements, Gantt-diagram, marketing objectives, sustainability, equal opportunity, dissemination; Project organization structures; Organization and initial conduct of management change; The project manager and associated roles; Detailed planning: an introduction to critical path networks; Detailed planning: critical path networks in practice; Scheduling resources, (principles, practical advice); Scheduling project cash flows; Introduction to project contracts and purchase orders; Managing procurement and the supply chain; Managing progress; Managing changes; Managing project costs; Earned value analysis and cost reporting; Managing project closure.	**1.**	Introduction to project management; Factors for project success or failure;
	2.	Defining the project; Estimating project costs;
	3.	First steps in planning the timescale; Financial appraisal and the business plan;
	4.	Managing project risk; Project authorization;
	5.	Special fields of project planning
	6.	Project organization structures; Organization and initial conduct of management change;
	7.	The project manager and associated roles;
	8.	Detailed planning
	9.	Scheduling resources and project cash flows;
	10.	Introduction to project contracts and purchase orders; Managing procurement and the supply chain;
	11.	Managing progress, changes and project costs;
	12.	Earned value analysis and cost reporting; Managing project closure.
	13.	Homework submission and presentation

Required readings:	Dennis Lock: Project Management. Gower Publishing Limited (UK), 2013. Rodney Turner: Handbook of Project Management. Gower Publishing Limited (UK), 2012
Recommended readings:	Berkun, Scott. Art of Project Management. Cambridge, MA: O'Reilly Media. ISBN 0-596-00786-8 (2005) Brooks, Fred. The Mythical Man-Month, 20th Anniversary Edition, Adison Wesley. ISBN 0-201-83595-9 (1995) Heerkens, Gary. Project Management (The Briefcase Book Series). McGraw-Hill. ISBN 0-07-137952-5 (2001) Kerzner, Harold. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 8th Ed., Wiley. ISBN 0-471-22577-0 (2003) Lewis, James. Fundamentals of Project Management, 2nd ed., American Management Association. ISBN 0-8144-7132-3 (2002) Meredith, Jack R. and Mantel, Samuel J.. Project Management : A Managerial Approach, 5th ed., Wiley. ISBN 0-471-07323-7 (2002) Project Management Institute. A Guide To The Project Management Body Of Knowledge, 3rd ed., Project Management Institute. ISBN 1-930699-45-X (2003)
Assessment methods and criteria:	Signature: personal home works - task: to compile and present a pilot project Exam: written work based on 3 essay tasks

Course Description

Course title:	Intellectual properties law
Neptun code:	MAKPOL264-17-M
Status: core, specialization, optional, other:	core
Type : lecture/seminar (practical)	3p.
Number of credits; hours per week	4;3
Name and position of lecturer:	Dr. György Czél, professor

Contact of lecturer:	femczel@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 4	
Requirements (exam/practical mark/signature/report, essay)	practical mark	
Course objectives (50-100 words):		
Course content:	**Week**	**Topic**
The concept, subject and extent of copyright. The concept and significance of voluntary register of works and the process of procedure. Copyrights and their limits. The specific rules of different genres, types of works and adaptations. The professional book as a book of copyright; the cases of free adaptation. The professional paper as a paper of copyright, citation and reference. Linked and adjacent legitimacy and their limits in the copyright. Specification of safe-keeping forms known in the industrial legal protection and the short review of their different fields. The content and limits of licences and patents as the safe-keeping form of industrial legal protection. The structure of description of patent. The conditions of patentability. Possibilities of obtaining the EU patents. The development and significance of patent data base. Content and development of the utility model protection. Significance and sphere of protection of trade marks. Content of classification system developed in Viena and Nice. The Community Trade Mark. Extent and significance of design protection. Significance of geographical brand names.	**1.**	Copyrights and their limits
	2.	citation and reference
	3.	Know- how and theri inportance
	4.	licences and patents
	5.	The structure of description of patent
	6.	Patent applications
	7.	patent drawings
	8.	patent search in espacenet
	9.	US patent procedure
	10.	EU patent procedure
	11.	design protection
	12.	trade marks
	13.	Trade marks classifications
Required readings:	• Davis: Intellectual Property of law Core text 4e Oxford University press • Waelde et al: Contemporary Intellectual property: Law and policy • Norman: Intellectual Property Law , Directions, Oxfor University Press	
Recommended readings:	Norman: Intellectual Property Law, Directions, Oxford University Press	
Assessment methods and criteria:	written test	

Course Description		
Course title:	Quality management systems	
Neptun code:	MAKMKT520-17-M	
Status: core, specialization, optional, other:	core	
Type : lecture/seminar (practical)	3l.	
Number of credits; hours per week	4; 3	
Name and position of lecturer:		
Contact of lecturer:	László Bagyal	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 4	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):		
Course content:	**Week**	**Topic**
Management Systems: historical development, objectives, applications, significance. A brief overview of the most commonly used certifiable management systems; structural and functional units, principles; the configuration, implementation and certification of the systems. The target systems discussed during the semester are: quality management systems, environmental management systems, food processing- and automotive supply systems, laboratory quality management and control systems.The course outlines the fundamental concepts of total quality management (TQM) and introduces the principles of the European Foundation of Quality Management (EFQM). The certification system and process flow is presented in details. Related concepts are: audit – definition, audit types, process flow and results; conformity assessment and standardization – definition, target organizations and institutions; accreditaion – definition, process flow and results. The role and tasks of Hungarian quality-related systems: NAT, MSZT, OMH. The structure of Hungarian national conformity assessment system.	**1.**	
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Required readings:	Juran, Joseph Moses: An executive handbook, New York – London, 1989 László Berényi: Fundamentals of quality management, Saarbrücken, 2013. https://ujdigispace.uj.ac.za/bitstream/handle/10210/2974/A%20%20Al-Saket%20(TQM%20Dissertation).pdf?sequence=1	

Recommended readings:	
Assessment methods and criteria:	

Course Description		
Course title:	Adhesive joining	
Neptun code:	MAKPOL260-17-M	
Status: core, specialization, optional, other:	specialization	
Type : lecture/seminar (practical)	2l. 2p.	
Number of credits; hours per week	7; 4	
Name and position of lecturer:	Dr. Gabriella Zsoldos, assistant professor	
Contact of lecturer:	femzsgab@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 1	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):		
Course content:	**Week**	**Topic**
The course explains in detail the most common, every day glues and adhesives, their theory and practical application. The course Explains the chemistry and physics of the bond formation, and mechanisms. Detailed discussion is presented about the processes occurring during joining and the methods of testing of the adhesives and the joints. Using common glues the general definitions and their usage is explained. Trough examples we can evaluate the potential errors, their causes and practical ways to avoid them.	**1.**	Adhesion theories
	2.	Surface tension and measurement
	3.	Surface preparation techniques
	4.	Adhesive materials
	5.	Special adherend materials
	6.	Joining design
	7.	Adhesive application and bonding processes
	8.	Adhesive solvents
	9.	Durability of adhesive bonds
	10.	Testing of adhesive bonds
	11.	Testing of adhesive bonds 2.
	12.	Quality control
	13.	Safety, envinonmental and economic aspects
Required readings:	Engineered Materials Handbook Volume 3: Adhesives and Sealants; Edward M. Petrie: Handbook of Adhesives and Sealants; Sina Ebnesajjad:Adhesives Technology Handbook	
Recommended readings:		
Assessment methods and criteria:		

Course Description		
Course title:	Polymer study II.	
Neptun code:	MAKPOL261-17-M	
Status: core, specialization, optional, other:	specialization	
Type : lecture/seminar (practical)	3l. 1p.	
Number of credits; hours per week	7; 4	
Name and position of lecturer:	Dr. Kálmán Marossy, professor	
Contact of lecturer:	polkal01@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 2	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):		
Course content:	**Week**	**Topic**
Polymers and plastics definition. preparation of polymer molecules. Description of polymers; average molecular weight, polydispersity. Stereo isomers, tacticity. Chain flexibility of polymers, related properties. Structure of polymeric bulks, behavior of polymeric chains and molecules, behavior of polymer segments in different force fields. Quantitative evaluation of physical behavior, using different methods. Determination of connections between the different behaviors (optical, electric, mechanical, thermal, etc…). Compatibility of polymers and additives, thermodynamics of mixing, preparation of blends and mixed systems. Structure-properties relations.	**1.**	
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Required readings:	Painter, Paul C.; Coleman, Michael M. (1997). Fundamentals of polymer science : an introductory text. Lancaster, Pa.: Technomic Pub. Co. p. 1. ISBN 1-56676-559-5 McCrum, N. G.; Buckley, C. P.; Bucknall, C. B. (1997). Principles of polymer engineering. Oxford ; New York: Oxford University Press. p. 1. ISBN 0-19-856526-7. Ashby, Michael; Jones, David (1996). Engineering Materials (2 ed.). Butterworth-Heinermann. pp. 191–195. ISBN 0-7506-2766-2.	
Recommended readings:		

Assessment methods and criteria:	

Course Description		
Course title:	Operation of polymer processing machines	
Neptun code:	MAKPOL262-17-M	
Status: core, specialization, optional, other:	specialization	
Type : lecture/seminar (practical)	2l. 2p.	
Number of credits; hours per week	7; 4	
Name and position of lecturer:	Dr. György Czél, professor	
Contact of lecturer:	femczel@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 3	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):		
Course content:	**Week**	**Topic**
Processing of plastic materials and technology of shaping of plastic products as well as the operation of machines. The different moulding technologies will be presented in detailed mechanical drawings and tool drawings. The students can learn the details of technology of production of thermoplastic materials by extrusion and injection moulding. The basic principles of the detailed calculation of extruder as well as of the sizing of screw will be the topics of lectures. The following tools will be detailed as moulding tools: Extruder- and injection -moulds for making thermoplastic materials. Pressing dies for making thermoset products. Thermal transport process during the formation of different plastic materials. Energy consumption necessary for producing different plastic products i.e. for maintaining the different technological lines. The problems of productivity. Aspects of choosing the technical plastic materials and the technologies that can be allocated to them.	**1.**	
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Required readings:	E.J. Hearn Mechanics of materials, Butterworth and Heinemann, Amsterdam 2003 Robert A. Malloy: Plastic Part Design for Injection Molding, hanser 1997 William D. Callister Fundamentals of Materials Science and engineering, Wiley 2002	
Recommended readings:		
Assessment methods and criteria:		

Course Description		
Course title:	Polymer product design	
Neptun code:	MAKPOL263-17-M	
Status: core, specialization, optional, other:	specialization	
Type : lecture/seminar (practical)	1l. 3p.	
Number of credits; hours per week	7; 4	
Name and position of lecturer:	Dr. Mariann Kollár, assistant professor	
Contact of lecturer:	femmaja@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 4	
Requirements (exam/practical mark/signature/report, essay)	practical mark	
Course objectives (50-100 words):	The aim of the course to provide students with practical experience in the plastic material production most commonly in injection molding technique and the process of material selection. During the semester, each student will receive a task/topic to design and plan the production of a simple plastic product. They have to select which material and method of production is the best too achieve a marketable product. At the end of the semester, an essay (product introduction, description, sizing, design drawings, material selection with reasoning, parameters for injection molding, instruments) must be submitted to the faculty and a presentation is expected.	
Course content:	**Week**	**Topic**
	1.	Choose the plastic product
	2.	Set the basic expectations
	3.	individual work on the topic w/ possibility of consultation
	4.	individual work on the topic w/ possibility of consultation
	5.	individual work on the topic w/ possibility of consultation
	6.	individual work on the topic w/ possibility of consultation
	7.	individual work on the topic w/ possibility of consultation
	8.	individual work on the topic w/ possibility of consultation
	9.	individual work on the topic w/ possibility of consultation
	10.	individual work on the topic w/ possibility of consultation
	11.	individual work on the topic w/ possibility of consultation
	12.	presentation and handing in the written material
	13.	presentation and handing in the written material

Required readings:	Process: 50 Product Designs from Concept to Manufacture by Jennifer Hudson Publisher: Laurence King Publishing; 2 edition (May 11, 2011) ISBN-10: 1856697258 ISBN-13: 978-18566972552008. M.F. Ashby: Material selection in Mechanical Design : Materials Selection in Mechanical Design Szerző Michael F. Ashby Publisher: Butterworth- Heinemann, 2004. ISBN 0080468640, 9780080468648
Recommended readings:	Books from manufacuring of plastic product
Assessment methods and criteria:	Minimum 10-page essay handing, attendance minimum 4 consultation

Course Description		
Course title:	Physical metallurgy of heat treated metals and alloys	
Neptun code:	MAKFKT348M	
Status: core, specialization, optional, other:	specialization	
Type : lecture/seminar (practical)	3l.	
Number of credits; hours per week	6; 3	
Name and position of lecturer:	Dr. Péter Barkóczy, associate professor	
Contact of lecturer:	peter.barkoczy@gmail.com	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	a, 1	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):		
Course content:	Week	Topic
Systematization of phase transformation, thermodynamic basic. Homogeneous transformation: homogenization, spinodal decomposition, GP zones, ordering. Heterogeneous transformation: kinetic of transformation with nucleation, grain growth (Avrami equation), processes with short range diffusion, processes with long range diffusion, processes with cooperative atom moving, martenzitic transformation, bainitic transformation.	1.	
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Required readings:	Maximilian Lackner, Franz Winter, Avinash K. Agarwal: Handbook of Combustion, 5 Volume Set, Wiley VCH Verlag GmbH, 2010. Kreith, F.; Boehm, R.F.; et. al. "Heat and Mass Transfer" Mechanical Engineering Handbook, Ed. Frank Kreith, CRC Press LLC, 1999. Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine: Fundamentals of Heat and Mass Transfer, Wiley, 2001. Maximilian Lackner, Arpad Palotas, Franz Winter: Combustion: From Basics to Applications, Wiley VCH Verlag GmbH, 2013.	
Recommended readings:		
Assessment methods and criteria:		

Course Description		
Course title:	Simulation of heat treatment processes	
Neptun code:	MAKFKT349-17-M	
Status: core, specialization, optional, other:	specialization	
Type : lecture/seminar (practical)	1l. 3p.	
Number of credits; hours per week	7; 4	
Name and position of lecturer:	Dr. Péter Barkóczy, associate professor	
Contact of lecturer:	peter.barkoczy@gmail.com	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 2	
Requirements (exam/practical mark/signature/report, essay)	practical mark	
Course objectives (50-100 words):		
Course content:	Week	Topic
Simulation procedures: analytical and numerical methods. Simulation of fundamental transformations processes: segregation, redissolving, recrystallisation , allotropic transformations. Structure of simulation software. Application of simulation software. Practical heat tetrament methods simulation with commercial softwares.	1.	
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Required readings:	Porter D.A., Easterling K.E.: Phase transformation of metals and alloys, Chappman and Hall, 1996 D. Raabe: Computational Materials Science, Wiley VCH, Weinheim, 1998
Recommended readings:	
Assessment methods and criteria:	

Course Description

Course title:	Fundamentals of metal forming
Neptun code:	MAKFKT350-17-M
Status: core, specialization, optional, other:	specialization
Type : lecture/seminar (practical)	3l.
Number of credits; hours per week	5; 3
Name and position of lecturer:	Dr. György Krállics, professor
Contact of lecturer:	femkgy@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	a, 3
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	The course intends to give fundamental knowledge (mechanics, materials, numerical and analytical methods) needed to understand the analysis of metal-forming operations. It spans the considerable gap between traditional materials approaches and purely mechanical ones.

Course content:

Tensile and upsetting test and basic materials behavior. Engineering and true variables. Analysis of work hardening.Necking, uniform elongation. Strain rate sensitivity. Tensors, matrices, vectors. Rotation of Cartesian axes. Matrix and tensor operations. Definition of stress and stress tensor. Deviatoric stress. Physical ideas of deformation. Lagrangian and Eulerian description of continuum kinematics. Deformation tensors. Lagrange, Euler an logaritmic strain sensor. Mechanical principles.The virtual work principle. Constitutive equations for elastic, plastic and viscoplastic materials.Plasticity. Yield surface and yield function.Strain hardening, evolution of yield surface..Basic concept of friction.Coulomb's law. Sticking friction and modified sticking friction.Upper and lower bound on power. Slab calculation. Stress and strain analysis of basic manufacturing processes. Forging of disk. Flow trough conical converging dies. Strip rolling. Deformability of metals. Theories of ductile fracture by Bogatov.Meso –damage by void evolution. Lemaitre damage mechanics. Gurson's model.

Week	Topic
1.	Tensile and upsetting test and basic materials behavior. Engineering and true variables.
2.	Analysis of work hardening. Necking, uniform elongation. Strain rate sensitivity
3.	Tensors, matrices, vectors. Rotation of Cartesian axes. Matrix and tensor operations.
4.	Definition of stress and stress tensor. Deviatoric stress. Equivalent stress. Eigen values and eigen vectors.
5.	Motion and deformation. Lagrangian and Eulerian description of continuum kinematics.
6.	Deformation tensors. Lagrange, Euler an logaritmic strain tensor.
7.	Constitutive equations for elastic, plastic and viscoplastic materials
8.	Plasticity. Yield surface and yield function. Strain hardening, evolution of yield surface.
9.	Basic concept of friction. Coulomb's law. Sticking friction and modified sticking friction.
10.	Upper and lower bound on power. Slab calculation
11.	Stress and strain analysis of basic manufacturing processes. Forging of disk. Flow trough conical converging dies. Strip rolling.
12.	Flow trough conical converging dies. Strip rolling.
13.	Deformability of metals. Theories of ductile fracture by Bogatov. Meso –damage by void evolution.

Required readings:	R.H. Wagoner, J.L. Chenot:Metal Forming Analysis. Cambridge University Press. 2010 Andrzej Sluzalec: Theory of Metal Forming Plasticity. Springer-Verlag Berlin Heidelberg GmbH.2004. B. Avitzur: Metal Forming: Processes and Analysis, McGraw Hill, 1968
Recommended readings:	
Assessment methods and criteria:	

Course Description

Course title:	Simulation of deformation technologies
Neptun code:	MAKFKT351-17-M
Status: core, specialization, optional, other:	specialization
Type : lecture/seminar (practical)	1l. 3p.
Number of credits; hours per week	7; 4
Name and position of lecturer:	Dr. Sándor Kovács, assistant professor
Contact of lecturer:	kosonick@gmail.com
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-6	s, 4
Requirements (exam/practical mark/signature/report, essay)	practical mark
Course objectives (50-100 words):	Initially, the course aims at delivering the general knowledge of the simulation techniques. Further, the student will learn the using of finite element software/formal mathematics software.

Course content:

Determination of the position of the neutral fiber in theroll gap .
Determination of the outcome strip thickness during striprolling.
Determination of rolling force as the flattened rollers taken into account.
Determining the rolling force and the temperature of the product during hot rolling of the steel. Determination of pass filling, résváltoztatás effect of

Week	Topic
1.	Introduction
2.	Basics of finite element/programming
3.	Software installing
4.	Release the projects
5.	Individual work on the topic / possibility of consultation

changing of the gap, graphic display. Determining the rolling force and the temperature of the stript during hot rolling of the aluminum alloys. Definition of the accessible height changing with during one punch forging. Definition of burr size for closed forging. Upsetting of cylindricalproducts on crank press. Determination of angle resulting in a minimum drawing force during wire drawing. Determination of compression force for squezing of aluminum alloys. Calculation of the heat penetration time of the billet.	6.	Individual work on the topic / possibility of consultation
	7.	Individual work on the topic / possibility of consultation
	8.	Individual work on the topic / possibility of consultation
	9.	Individual work on the topic / possibility of consultation
	10.	Individual work on the topic / possibility of consultation
	11.	Handing in the reports
	12.	Possibility of correction of the report
	13.	Possibility of correction of the report
Required readings:	Betzalel Avitzur Metalforming	
Recommended readings:	Simufact.forming Tutorial, Maple Help	
Assessment methods and criteria:	Project work	

Course Description		
Course title:	Complex planning or Project work	
Neptun code:	MAKFKT352-17-M	
Status: core, specialization, optional, other:	specialization	
Type : lecture/seminar (practical)	2p.	
Number of credits; hours per week	3; 2	
Name and position of lecturer:	Dr. Gréta Gergely, assistant professor	
Contact of lecturer:	femgreta@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	s, 4	
Requirements (exam/practical mark/signature/report, essay)	practical mark	
Course objectives (50-100 words):	Ability to find, select, process professional literature and make a high quality presentation.	
Course content:	**Week**	**Topic**
Independent project work supported by lecturer. The project task includes: research literature, experimental design process , carry out experiments, presenting results and the project.	1.	Assigning tasks.
	2.	Consultation on literature research.
	3.	Consultation on literature research.
	4.	Literature research and consultation on its processing.
	5.	Literature research and consultation on its processing.
	6.	Literature research and consultation on its processing.
	7.	Consultation on experimental design.
	8.	Carry out experiments.
	9.	Carry out experiments.
	10.	Consultation on result processing.
	11.	Final consultation.
	12.	Report submission.
	13.	Presentation.
Required readings:	Related relevant research articles	
Recommended readings:	Dr. Graham Baster: Introduction to Scientific Research project 2010, ISBN 978-87-7681-674-2 (Download free at bookboon.com)	
Assessment methods and criteria:	Continuous participation in the consultations, project presentation	

Course Description		
Course title:	Drawing and extrusion	
Neptun code:	MAKFKT280-17-B	
Status: core, specialization, optional, other:	compensational	
Type : lecture/seminar (practical)	lecture	
Number of credits; hours per week	5; 4	
Name and position of lecturer:	Prof. György Krallics	
Contact of lecturer:	femkgy@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	english	
Suggested semester: autumn /spring, 1-6	spring, 2	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):	Learning the students on the elements of theory of metal forming and on the	
Course content:	**Week**	**Topic**
	1.	Mechanism of plastic deformation.
	2.	Motion of the body. Strain and stress.
	3.	Material law. Plastic and elastic properties.
	4.	Machine tool for metal forming.
	5.	Friction and elements of tribology.
	6.	Deformability of metals at different condition.
	7.	Plastic instability and ductile fracture.
	8.	Metal flow in conical dies. Velocity and strain
	9.	Process variables on direct and indirct extrusion.
	10.	Cross section to be extruded
	11.	Defect and residual stresses of extrusion.
	12.	Die design and die materials.
	13.	Drawing equipments.
Required readings:	R.H.Wagoner, J.-L. Chenot, Metal Forming Analysis	
Recommended readings:	B.Avitzur, Metal Forming: Process and Analyses.	

Assessment methods and criteria:	Semester-works and oral examination

Course Description		
Course title:	Heat treatment of Ferrous alloys	
Neptun code:	MAKFKT255B	
Status: core, specialization, optional, other:	compensational	
Type : lecture/seminar (practical)	lecture	
Number of credits; hours per week	2; 2	
Name and position of lecturer:	Dr. Zsolt VERES, ass.professor	
Contact of lecturer:	femvezso@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester:	autumn, 1st semester	
Requirements (exam/practical mark/signature/report, essay)	exam (written)	
Course objectives (50-100 words):	The aim of the course is the presentation of the metallurgical physical basics of the heat	
Course content:	**Week**	**Topic**
	1.	Types and classification of ferrous alloys
	2.	Physical and thermal properties of steels
	3.	Types of heat transfer, cooling mediums
	4.	Solid state transformations in ferrous alloys
	5.	Stress in steels, stress relieving
	6.	Annealing, homogenization
	7.	Recrystallization, austenitization
	8.	Temper-hardening
	9.	Normalizing, austempering, martempering
	10.	Surface hardening
	11.	Thermochemical treatments
	12.	Heat treatment installation
	13.	Z.H.
Required readings:		
Recommended readings:	J. R. Davis, ASM Handbook, Volume 4, Heat treating, ASM International, 1991	
Assessment methods and criteria:		

Course Description		
Course title:	Rolling	
Neptun code:	MAKFKT271-17-B	
Status: core, specialization, optional, other:	compensation	
Type : lecture/seminar (practical)	lecture and practice	
Number of credits; hours per week	4 4	
Name and position of lecturer:	Dr. Gábor SZABÓ	
Contact of lecturer:	szabogabor@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	spring, 2	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):	During this semester, students will gain insight into cold and hot rolling, typically in the	
Course content:	**Week**	**Topic**
	1.	Introduction to rolling technology
	2.	Production of raw materials for profile products
	3.	Structure of Profile Roll Stand Mills I.
	4.	Structure of Profile Roll Stand Mills II.
	5.	Serving equipment
	6.	Opened and closed groove systems, test
	7.	Technology planning, repeating the test
	8.	Production of raw materials for flat products
	9.	Structure of Flat Roll Stand Mills
	10.	Calculations I.
	11.	Calculations II.
	12.	Serving equipment, test
	13.	Technology planning, repeating the test
Required readings:		
Recommended readings:		
Assessment methods and criteria:		

Course Description		
Course title:	Heat treatment of Non-ferrous alloys	
Neptun code:	MAKFKT254B	
Status: core, specialization, optional, other:	compensation	
Type : lecture/seminar (practical)	lecture	
Number of credits; hours per week	2 2	
Name and position of lecturer:	Dr. Gréta Gergely, assistant professor	
Contact of lecturer:	femgreta@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	spring, 2	
Requirements (exam/practical mark/signature/report, essay)	signature, exam	
Course objectives (50-100 words):	The aim of the course to get knowlegde about heat treatment of non ferrous alloys and	
Course content:	**Week**	**Topic**

	1.	Properties and characterization of Aluminum and its application fields
	2.	Grouping of alloying elemnets of aluminum
	3.	Types of Aluminum alloy: pure metal grads (unalloyed aluminum), solid solvents, tempering alloys
	4.	Multi-phase (casting) aluminum alloys. Characterization of the structure created during casting.
	5.	Recrystallization of cold-formed aluminum alloys
	6.	Structure of aluminum alloy due to heat treatment: Processes occurring during homogenization (characterization of the resulting tissue structure)
	7.	Microstrucure of aluminum alloys formed after heat treatment : characterization of microstructure during heterogenization
	8.	Microstructure formed during the heat treatment of aluminum alloys:Processes during softening (recrystallization of cold - formed aluminum alloys)
	9.	Heat treatment of aluminum alloys
	10.	TEST
	11.	The concept of composites and their beneficial properties. Application fields of composites
	12.	Fiber and particle reinforced composites. Processing technologies, main properties
	13.	Production of metal composites by various methods
Required readings:	-	
Recommended readings:		
Assessment methods and criteria:	Evaluation is based on exam (60%) and test (40%). The grade/mark of the exam is based	

Course Description		
Course title:	Polymer Composites	
Neptun code:	MAKPOL235B	
Status: core, specialization, optional, other:	compensation	
Type : lecture/seminar (practical)	lecture	
Number of credits; hours per week	4 2	
Name and position of lecturer:	Dr. Tamas J. Szabo associate professor	
Contact of lecturer:	polsztam@uni-miskolc.hu	
Prerequisite course(s):	-	
Language of the course:	English	
Suggested semester: autumn /spring, 1-6	autumn, 3	
Requirements (exam/practical mark/signature/report, essay)	exam	
Course objectives (50-100 words):	The goal of the course is to give an introduction of polymer based composite materials	
Course content:	**Week**	**Topic**
	1.	Itroduction to the polymer matrix
	2.	Fillers
	3.	Reinforcing components
	4.	Composite preparation in melt phase
	5.	Natural additives
	6.	Composites calandering methods
	7.	Composites extrusion
	8.	Composites
	9.	Fiber manufacture in polymer industry, fibers, veawes fabrics and non vowen layers
	10.	Theory of crosslinking
	11.	Orientation of reinforcing fibers
	12.	Preparation of composites; manual lamination
	13.	Preparation of composites; advanced methods and repairs
Required readings:		
Recommended readings:	Schwarz-Ebeling Lüpke-Schelter: Polymer processing	
Assessment methods and criteria:	participation on practical lessons and in discussions, acceptable grade on a quiz	

Course Description		
Course title:	Elastomers	
Neptun code:	MAKPOL231B	
Status: core, specialization, optional, other:	compensation	
Type : lecture/seminar (practical)	practical	
Number of credits; hours per week	3;2	
Name and position of lecturer:	Dr. Zsoldos Gabriella, assistant professor	
Contact of lecturer:	femzsgab@uni-miskolc.hu	
Prerequisite course(s):		
Language of the course:	english	
Suggested semester: autumn /spring, 1-6	autumn, 3	
Requirements (exam/practical mark/signature/report, essay)	practical mark	
Course objectives (50-100 words):	Introduction to the natural and artificial rubber materials, its additives, its processing	
Course content:	**Week**	**Topic**
	1.	The elastomer behaviours, conditions of the elasticity
	2.	Crosslinked and linear elastomer types
	3.	The main raw materials of elastomer industry
	4.	Crosslinking and vulcanization methods
	5.	Thermoplastic elastomers
	6.	Additive types in elastomer industry

	7.	The machines of the elastomer industry
	8.	The manufacturing of a rubber product
	9.	Special elastomer types for special usage
	10.	Measurement types of rubber mixtures
	11.	Measurement types of rubber products
	12.	Waste materials usage possibility
	13.	Test
Required readings:	Andrew Ciesielski: An Introduction to Rubber Technology	
Recommended readings:	Treloar: Rubber Elasticity	
Assessment methods and criteria:		

Course Description	
Course title:	Materials Testing
Neptun code:	MAKPOL227B
Status: core, specialization, optional, other:	compensational
Type : lecture/seminar (practical)	lecture and practice
Number of credits; hours per week	4 2+2
Name and position of lecturer:	Prof. György CZÉL
Contact of lecturer:	femczel@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	english
Suggested semester: autumn /spring, 1-6	autumn, 1
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	Purpose of the subject: Theoretical and practical knowledge transmission in the topic of materials testing. The subject intends to explain the role and importance of material testing in construction, manufacture, diagnostic of operating condition, analyzing damages. Practical knowledge transmission in measurements techniques are also one of the most important tasks. Definition of stress and strain. Definition of hardness: Brinell method, the tool and inprint geometry, relation of ball–size loading force and loading time, Vickers method, the tool, trace geometry, micro hardness, Rockwell method, principle of hardness, measuring tools and equations, harness of polymers. Tensile test: tensile tester equipment, the test specimen, force measurement, measuring of strain, the effect of deformation velocity, stress-strain curve, sections of elastic in curve, characteristic of the material: extension, contraction, resistance to tensile stress, yield strength. Material characteristics: defined by tensile test: modulus, Poisson ratio, hardening exponent, rigidity, Test serial: Compression test, compressive stress-strain curves, flexure test: basics and practical presentation. Fracture mechanics investigations: Fundaments of fracture mechanics, crack propagation, role of crack propagation, Charpy experiment, fracture of ideal elastic material, tension intensity factors KI, KII, KIII, KIC, elasto-plastic model, plastic model, fracture toughness. Fundaments of creep effect, creep-time diagram, creep-rupture strength, role of temperature on creep, relaxation process. Endurance test: basics, Wöhler- diagram, internal force, fatigue strength diagram, statistical methods (Weibull), simplified methods (LOCATI) Material category in terms of fracture behaviours: Brittle material, plastic super plastic fracture, Type of fracture and their material and temperature relation, transient temperature of different materials. Non-destructive testing: radiological testing, basics characteristics of ray, mass-absorption coefficient, contrast, sharpness, dosimeters, transparency, isotopic test Ultrasonic testing: basics, ultra sound generation, detectors, testing methods, acoustic tests. Significance of material testing in the industry: regulations of sample selection, basics; quality, data
Required readings:	credit requirement minimum 50 % knowledge level, written test + oral presentation
Recommended readings:	William D. Callister, Fundamentals of Materials Sciences and Engineering
Assessment methods and criteria:	Practice: Measurements notes and documentation