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. Dávid GÖNCZI senior lecturer
Contact of lecturer:	david.gonczi@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 1
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	The main objective of this course is to provide the students with an introduction to the theory of elasticity, finite element modelling and plasticity. Further aim is to present the fundamental concepts and methodologies, then to apply them to the solutions of engineering problems (such as design of pressure vessels, pipes and tubes, disks or beams). Main topics: tensor algebra in indicial notation, kinematics of deformation for large and infinitesimal deformations, strain and stress tensors and measurement methods, constitutive equations, basic boundary value problem of thermoelasticity and its solution approaches, variational approach, basics of finite element modelling and plasticity.
Required readings:	1. Sadd M. H.: Elasticity: Theory, Applications and Numerics. Third edition, Academic Press, 2014. 2. Reddy J. N.: Energy Principles and Variational Methods in Applied Mechanics, 2nd Edition, John Wiley and Sons, 2002.
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:	peter.varga@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	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 their 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 Object and purpose of the course: Application of differential equations for characterization of static and dynamic systems. Linear systems theory, partial differential equations theory. Numerical methods. Thematic description of the subject: Concept and classification of ordinary and partial differential equations, geometric interpretation of first order differential equations. Numerical methods (Euler, Heun), Taylor's solution of the solution, error estimation. Qualitative behavior of first-order DE, concept of linearization. The problem of the existence and clarity of the solution. Homogeneous systems of linear differential equations. Eigenvalues and eigenvectors. Exponential function of matrices. Jordan resolution. Stability test. Complex exponential function. Derivation of complex functions, Taylor series. Nonlinear DE systems. Linearization, stability. Inhomogeneous constant coefficients DE (system). Pulse and frequency response. Laplace transformation and its applications. Line integrals of complex functions. Cauchy formulas. Types of partial DEs. Fourier series, integrals. Thermal equation and wave equation. Laplace operator and equation.
Required readings:	1. Paul Dawkins: Differential Equations (free textbook, http://tutorial.math.lamar.edu/Classes/DE/DE.aspx) 2. MIT OCW: Honors Differential Equation 18.034 http://mit.ocw.edu/courses/mathematics
Recommended readings:	P. Olver : Introduction to Partial Differential Equations, Springer, 2014.
Assessment methods and criteria:	

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	4; 3
Name and position of lecturer:	Dr. Ferenc MOGYORÓDY associate professor
Contact of lecturer:	ferenc.mogyorody@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 2
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	The purpose of the course: To introduce the students to the chemical knowledge required for non-chemical engineering activites. The course' content: Type and influence of the chemical reactions, the chemical speciality of the materials used in engineering. Quantity of the technological waters, chemical principles of technological water treatment. Water, water treatment, drinking water, industrial water, waste water and treatment. Type of catalysts and structures. Connection to chemical technologies. Raw materials of the chemical industry. Basics of Unit Operations. The chemistry of the natural gas, oil, mineral coal used for energy production. Energy production. Basics of the Green chemistry. Basics of C1-chemistry, Transport processes, viscosity, diffusion, heat transport, electric conductance, basics of hydrodynamics. Corrosion phenomena.
Required readings:	1. The material of the lectures is available for the students in pdf format. 2. P.W.Atkins: Physical Cemistry II. 3. Plawsky, Joel L. (April 2001). Transport phenomena fundamentals (Chemical Industries Series). CRC Press. pp. 1, 2, 3. ISBN 978-0-8247-0500-8. 4. Transport Phenomena (1 ed.). Nirali Prakashan. 2006. p. 15-3. ISBN 81-85790-86-8., Chapter 15, p. 15-3
Recommended readings:	
Assessment methods and criteria:	

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:	Prof. Dr. György KAPTAY professor
Contact of lecturer:	kaptay@hotmail.com
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 2
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	Aim of the course: To demonstrate that in addition to classical temperature, pressure, and composition state determinants, phase size is determinative in the nanometer range, that is, it determines phase equilibria, not to mention chemical and electrochemical equilibria. Students will learn the expected phase balance, chemical balance in nano-sized materials and the basics of electrochemical equilibrium. To teach both theoretically and technically how to calculate phase equilibria in one- and two-component materials systems and how to read the characteristics of equilibrium from them. Keywords: System, phase, component, mole fraction, phase fraction, materials balance, characteristics of the equilibrium state, state parameters, Gibbs energy, laws of thermodynamics, condition of global and heterogeneous equilibria, phase rule, one-component phase diagrams (construction and interpretation), Gibbs energy of two-component mixtures and solutions, ideal solution and their phase diagrams (their derivation and interpretation), solutions models and the 4th law, compound phases, two-component phase diagrams (their derivation, interpretation and classification), phase diagrams + phase ratio diagrams + phase composition diagrams.

Required readings:	1. N.Saunders, AP Miodownik: CALPHAD, a Comprehensive Guide, Pergamon, 1998, 479 p 2. Lukas HL, Fries SG, Sundman B: Computational Thermodynamics. The Calphad method. Cambridge University Press, 2007, Cambridge, UK, 313 pp. 3. 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. 4. G.Kaptay: Nano-Calphad: extension of the Calphad method to systems with nano-phases and complexions - J Mater Sci, 2012, vol.47, pp.8320-833 5. G.Kaptay. The exponential excess Gibbs energy model revisited. Calphad, 2017, vol.56, pp.169-184. doi: 10.1016/j.calphad.2017.01.002. + course material (manuscript) written by G.Kaptay 2016 – 2018.
Recommended readings:	
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:	**Interfacial phenomena**
Neptun code:	MAKFKT347M
Status: core, specialization, optional, other:	core
Type : lecture/seminar (practical)	2l.
Number of credits; hours per week	4; 2
Name and position of lecturer:	Prof. Dr. György KAPTAY professor
Contact of lecturer:	kaptay@hotmail.com
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 1
Requirements (exam/practical mark/signature/report, essay)	exam

Course objectives (50-100 words):	Study goals: Demonstrate that material engineering practice can only be extended to nano-material production if the engineer acquires knowledge of interfacial phenomena. To make it clear that the majority of materials technologies are dependent on interfacial phenomena. Teaching the method to convert this understanding into the ability for materials and technological design Course' content: Basics on interfaces (specific surface area, molar surface area, classification and understanding of interfacial energies, the integral Gibbs energy as function of interfacial energies). Modeling interfacial energies (surface tension, surface energy, liquid/liquid interfacial energy, solid/liquid interfacial energy, solid/solid interfacial energy) as function of materials quality (chemical bond type) and temperature. Modeling interfacial energies as function of composition (Gibbs and Langmuir vs. Butler). Understanding and modeling interfacial phase separation. Phase equilibria influenced by interfacial energies (the extended phase rule and the corrected phase diagrams). Understanding interfacial forces. Modeling complex phenomena involving interfacial forces.
Required readings:	1. A.W.Adamson: Physical Chemistry of Surfaces, 5th ed., John Wiley and Sons Inc., NY, 1990. 2. J.N.Israelachvili: Intermolacular and surface forces, Academic Press, London, 1992 3. R.Defay, I.Prigogine, A.Bellemans, D.H.Everett. Surface tension and adsorption. Logmans, Green and Co, London (1966). 4. H.N. Butt, K. Graf, M. Kappl. Physics and Chemistry of Interfaces. Weinheim: Wiley (2003). 5. N.Eustathopoulos, M.G.Nicholas, B.Drevet: Wettability at High Temperatures, Pergamon, 1999, 420 pp. + course material (manuscript) written by G.Kaptay 2015 – 2018.
Recommended readings:	
Assessment methods and criteria:	Requirements during the semester: One home work + one test 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:	**Intellectual properties law**
Neptun code:	MAKPOL264M
Status: core, specialization, optional, other:	core
Type : lecture/seminar (practical)	3p.
Number of credits; hours per week	4; 3
Name and position of lecturer:	Prof. Dr. György CZÉL professor
Contact of lecturer:	gyorgy.czel@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 4
Requirements (exam/practical mark/signature/report, essay)	practical mark

Course objectives (50-100 words):	Study goals: The purpose of subject is to acquaint the students with the forms of intellectual property law. Course content: The means of effective protection of intellectual property is demonstrated in the framework of this subject. The following topics are especially highlighted: 1. The branches of protection of intellectual property and their fields 2. The concept, subject and extent of copyright 3. The concept and significance of voluntary register of works and the process of procedure Copyrights and their limits 4. The professional book as a task of copyright; the cases of free adaptation 5. The professional paper as a paper of copyright, citation and reference 6. Linked and adjacent legitimacy and their limits in the copyright 7. Specification of safe-keeping forms known in the industrial legal protection and the short review of their different fields. 8. The content and limits of licences and patents as the safe-keeping form of industrial legal protection 9. The structure of description of patent. The conditions of patentability 10. Possibilities of obtaining the EU patents 11. The development and significance of patent data base 12. Content and development of the utility model protection 13. Significance and sphere of protection of trade marks. Content of classification system developed in Viena and Nice. The Community Trade Mark 14. Extent and significance of design protection 15. Significance of geographical indication. Method of validation and content of this form of protection
Required readings:	1. WIPO: Protection of Intellectual properties 2. L. Bently, B. Sherman: Intellectual Property Law 3. R. Radhakrishnan,S. Balasubramanian: Intellectual Property Rights 4. Howell Claire, Farrand Benjamin: Intellectual Property Law
Recommended readings:	
Assessment methods and criteria:	

Course Description

Course title:	**Project management**
Neptun code:	MAKMET300M
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. Béla TÖRÖK associate professor
Contact of lecturer:	bela.torok@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 4
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: Project management has evolved to plan, coordinate and control the complex and diverse activities of modern industrial, commercial and management change and IT projects. The purpose of project management is to foresee or predict as many of the dangers and problems as possible and to plan, organize and control activities so that projects are completed successfully in spite of all the risks. The course involves the descriptions about perspectives, principles, stakeholders, sponsors, managers and processes of a general project. Moreover the course provides detailed information about managing the team, scope, schedule, budget, quality and risks of the projects.
Required readings:	1. Dennis Lock: Project Management. Gower Publishing Limited (UK), 2013. ISBN-13: 978-0-566-08772-1 2. Rodney Turner: Handbook of Project Management. Gower Publishing Limited (UK), 2012 3. Scott Berkun: Art of Project Management. Cambridge, MA: O'Reilly Media. ISBN 0-596-00786-8 (2005) 4. A Guide To The Project Management Body Of Knowledge, 3rd ed., Project Management Institute. ISBN 1-930699-45-X (2003) 5. James Lewis: Fundamentals of Project Management, 2nd ed., American Management Association. ISBN 0-8144-7132-3 (2002)

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: test writing (20 questions, at least 11 good answers = allowed to exam) Exam: written work based on 3 essay tasks

Course Description	
Course title:	**Quality management systems**
Neptun code:	MAKMKT520EN
Status: core, specialization, optional, other:	core
Type : lecture/seminar (practical)	2l
Number of credits; hours per week	4; 2
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, 1-4	s, 4
Requirements (exam/practical mark/signature/report, essay)	exam

Course objectives (50-100 words):	The objective of the course is to learn quality management concept of production companies; the main quality-related tasks at management level. The students will be able to organise their works and work processes in a quality-oriented manner. The topics are supported by best practice case studies. The students solve practice-oriented project tasks. Course content: Essentials and tendencies of quality approaches. The main areas of quality management (QM). Special QM tasks in material science research institutes and laboratories. Process model of quality management. Introduction to the ISO 9001 quality management standard; QM audit process. Essentials of Total Quality Management (TQM). Statistical Process Control (SPC); its place in QM and the connecting managerial tasks. Lean Six Sigma as a QM/QA system. Managerial support of continuous improvement (CI). Supplier Quality Management (SQM), tendencies and standards. Challenges of Quality 4.0.
Required readings:	• Juran, J. M.: A history of managing for quality: The evolution, trends, and future directions of managing for quality, ASQC QP, 1995. • 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. • Luis, R-L: Building quality management systems: Selecting the right methods and tools, CRC, 2013.
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:	Ágota HARGITAI-KAZUP, assistant research fellow
Contact of lecturer:	agota.kazup@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 1

Requirements (exam/practical mark/signature/report, essay)	practical mark
Course objectives (50-100 words):	Students acquire knowledge about special microstructure investigation techniques. Some of them will be used in practice and theory as well. Course content: Morphological classification of single and multi-phase materials. Characterization of grains and particles, interpretation of grain size distribution. Structural anisotropy and orderliness. Classification of two dimensioned grains by shape. Principles of SEM, XRD and TEM. Using image analysis method to characterize multi-phase structural. Project work. In the framework of project work, all students get an unknown sample. During lecture to pratical course, students get information about his/her samples. The source of the information is provided by the studied examination methods. Based on this approach, they get knowlegde both the theoretical and practical side of the techniques, while the identify and characterize their samples. At the end of the semester, students have to make a presentation about their samples, i.e. they have to present their project.
Required readings:	1. Microstructural Investigation and analysis, Volume 4, B. Jouffrey, Online ISBN: 9783527606160, Print ISBN: 9783527301218, DOI: 10.1002/3527606165 2. ASM Metals Handbook, Ninth Edition, v. 9, ""Metallography and Microstructures"", American Society for Metals, Metals Park, OH, 1985, p. 1 3. Underwood E. E.: Quantitative Stereology. Menlo Park, California. Addison-Wesley Publishing Company. (1970) p. 23.
Recommended readings:	
Assessment methods and criteria:	

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. Zoltán Dávid GYÖKÉR, research fellow
Contact of lecturer:	david.gyoker@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 3
Requirements (exam/practical mark/signature/report, essay)	exam

Course objectives (50-100 words):	"Composites" is a one-semester course which is designed to provide students the general knowledge about composite materials. Lectures give the theoretical background, while practical work realize the knowledge utilization. The course covers the following topics: type and classification of composites (general); role of composites (general); classification of composites (general); classification of reinforcements, fabrication and properties of different type of reinforcements; main types of matrix materials and their properties; types and fabrication processes of PMC and CMC composites; types and production methods of MMCs; application field of different types of composites. Preparation and investigation of own MMC composite sample. Calculation practice. Project work Students can choose a self defined composite topic. In this field they have to collect 3-5 scientific article. They have to process the articles. It means they have to prepare literature matrix (highlight the aim of the studies, the applied techniques and the main results/ conclusions). Finally students have to present the main results of the articles and the compariosn of the different studies in a framework of a presentation.
Required readings:	1. KrishanK.Chawla. CompositeMaterials. Science andEngineering. ISBN 978-0-387-74364-6 ISBN 978-0-387-74365-3 (eBook) DOI 10.1007/978-0-387-74365-3 Springer New York Heidelberg Dordrecht London 2013 2. ASM Handbook Volume 21: Composite. Editor: D.B. Miracle and S.L. Donaldson. ISBN: 978-0-87170-703-1 3. Deborah D.L.Chung. CompositeMaterials. Science and Applications ISSN 1619-0181 ISBN 978-1-84882-830-8 e-ISBN 978-1-84882-831-5 DOI 10.1007/978-1-84882-831-5 Springer London Dordrecht HeidelbergNewYork
Recommended readings:	
Assessment methods and criteria:	

Course Description	
Course title:	**Polymer adhesives**
Neptun code:	MAKPOL260-17-M
Status: core, specialization, optional, other:	POLYMER ENGINEERING specialization
Type : lecture/seminar (practical)	2l. 2p.
Number of credits; hours per week	7; 4
Name and position of lecturer:	Dr. Tamás J. SZABÓ associate professor

Contact of lecturer:	tamas.szabo.mak@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 1
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	The course explains in detail the most common, every day glues and adhesives, their theory and practical application. Course content: Explaining of the chemistry and physics of the bond formation, and mechanisms. Discussing the importance of interfacial processes, their measurement and modification. Examination, determination and modification of flow properties of different liquid adhesives. Detailed discussion is presented about the processes occurring during joining and the methods of testing of the adhesives and the joints. Introduction of most common and historical important natural and synthetic adhesives, their properties and application. 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. For different material groups we discuss the optimal joining method for the plant loadbearing structures.
Required readings:	1. Anthony J. Kinloch: Adhesion and Adhesives: Science and Technology 2. Sina Ebnesajjad, Arthur H. Landrock: Adhesives Technology Handbook 3. David Lammas: Adhesives and Sealants (Workshop Practice)
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:	POLYMER ENGINEERING specialization
Type : lecture/seminar (practical)	2l. 2p.
Number of credits; hours per week	7; 4
Name and position of lecturer:	Prof. Dr. György CZÉL professor
Contact of lecturer:	femczel@uni-miskolc.hu
Prerequisite course(s):	

Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 4
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	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. Educated processes: mixing, hot mixing, rolling, calendaring, injection moulding, extrusion, blow moulding, Hot-forming of plastics, vacuum forming, fiberising techniques, their material-specific characteristics and machinery. Calculation tasks: Calculation of closing force during injection moulding. Extent of orientation during extruded tube blowing.
Required readings:	1. Sors-Balázs: Design of Plastic Moulds and dies Akadémiai Kiadó 1989 ISBN 963 05 4690 6 2. Robert O. Ebewelle: Polymer Science and Technology, CRC Press Boca Raton, New York, 2000.
Recommended readings:	
Assessment methods and criteria:	

Course Description	
Course title:	**Polymer study II.**
Neptun code:	MAKPOL261-17-M
Status: core, specialization, optional, other:	POLYMER ENGINEERING specialization
Type : lecture/seminar (practical)	3l. 1p.
Number of credits; hours per week	7; 4

Name and position of lecturer:	Dr. Tamás J. SZABÓ associate professor
Contact of lecturer:	tamas.szabo@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 2
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	The aim of the course is to deepen students' knowledge of polymeric materials, formerly Polimertan I scientific explanation of the relationships learned in the course, acquisition of new knowledge. Course' content: 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.
Required readings:	1. 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 2. 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. 3. 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:	**Polymer product design**
Neptun code:	MAKPOL263-17-M

Status: core, specialization, optional, other:	POLYMER ENGINEERING specialization
Type : lecture/seminar (practical)	1l. 3p.
Number of credits; hours per week	7; 4
Name and position of lecturer:	Dr. Tamás J. SZABÓ associate professor
Contact of lecturer:	tamas.szabo@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 3
Requirements (exam/practical mark/signature/report, essay)	practical mark
Course objectives (50-100 words):	Learn to conceptualize and evaluate ideas before turning them into products. Description of the conceptual process for the preparation of a given object, with particular regard to material selection. During the semester, students may encounter various manufacturing and processing problems and criteria that can better understand the problems of introducing a new product. Choose a polymer product (keyholder, firsbee etc.). Design the look of the product, the processing method and choose the best polymer base material. The students have to build up their project based on their selection of product as checking the historical and current materials choices. They have to define a property criteria parameter set in order for the product fulfill its intended purpose. They have freedom of design the lock of the product but they have to pick a material and a processing technique which can produce their envisioned design. They have to prepare a written material describing the design, selection, process with some conceptual drawings of their product by the end of the semester. At the end of the semester they have to give a short presentation about their product, the material, the design, the process and their path getting there.
Required readings:	1. 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. 2. 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:	
Assessment methods and criteria:	

Course Description	
Course title:	**Colloid chemistry**
Neptun code:	MAKKEM274-17-M
Status: core, specialization, optional, other:	CHEMICAL TECHNOLOGY specialization
Type : lecture/seminar (practical)	2l; 2p
Number of credits; hours per week	7; 4
Name and position of lecturer:	Prof. Dr. Milán SZŐRI professor
Contact of lecturer:	milan.szori@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 1
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	1. Introduction to Colloid and Surface Chemistry: the importance of the surface for small particles, classification of colloids based on affinity to carrier fluid, concept of stability of colloidal systems some physical characteristics of colloids. 2. Sedimentation and diffusion and their equilibrium: gravitational and centrifugal sedimentation, Brownian motion and diffusion. Basic of the random coil and random walk statistics. 3. Solution Thermodynamics: Osmotic and Donnan equilibria. Osmotic equilibrium in charged systems 4. The rheology of dispersions: Newton's Law of viscosity. Viscometers. The equation of motion: Navier-Stokes equation. Einstein's theory of viscosity of dispersions. Beyond the Einstein Model, Non-Newtonian behavior. Viscosity of polymer solutions 5. Static and dynamic light scattering and other radiation scattering 6. Surface tension and contact angle. Effects of curved interfaces on phase equilibria and nucleation: the Kelvin equation. Contact of liquids with porous solids and powders. Molecular interpretation of surface tension. 7. Adsorption from solution and monolayer formation. The Gibbs equation. Adsorption on solid surfaces. Applications of adsorption from solution 8. Association Colloids. Colloidal structures in surfactant solutions. Structure and Shapes of Micelles. Critical micelle concentration (cmc) and the thermodynamics of micellization. Solubilization. Reverse micelles. Emulsions and microemulsions. Biological membranes. 9. Adsorption at gas-solid interfaces: experimental and theoretical treatments of adsorption. Thermodynamics of adsorption. Multilayer adsorption: The Brunauer-Emmett-Teller (BET) isotherm. Adsorption in porous solids and on crystallines. 10. van der Waals Forces. Role of van der Waals forces in Colloid and Surface Chemistry. Molecular Origins and the Macroscopic Implications of van der Waals Forces. Extremes: van der Waals Forces Between Large Particles and Over Large Distances 11. The Electrical Double Layer and Double-Layer Interactions. Surface Charges and Electrical Double Layer: The Capacitor Model, The Debye-Huckel Approximation, Gouy-Chapman Theory. Stern Adsorption. 12. Electrophoresis and other electrokinetic phenomena. Mobilities of small ions and macroions in electric fields. Zeta potential. Electroosmosis. Streaming potential. The surface of shear and viscoelectric effect. Applications of electrokinetic phenomena. 13. Electrostatic and Polymer-Induced Colloid Stability. Interparticle forces and the structure and stability of dispersions. The Derjaguin-Landau-Verwey-Overbeek (DLVO) theory of colloid stability. Theory of coagulation in dilute dispersions. Polymer-colloid mixtures. Polymer-induced forces. Steric stabilization.

Required readings:	1. Paul C. Hiemenz, Raj Rajagopalan: Principles of Colloid and Surface Chemistry (3rd Edition), CRC Press, New York (1997). ISBN 0-8247-9397-8 2. Barnes G.T., Gentle I. R.: Interfacial Science, Oxford University Press, (2005). ISBN 978-0199571185 3. Arthur W. Adamson, Alice P. Gast Physical Chemistry of Surfaces, John Wiley &Sons, Inc., New York (1997) ISBN 0-471-14873-3 4. Laurier L. Schramm: Emulsions, Foams, Suspensions, and Aerosols Microscience and Applications (2nd Edition) Wiley-VCH Verlag GmbH & Co. (2014). ISBN: 978-3-527-33706-42014 5. Carl W. Garland, Joseph W. Nibler, David P. Shoemaker: Experiments in Physical Chemistry (8th edition) McGraw-Hill, New York 2009, ISBN 978-0-07-282842-9
Recommended readings:	
Assessment methods and criteria:	

Course Description	
Course title:	**Reaction kinetics and catalyzis**
Neptun code:	MAKKEM275-17-M
Status: core, specialization, optional, other:	CHEMICAL TECHNOLOGY specialization
Type : lecture/seminar (practical)	3l; 1p
Number of credits; hours per week	7; 4
Name and position of lecturer:	Prof. Dr. Béla VISKOLCZ professor
Contact of lecturer:	bela.viskolcz@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 2
Requirements (exam/practical mark/signature/report, essay)	exam

Course objectives (50-100 words):	The (chemical) thermodynamics and reaction kinetics. Reaction parameters affecting chemical changes, reactions and speeds. Reaction rate, velocity equation, reaction order, molecularity. Experimental determination of reaction rate. Homogeneous chemical reactions. Speed equations of simple reactions. Reaction of the reaction. Determination of reaction order and subdivisions. Null, first, second, third, n-ed reactions. Dependence of reaction rate. Collision and Activated (Temporary) Complex Theory. Pressure volume-dependent reactions. Compound reactions. Parallel reactions. Serial reactions. Consecutive-competitive responses. Homogeneous catalytic reactions, autocatalytic reactions. Stage reactions, chain reactions, combustion, explosion, detonation. Reversible steady and irreversible reactions. Heterogeneous reactions. Parameters influencing heterogeneous processes. Heterogeneous catalysis, heterogeneous catalysts. Reactor types suitable for industrial application of reactions. Decomposition reactions. Thermal, catalytic, decomposition. Kinetics of polymerization processes. Types of chemical reactors. Introduction to the operation of chemical processes.
Required readings:	1. G. F. Froment, K. B. Bischoff: Chemical Reactor Analysis and Design. John Wiley & Sons, 1990. 2. M.J. Pilling- P.W. Seekins: Reaction Kinetics Oxford Science Publications, 1996. 3. O. Levenspiel: Chemical Reaction Engineering. John Wiley & Sons, 1999. 4. P. Atkins, J. de Paula, Physical Chemistry 9th Edition, Oxford University Press 2010.
Recommended readings:	
Assessment methods and criteria:	

Course Description	
Course title:	**Chemical processes II.**
Neptun code:	GEVGT227-17-M
Status: core, specialization, optional, other:	CHEMICAL TECHNOLOGY specialization
Type : lecture/seminar (practical)	3l; 3p
Number of credits; hours per week	7; 6
Name and position of lecturer:	Prof. Dr. Gábor L. SZEPESI professor
Contact of lecturer:	gabor.szepesi@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 3
Requirements (exam/practical mark/signature/report, essay)	exam

Course objectives (50-100 words):	Object and purpose of the course: The aim and task of the course is to provide students with a basic understanding of the operational calculus of heat transfer related tasks, and to be able to dimension appliances / equipment. This course will introduce the basics of the unit operations and chemical processes. The students will get to know the fundamentals of mechanical separation technics (including filtration, sedimentation, fluidization, gas-solid separation), the methods of the heat transfers and evaporation, basics and detailed knowledge of mass transfer (including the phase equilibrium between vapor-liquid, gas-liquid and solid-liquid phases). During the course the students pick up a knowledge about the operational calculation of the heat exchangers and distillation and absorption columns. This subject also introduces the drying methods and equipment. The topic is as follows: presentation of heat transfer forms. Fourier I. Experimental Heat Conductivity and the Differential Equation of Heat Conduction. The differential equation of heat conduction and convection. Numerical methods for calculating thermal conductivity. Convective forms of heat transfer. Criteria for similarity. Determination of heat transfer coefficients in and outside the pipe. Basic equation for heat exchangers, standard temperature difference. Heat exchanger structures. Thermal radiation. Operation of evaporation. Evaporative constructions. Barometric vacuum condenser.
Required readings:	1. Perry's Chemical Engineers' Handbook, Eighth Edition. McGraw-Hill Education – Europe. 2007. New York. ISBN 978-0-07-142294-9 Vol. 5,6,11,12,13,15,16,17,18 2. Ramesh K. Shah, Dusˇan P. Sekulic - Fundamentals of heat exchanger design. John Wiley & Sons, Inc., Hoboken, New Jersey pp97 - pp227. ISBN 0-471-32171-0 3. Diran B. - Mass Transfer -Principles and Applications 2004 CRC Press LLC ISBN 0-8493-2239-1 pp.1-33, pp189-238. pp243-345.
Recommended readings:	
Assessment methods and criteria:	

Course Description	
Course title:	**Modelling of chemical systems**
Neptun code:	GEVGT228-17-M
Status: core, specialization, optional, other:	CHEMICAL TECHNOLOGY specialization
Type : lecture/seminar (practical)	2l; 1p
Number of credits; hours per week	3; 3
Name and position of lecturer:	Dr. Viktória KÁLLAI, assistant research fellow
Contact of lecturer:	viktoria.kallai@uni-miskolc.hu

Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 3
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	Object and purpose of the course: Learn the basics of chemical process modeling. Course' content: Analysis and synthesis of chemical processes. The application areas of modelling in the practice of chemical engineering. Set up of models for chemical unit operations, processes, technologies. Design equations. Elements of models, mass balance, heat balance, transport processes. Theories, alternatives and practice of modelling. Different levels of chemical prong, unit operation level, complex systems, processes and technologies. Specialties and challenges of the different levels. Treatment of heat and mass recycles. Convergence acceleration. Computer aided chemical engineering. Professional flowsheeting packages. Individual work: design and modelling of chemical processes.
Required readings:	1. William L. Luyben, Process Modeling, Simulation, and Control for Chemical Engineers, ISBN 0-07-017762-7 2. J. M. Douglas, Conceptual Design Chemical Processes, ISBN 0-07-017762-7
Recommended readings:	
Assessment methods and criteria:	

Course Description	
Course title:	**Optimalization of chemical systems**
Neptun code:	MAKKEM280-17-M
Status: core, specialization, optional, other:	CHEMICAL TECHNOLOGY specialization
Type : lecture/seminar (practical)	2l, 1p
Number of credits; hours per week	4; 3
Name and position of lecturer:	Prof. Dr. Péter MIZSEY professor emeritus
Contact of lecturer:	peter.mizsey@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	a, 3
Requirements (exam/practical mark/signature/report, essay)	exam

Course objectives (50-100 words):	Object and purpose of the course: The course is designed to provide students with a deeper understanding of chemical industry modeling. The aim is that students be able to examine smaller systems using available software and learn the modeling capabilities of more complex heat and material transfer processes. Course' content: Modelling, different applicable models, basics of mathematical modelling aiming to determine an objectiive function for the sake of optimization. Definition of local and global optima. Examples for objective function model: unit operations, perfectly mixed tank reactor, plug flow reactor Optimization methods: Classical function analysis, maxima and minima, analysis of derivatives Theory and method of Lagrange multiplicator Non-linear programming, basics, numerical calculation of derivatives, different kinds of gradient methods, other numerical methods. Methods without gradients, determination of minima and maxima of objective function of one variable and multivariable. Scanning method. Comparison of methods, methods for global and local optimization. Individual optimization work.
Required readings:	1. Rajesh Kumar Arora, Optimization: Algorithms and Applications, ISBN-13: 978-1498721127 2. Suman Dutta, Optimization in Chemical Engineering, ISBN: 9781107091238
Recommended readings:	
Assessment methods and criteria:	

Course Description	
Course title:	**Fundamentals of ceramics II.**
Neptun code:	MAKKSZ261M
Status: core, specialization, optional, other:	CERAMIC ENGINEERING specialization
Type : lecture/seminar (practical)	2l, 2p
Number of credits; hours per week	6, 4
Name and position of lecturer:	Dr. István KOCSERHA, associate professor
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English

Suggested semester: autumn /spring, 1-4	a, 1
Requirements (exam/practical mark/signature/report, essay)	exam
Course objectives (50-100 words):	Aim of the course: the main fields of the ceramics industry are introduced. Students will gain an in-depth understanding of the material structure and properties of ceramic materials. The basic materials and their properties of traditional, structural and functional ceramics will be introduced based on two- and three-element phase diagrams. The main shaping technologies are being presented and an overview of ceramic shaping operations is given. A general introduction to equipment for the heat treatment of ceramics and an overview of solid phase sintering. Each topic is complemented by practical exercises specific to the topic. After completing the course, students should have sufficient knowledge to be able to understand ceramic materials, both in terms of raw materials and production technologies.
Required readings:	Phillipe Boch, Jean-Claude Niepce, Ceramic Materials, ISTE Ltd, 2007
Recommended readings:	B. Gartner, G. Norton: Ceramic Materials, Science and Engineering, Springer, 2007 Duggal S.K.: Building Materials, New Age Int. Ltd., 2008 Harbison-Walker – Handbook of refractory practice, 2005 B. Kohlas. Cement Engineers Handbook, Bau-Verlag, 1983 James E Shelby: Introduction to Glass Science and Technology, 2005
Assessment methods and criteria:	

Course Description	
Course title:	**Ceramic technology I.**
Neptun code:	MAKKSZ261M
Status: core, specialization, optional, other:	CERAMIC ENGINEERING specialization
Type : lecture/seminar (practical)	3l, 2p
Number of credits; hours per week	6, 5
Name and position of lecturer:	Dr. Róbert GÉBER, associate professor
Contact of lecturer:	robert.geber@uni-miskolc.hu
Prerequisite course(s):	-
Language of the course:	English
Suggested semester: autumn /spring, 1-4	autumn, 3
Requirements (exam/practical mark/signature/report, essay)	signature, exam

Course objectives (50-100 words):	This course provides a comprehensive overview of the raw materials, technologies and most important properties of the binder industry, building materials (asphalt and concrete) and glass industry. The aim of the course is to enable students to identify the links between the selected raw materials, technologies and the composition and properties of the final product, to interpret and solve professional problems, and to plan and carry out independent research.
Required readings:	1. https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/CLM_Published_def_0.pdf 2. https://op.europa.eu/en/publication-detail/-/publication/ff8a3955-d0d0-46f5-8a15-4b638896cb56
Recommended readings:	1. https://www.geopolymer.org/ 2. https://www.cement.org/ 3. https://www.lime.org/publications/free-downloads/
Assessment methods and criteria:	The content of the course is assessed by an oral exam, with a grade of 1-5. The candidate will be given a series of questions corresponding to the topics of the lectures, which he/she will have to outline on paper and then present orally.

Course Description	
Course title:	**Ceramic technology II.**
Neptun code:	MAKKSZ263M
Status: core, specialization, optional, other:	CERAMIC ENGINEERING specialization
Type : lecture/seminar (practical)	2l, 2p
Number of credits; hours per week	5, 4
Name and position of lecturer:	Dr. Róbert GÉBER, associate professor
Contact of lecturer:	robert.geber@uni-miskolc.hu
Prerequisite course(s):	-
Language of the course:	English
Suggested semester: autumn /spring, 1-4	spring, 4
Requirements (exam/practical mark/signature/report, essay)	practical mark
Course objectives (50-100 words):	This course is to provide knowledge of fine ceramics, refractories and technical ceramics technologies (in particular production technologies for functional and structural ceramics). The aim of the course is to enable students to identify the links between the chosen raw materials, technologies and the composition and properties of the final product, to interpret and solve professional problems, and to plan and carry out independent research.
Required readings:	1. Ceramic Materials - Processes, Properties, and Applications, Ed. P. Boch, J. Niépce; ISTE Ltd, (2007) 2. M. N. Rahaman: Ceramic Processing and Sintering, 2nd Edition; Marcel Dekker Inc. (2003) 3. A. M. Alper: Phase diagrams in advanced ceramics; Elsevier Inc. (1995)

Recommended readings:	1. https://cinn.es/en/functional-ceramics/ 2. https://www.glass-ceramics.tf.fau.de/publications/
Assessment methods and criteria:	The content of the course is assessed by an oral exam, with a grade of 1-5. The candidate will be given a series of questions corresponding to the topics of the lectures, which he/she will have to outline on paper and then present orally.

Course Description	
Course title:	**Testing of ceramic materials**
Neptun code:	MAKKSZ264M
Status: core, specialization, optional, other:	CERAMIC ENGINEERING specialization
Type : lecture/seminar (practical)	2l, 2p
Number of credits; hours per week	5, 4
Name and position of lecturer:	Dr. István KOCSERHA, associate professor
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu
Prerequisite course(s):	
Language of the course:	English
Suggested semester: autumn /spring, 1-4	autumn, 3
Requirements (exam/practical mark/signature/report, essay)	Practical mark
Course objectives (50-100 words):	Students will learn the most common methods of ceramic materials testing. For each method it is explained when to use the method, what measurement results can be obtained using it, its limitations, and errors. The sample preparation requirements for each method are addressed separately. We will cover, among others, XRF, XRD, DTA, DSC, FTIR, ICP, HFM, particle size determination, rotational rheometry, mercury porosimetry. Students will learn the statistical analysis and methods required for measurements
Required readings:	B. Gartner, G. Norton: Ceramic Materials, Science and Engineering, Springer, 2007
Recommended readings:	
Assessment methods and criteria:	On the basis of the assessment of the submitted project and the mark given for the presentation. Grade of 1-5.

Course Description	
Course title:	**Complex planning**
Neptun code:	MAKKSZ262M
Status: core, specialization, optional, other:	CERAMIC ENGINEERING specialization
Type : lecture/seminar (practical)	3l, 2p
Number of credits; hours per week	6, 5
Name and position of lecturer:	Dr. István KOCSERHA, associate professor
Contact of lecturer:	istvan.kocserha@uni-miskolc.hu
Prerequisite course(s):	Fundamentals of ceramics II.

Language of the course:	English
Suggested semester: autumn /spring, 1-4	s, 4
Requirements (exam/practical mark/signature/report, essay)	practical mark
Course objectives (50-100 words):	The aim of the course is to give students the opportunity to solve a factory and production design problem through a complex project task. In addition to multi-stage capacity calculations, machine selection, human resources organisation, production scheduling, energy balancing, they have to solve a subtask related to the production process. The progress of the project has to be presented in a presentation, which also improves the students' presentation skills and their preparation for the state examination.
Required readings:	No specific literature, Literature for each student's task will be determined individually, according to the content of the task. (eg. ceramic subjetcs: glass, brick, technical ceramics..)
Recommended readings:	
Assessment methods and criteria:	On the basis of the assessment of the submitted project and the mark given for the presentation. Grade of 1-5.