Courses Offered in Foreign Language; Faculty of Materials Science and Engineering University of Miskolc, Hungary

FALL SEMESTER

COURSE CODE*	COURSE NAME	CREDITS

Bachelor (BSc.) courses

MAKETT236B	**Combustion Theory**	**4**

Contact hours pro week: **0+3 (lectures+lab practice) /** Dr. PALOTÁS Árpád Bence

Course description

Thermodynamics (basic concepts, First Law of Thermodynamics, states and processes, system changes, entropy, thermodynamic cycles), thermal and flow properties of fluids and gases described by balance equations (balance equations, flow field and temperature distribution in continuing, applicability of Bernoulli's equation), heat transfer (convective heat transfer, heat tarnsport processes in solid objects, heat radiation), the ignition theory of gases.

Literature:

- Maximilian Lackner, Arpad Palotas, Franz Winter: Combustion: From Basics to Applications, Wiley VCH Verlag GmbH, 2013.
- Maximilian Lackner, Franz Winter, Avinash K. Agarwal: Handbook of Combustion, 5 Volume Set, Wiley VCH Verlag GmbH, 2010.
- Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine: Fundamentals of Heat and Mass Transfer, Wiley, 2001.
- Yeshvant V. Deshmukh: Industrial Heating: Principles, Techniques, Materials, Applications, and Design, CRC Press, 2005.

*Codes ending with "B" are for Bachelors (BSc) level, and courses ending with "M" are for Masters (MSc) level studies

MAKFKT225B **Physical metallurgy I.** **4**

*Contact hours pro week:***3+1 (lectures+lab practice) /** Dr. MERTINGER Valéria

Course description

Classification of forming processes . The metrics of deformation. Friction conditions . Cold and hot forming. The open die forging technological base . A typical free -forming operations. The general context of swaging . Deburring. Forging without burrs . Determination of the basic parameters necessary for machinery , forming machine selection. The extrusion forming process parameters . Rolling . The system of rolled products . The structure and main units of the rolling mills . Slabheating. Providing rough and ending mills. Shaped products (profiles) rolling. Cast Rolling. Cool, winding, finishing. Cold rolling. The initial product preparation. Pickling. And one-way reversing rolling mills . Pipe Manufacturing . Seamless steel pipe manufacturing. Squeezing of ease and non-ferrous tubes. Manufacturing of welded pipes. Drawing. Drawing technology. Wire drawing. Tube-drawing with wall thinning. Drawing conditions. Overview of alloys, including primarily the steel structures, the relationship between structure and properties, a Course description of the practical heat treatment of steels , heat treatments. The most important heat treatments of non- ferrous metals.

Literature:

- R. F. Tylecote (1992) A History of Metallurgy ISBN 0-901462-88-8
- Arthur Reardon (2011), Metallurgy for the Non-Metallurgist (2nd edition), ASM International, ISBN 978-1-61503-821-3

MAKPOL228B **Polymer study** **4**

*Contact hours pro week:***3+1 (lectures+lab practice) /** Dr. MAROSSY Kálmán

Course description

The course introduces the categories, the manufacturers, types and properties of the most common polymeric structural materials. Shows and explains the materials produced by domestic producers trough their catalogs and material data sheets. Evaluating and explaining the different information provided by the manufacturers of specific compounds.

Literature:

- "Define polymer". Dictionary Reference. Retrieved 23 July 2013.
- cCrum, 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.
- Sperling, L. H. (Leslie Howard) (2006). Introduction to physical polymer science. Hoboken, N.J.: Wiley. p. 10. ISBN 0-471-70606-X.

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MAKFKT267B **Nano-phenomena** **4**

*Contact hours pro week:***3+1 (lectures+lab practice) /** Dr. BAUMLI Péter

Course description

The system of units. The methods of nanotechnology. Specific surface area. Molar volume and molar surface area. The ratio of surface atoms. The Gibbs energy of nano-phases. The size dependence of one-component phase diagrams. Nomenclature and thermodynamic definition of interfacial energies. The mechanical definition of surface tension. Optimum shape of droplets; contact angle, adhesion energy. Characteristic values for surface tension and contact angle for different types of liquids and solids. Wettability of nano-structured surfaces; superhydrophobic surfaces. Penetration of liquids into porous solids. Adsorption and absorption. Segregation. Temperature and concentration dependence of surface tension. Marangoni convection. Nucleation. The general equation for interfacial forces. The interfacial anti-stretching force, the curvature induced interfacial force, the interfacial gradient force, the interfacial spreading force, the interfacial capillary force, the interfacial meniscus force, the interfacial adhesion force and the fluid bridge induced interfacial force. Stabilization of foams and emulsions by nano-particles. The Kirkendall effect (how to make porous nano-particles).

MAKMÖT255B **Surface Treatment** **4**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. TÖRÖK Tamás

Course description

Characterization of surfaces. Fundamental aims and techniques of surface treatments, and major trends in their evolution and further developments. Surface coating systems (their selection; technical possibilities and restrictions of their development; properties of coatings and their functions in practice). Complex systems of surface cleaning and pre-treatment techniques. Surface coatings /developing surface layers by high temperature and diffusion based methods/. Exploiting and application of thermal diffusion for surface treatment. Developing surface films and surface layers via electrochemical deposition techniques and technologies (like electroplating, etc.). Chemical and electrochemical surface treatments for surface modification (of surface roughness, reflection, etc.) and polishing. Corrosion and corrosion phenomena of metallic and non-metallic structural materials. Protective measures against corrosion. Environmental and corrosion protection in surface technologies and surface engineering. Testing techniques in the field of corrosion science and technologies. Inorganic non-metallic and conversion surface films and thin surface layers. Vitreous (glassy) enamels and techniques of enameling. Organic surface coatings (lacquers, paints, polymers, rubbers, and composite layers). Testing, evaluation and reparation techniques of coatings, modified surface zones and improved quality functional surface layers. Principles of tribology (surface properties, friction and wear, lubricants, and the related techniques and technological fundamentals). Novel surface treatment techniques (artificial diamond, deposition of thin polycrystalline and amorphous surface layers from gases; vacuum and plasma coating techniques like PVD, CVD, and PACVD).

Literature:

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- Wranglén, G.: An Introduction to Corrosion and Protection of Metals (1985) Chapman and Hall
- Oxtoby, D.W., Gillis, H.P., Nachtrieb, N.H.: Principles of Modern Chemistry (1999) Saundres College Publishing
- Gabe, D.R.: Principles of Metal Surface Treatment and Protection (2nd Ed. 1978), Pergamon Press
- Surface Engineering, Vol. 5 ASM International (1994) Materials Park, OH
- Handbook of Hard Coatings, Ed. Bunshah, R.F. (2001) Noyes Publications

MAKKEM231B **Analytical Chemistry** **4**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. LAKATOS János

Course description

Types, levels and steps of analyses. Sampling and sample preparation. Chemical methods of analyses: gravimetric, titrimetric methods, instrumental methods of analyses: elektroanalytical methods, spectral analytical methods, thermo analytical methods, Separation methods: mass spectrometry, chromatography.

Literature:

- Analytical chemistry, Douglas A. Skoog, Donald M. West Holt, Rinehart and Winston, (1979).
- Principles of instrumental analysis ,Douglas A. Skoog, F. James Holler, Timothy A.NiemanSaunders College Pub., (1998).
- Schaum's Outline of Analytical Chemistry, Adon Gordus McGraw-Hill Education, (1985).
- Quantitative Chemical Analysis, Sixth Edition Daniel C. Harris W. H. Freeman, (2003).

MAKPOL235B **Polymer Composites** **2**

*Contact hours pro week:***1+1 (lectures+lab practice) /** Dr. SZABÓ Tamás

Course description:

Classification of composite materials, grouping and classifying of polymer composites. Types and properties of reinforcing components. Particle reinforced composites, coatings layers and lamination methods. Surface and interface phenomena. Mechanical properties of PMC composites. Delamination and other failure types. Manufacturing of composites.

Literature:

- ASTM STP546: Composite Materials: Testing and Design

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MAKKEM212B **Organic Chemical Technologies** **3**

*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr. LESKOVICS Katalin

Course Description

Compulsory subject for chemical engineering technology specialized material engineering students. Course Objectives: Giving an overview of the important chemical transformation methods, processes in organic chemistry, using as example the BorsodChem technologies. Practice oriented education, the factory visits and laboratory work helps understanding, engineering thinking acquistion.

MAKKEM235B **Organic Chemical Analysis** **2**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. MURÁNSZKY Gábor

Course description

Organic Microanalysis: Basic Methods (C, H, N, halogen determination) , qualitative and quantitative analytics of the major functional groups. UV spectroscopy of molecules: electron structure, the symmetry of the energy fields and selection rules. Chromophore and auxochrome groups. Steric conditions and effects of the solvent. Chiroptical Spectroscopy: Optical activity and chirality. Properties of polarized light and the interaction of the light with chiral systems. Infrared spectroscopy: the formation of the vibrational and rotational spectra. Diatomic molecules, harmonic and anharmonic oscillator model. Normal vibrations of polyatomic molecules, binding and characteristic group frequencies and the conditions for the appearance. The relationship between IR and Raman spectroscopy. Vibration nomenclature types, external and internal (structural) factors affecting the frequency of the IR bands. Mass spectrometry. Different ionization methods, single and double focusing ion detection, sensitivity, resolution power, mass range. Mass spectrometry coupling (MS-MS, GC-MS, HPLC-MS). Natural abundance of isotopes. Nuclear magnetic resonance spectrometry (NMR): relaxation, chemical shift and spin -spin coupling, their effects and their relationship to the spectrum structure. Factors influencing the chemical shifts, substituent effects. Separation methods. Migration conditions for chromatography, retention time, distribution coefficient, selectivity, capacity. Chromatography columns, column resolution. Various methods of chromatography. Gas chromatography. Liquid chromatography. Electrophoresis.

MAKKEM236B **Practice of the Organic Chemical Analysis** **3**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. MURÁNSZKY Gábor

Course description

Organic Microanalysis: Basic Methods (C, H, N, halogen determination) , qualitative and quantitative analytics of the major functional groups. UV spectroscopy of molecules: electron structure, the symmetry of the energy fields and selection rules. Chromophore and auxochrome groups. Steric

conditions and effects of the solvent. Chiroptical Spectroscopy: Optical activity and chirality. Properties of polarized light and the interaction of the light with chiral systems. Infrared spectroscopy: the formation of the vibrational and rotational spectra. Diatomic molecules, harmonic and anharmonic oscillator model. Normal vibrations of polyatomic molecules, binding and characteristic group frequencies and the conditions for the appearance. The relationship between IR and Raman spectroscopy. Vibration nomenclature types, external and internal (structural) factors affecting the frequency of the IR bands. Mass spectrometry. Different ionization methods, single and double focusing ion detection, sensitivity, resolution power, mass range. Mass spectrometry coupling (MS-MS, GC-MS, HPLC-MS). Natural abundance of isotopes. Nuclear magnetic resonance spectrometry (NMR): relaxation, chemical shift and spin -spin coupling, their effects and their relationship to the spectrum structure. Factors influencing the chemical shifts, substituent effects. Separation methods. Migration conditions for chromatography, retention time, distribution coefficient, selectivity, capacity. Chromatography columns, column resolution. Various methods of chromatography. Gas chromatography. Liquid chromatography. Electrophoresis.Practical knowledge of the analytical methods used in organic analytical chemistry.

MAKKEM272B **Inorganic Chemical Technologies** **3**

*Contact hours pro week:***2+0 (lectures+lab practice) /** NÉMETHNÉ Dr. SÓVÁGÓ Judit

Course description

The subject of the inorganic chemical technology. Principles the inorganic chemical technology, basic concepts. The role of engineers in the chemical process operation. The main Operation Units in the chemical technology. Devices and operating systems, the concept of operational units .
Inorganic technological processes : Water technology : properties, occurrence, purification processes: characteristics and quality requirements of industrial water, physical and chemical preparation methods, treatment of waste water to reduce environmental harm. Chlorine Industry: Electrolysis of Sodium Chloride solution in order to Chlorine production. Production the solution of sodium hydroxide. Hydrochloric acid production, purification, Solvay soda ash production. Sulfuric acid production : sulfuric acid production technologies. Nitrogen Industry: Ammonia production. Production of nitric-oxide from ammonia . Nitric- acid production . Calculation excercises : Tasks related to water hardness by calculation, equilibrium composition calculation relating to ammonia, and sulfur-trioxide gas production, computing experience based on the principle of electrolysis. Visiting of Chlorine- and Water- and Waste Water Plant at BorsodChem, Water Plant at TVK and ADITY BIRLA Carbon Black Plant at Tiszaújváros.

MAKETT244B **Energy sources II.** **3**

*Contact hours pro week:***1+1 (lectures+lab practice) /** Dr. PÓLISKA Csaba

Course description

Types, characteristics and future perspectives of renewable energy sources in the global and domestic energy supply. Discussion of renewable-based technologies that are currently available or under development. Storage facilities and related problems.

Literature:

- Bent Sorensen: Renewable Energy, 3rd edition, Elsevier Inc., 2004.
- Neil Schlager and Jayne Weisblatt, editors: Alternative Energy, Volume 1., Thomson Gale, 2006.
- Sjaak Van Loo, Jaap Koppejan: The handbook of Biomass combustion & co-firing, Earthscan, 2007.
- Scott Bennett: Encyclopedia of Energy, Global Media, First Edition, 2007.
- Robert Foster, Majid Ghassemi, Alma Cota: Solar Energy: renewable Energy and the Environment, CRC Press, 2010.

MAKETT233B **Biomass Combustion** **3**

*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr. SZEMMELVEISZ Tamásné

Course description

The role of biomass feeds in the utilization of solid combustion fuels. Characterization of biomass fuels: types, combustion characteristics, combustivity index and other burning parameters, properly selected burning conditions, environmental impacts of biomass combustion. Industrial utilities and residential combustion devices (for biomass-based heat production): types and principles of operation.
Literature:

- Sjaak Van Loo, Jaap Koppejan: The handbook of Biomass combustion & co-firing, Earthscan, 2007.
- Bent Sorensen: Renewable Energy, 3rd edition, Elsevier Inc., 2004.
- Robert Foster, Majid Ghassemi, Alma Cota: Solar Energy: renewable Energy and the Environment, CRC Press, 2010.
- Edition 4 of the Biomass Energy Data Book: http://cta.ornl.gov/bedb/download.shtml
- Biomass Energy Data Book – 2011 – http://cta.ornl.gov/bedb

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MAKFKT271B **Technology of rolling** **2**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. KRÁLLICS György

Course description

Basic technological concepts of rolling. Hot, cold and warm rolling. The raw material for rolling mills. Products of rolling. The Flat Rolling Process. The Hot Rolling Process. Reheating furnace, Rough rolling, Coil boksz, Finish rolling, Cooling. The hot strip mill. Temperature conditions of hot rolling and their influence on the quality of flat rolled sheet The cold rolling Process. Cold rolling mill configurations. The warm-rolling process. Mathematical and physical modelling of the flat rolling process. A simple model of rolling. The classical Orowan model . Refinements of the Orowan model. The effect of the inertia force. The equations of motion. The friction factor in the flat rolling process.
The metallurgical events before and after the rolling process.
Elastic deformations of the working elements of strip-rolling mills. Roll-separating force and elastic deformations of the rolls of four-high mills. Main factors affecting the elastic deformations of working stands and the accuracy of the dimensions of flat rolled products.

Literature:

- J.G. Lenard :Primer on Flat Rolling. Elsevier, Oxford, 2007
- V.B. Ginzburg, R. Ballas: Flat Rolling Fundamentals. CRC press, 2000
- W.L. Roberts: Hot rolling of steel . CRC press, 1983

MAKFKT272B **Metalforming practices I.** **6**

*Contact hours pro week:***0+4 (lectures+lab practice) /** Dr. KOVÁCS Sándor

Course description

Classification of forming processes . The metrics of deformation. Friction conditions . Cold and hot forming. The open die forging technological base . A typical free -forming operations. The general context of swaging . Deburring. Forging without burrs . Determination of the basic parameters necessary for machinery , forming machine selection. The extrusion forming process parameters . Rolling . The system of rolled products . The structure and main units of the rolling mills . Slabheating. Providing rough and ending mills . Shaped products (profiles) rolling. Cast Rolling. Cool, winding , finishing. Cold rolling. The initial product preparation. Pickling . And one-way reversing rolling mills. Pipe Manufacturing . Seamless steel pipe manufacturing. Squeezing of ease and non-ferrous tubes.Manufacturing of welded pipes. Drawing. Drawing technology. Wire drawing . Tube-drawing with wall thinning. Drawing conditions. Overview of alloys, including primarily the steel structures, the relationship between structure and properties, a Course description of the practical heat treatment of steels , heat treatments. The most important heat treatments of non- ferrous metals.

Literature:

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- G. Lenard: Metal Forming Science and Practice; Elsevier, 2002
- Heinz Tschaetsch: Metal Forming Practise –Processes, Machines, Tools. Springer, 2006
- Hottinger-Baldwin Measurements: Product descriptions
- Taylan Altan: Cold and Hot Forging – Fundamentals and Applications. ASM International 2004
- Henry S. Valberg: Applied Metal Forming. Cambridge University Press 2010

MAKFKT279B **Simulation of technological processes** **6**

*Contact hours pro week:***0+4 (lectures+lab practice) /** Dr. KOVÁCS Sándor

Course description

Basic concepts of rolling. The properties of forming process during rolling: deformation of the part, velocity conditions of rolling and widening. Forming strength, forming resistance, rolling force, torque, performance. The effects determining the temperature of the part during rolling. Hole filling and its effects. Rolled products and machinery. Production of the initial parts, the base materials of the rolling. Technology of profile rolling: coarse-, medium- and fine wire lines. Broaching of the rolls. Designing stretching roll lines. Broaching steel sections. The properties of hot-rolled long-goods according to the technological conditions. The cooling, finishing and shipping of the rolled goods. Basics of the technological designs. Presentation of the transitions which take place during heat treatment processes. Simulation of the transition processes with kinetic equations. Simulation of the load heating with finite element method. Coupling the kinetic equations with the finite element methods. Simulation of recrystallization. Coupling the recrystallization simulation with the simulation of the rolling processes, simulation of hot rolling.

Literature:

- P.M. Dixit, U.S.Dixit : Modeling of Metal forming and Machining Processes, Springer, 2008
- Henry S. Valberg: Applied Metal Forming Including FEM analysis. Cambridge University Press. 2010
- Z. Marciniak, J.L. Duncan, S.J. Hu :Mechanics of Sheet Metal Forming. Published by Butterworth-Heinemann 2002

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*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr. KÉKESI Tamás

Course description

The increasing role of light metals, especially aluminium, in the sustainable metals technologies and in the technical and economic development. Discussion of the chemical fundamentals and processes of characteristic techniques of light metals technologies (preparation of pure metal compounds from primary raw materials, techniques and methods of electro- and metallothermic reduction of light metals, processing of aluminium scrap, melting, alloying and refining processes). Introducing the development and modern applications of the technologies. Characterisation of the raw materials – mostly industrial by-products - which can be treated in this way. Technologically significant examples to illustrate the metallurgical processing of primary and secondary raw materials. Introduction of the fundamental metallurgical operations to produce pure metal compounds (alumina production, magnezite and dolomite processing, producing oxides and chlorides), as well as the preparation of specialty oxides and hydroxides. The possibilities of extracting the rare metals accompanying the base metal. The preparation of ultra high purity gallium, vanadium-pentoxide and other products. Special electrometallurgical and vacuum metallurgical processes and the purification of light metals. Analysis of costs and current efficiencies by the complex evaluation of the reduction and reoxidation processes and the heat balance of the electrolysis cells. Metal losses and dross formation taking place during the melting of aluminium scrap. Laboratory practices for the extraction of metal Course description from the aluminium dross and for the elimination of the impurities from aluminium melts. Work-shop with autoclaves.

Literature:

- Habashi, F.: Textbook of Hydrometallurgy, Métallurgie Extractive Québec, 1999
- Habashi, F.: Principles of Extractive of Extractive Metallurgy Volume 4 Amalgam and Electrometallurgy, Métallurgie Extractive Québec, 1998
- Grjotheim, K. et al.: Aluminium Electrolysis, Aluminium-Verlag, Düsseldorf, 1982.
- „Industrial Electrochemistry” c. könyvből /2nd ed. D. Pletcher, F.C. Walsh; Chapman & Hall, 1989/HSC Chemistry, Chemical Reaction and Equilibrium Software with extensive Thermo-chemical Database, Outokumpu Research Oy, A. Roine, 2002
- Krone, K.: Aluminium Recycling, VDS, Düsseldorf, 2000

MAKMÖT266B Noble metals and coatings 3

*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr. TÖRÖK Tamás

Course description

Course description of the major extractive and recycling metallurgical techniques of noble and platinum group metals production. Characterization of noble and platinum group metals and PGM alloys including their quality testing procedures. Sophisticated high-tech gravimetrical and other analytical techniques and their applications in noble metal assaying. Application of RF powered Glow Discharge Optical Emission Spectrometry (GD OES) in depth profile analysis of metals, metallic and non-metallic layers and multilayered coatings. Developing different functional coatings and modified surface layers in order to improve surface properties (like wear resistance, corrosion resistance, better lubrication, stronger adhesion, altered optical, electrical, magnetic and other physical properties). Design and control of unit processes in surface preparation and application of the coatings. Quality control and laboratory testing techniques and practical exercises of bulk materials and on the surface properties of materials. Visiting of and practical work at factory sites of metallurgical and metals processing industries and coating workshops.

Literature:

- Benner, L.S., Suzuki, T., Meguro, K., Tanaka, S.: Precious Metals Science and Technology (1991) Allentown PA: Int. Prec. Met. Inst. (IPMI)
- Habashi, F.: Principles of Extractive Metallurgy Vol. 4 Amalgam and Electrometallurgy (1998) Métallurgie Extractice Québec
- Pletcher, D., Walsh, F.C.: Industrial Electrochemistry(1990) Chapman and Hall, London-New York
- Gabe, D.R.: Principles of Metal Surface Treatment and Protection (2nd Ed. 1978), Pergamon Press
- 5. Surface Engineering, Vol. 5 ASM International (1994) Materials Park, OH

MAKMÖT268B Mould and core production 3

*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr. MOLNÁR Dániel

Course description

Mineralogy and thermal properties of moulding materials heat-resistant matrix. Granulometry properties. Organic and inorganic binders, application examples. Properties of moulding and core materials (inorganic: bentonite, water glass, cold-and warm setting resins). Preparation of moulding and core materials, quality methods. Special moulding methods, binder-free moulding.

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Master (MSc.) courses

MAKFKT347M **Interfacial phenomena** **4**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. KAPTAY György

Course description

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.

MAKKEM274M **Colloid Chemistry** **8**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. LAKATOS János

Course description

Definitions of colloid systems, comparison colloids to the macroscopic and molecular systems. Characterization, production, stability of colloid dispersions, association colloids, macromolecular systems. Interfaces: gas solid, gas-liqid, solid liquid. Phenomena on interfaces.

MAKETT273M **Theory of Heat transport** **8**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. PALOTÁS Árpád Bence

Course description

Several industrial-scale and laboratory-scale applications are based on heat transmission processes. The concept of heat transfer implies the transmission of thermal energy between different types of media. The driving force of these processes is temperature difference. The second law of thermodynamics assumes that part of the internal energy of a higher-temperature medium (thermodynamic system) is normally transmitted to a lower-temperature medium (thermodynamic system). In other words, heat never “passes” spontaneously from a cooler medium to a warmer one. While thermodynamics describe thermal equilibration and transformation processes, the theoretical models of heat transfer are concerned with dynamic processes, where certain forms of thermal energy defined by special parameters are converted to other forms of thermal energy defined by different parameters. Quantitatively, heat transfer is effected in accordance with the law of

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conservation of energy, which means that for closed systems, energy output equals to the initial energy input (the energy absorbed by the system).

Literature:

- 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.

MAKETT275M Energy Modelling 8

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. PALOTÁS Árpád Bence

Course description

Theoretical foundation. Knowledge revival: thermodynamics and flow dynamics. Conservation of impulse, energy and mass. Differential equations of heat conduction. Theoretical models for the determination of heat transfer. Numerical calculation methods. Simple problem-solving tasks with possible solutions using the finite difference method. Understanding of the academic version of ANSYS FLUENT CFD-software. Aquiring the skill of how to use the software operationally: practice through simplified sample excercises and problem-solving tasks. Individual tasks for students: the validation of calculations, data recording and result analysis. If necessary, the correction or refining of input data, initial and boundary conditions, modifications to the mathematical methods and models used. Documentation and presentation of final results.

Literature:

- Energy Management Handbook, http://www.bsr.org/reports/bsr-energy-management-handbook.pdf
- Barrie Jenkins, Peter Mullinger: Industrial and Process Furnaces: Principles, Design and Operation, Butterworth-Heinemann, 2011.
- Franz Beneke, Bernhard Nacke, Herbert Pfeifer: Handbook of thermoprocessing technologies, Vulkan Verlag Gmbh, 2012.
- Hartmut Spliethoff: Power Generation from Solid Fuels, Springer-Verlag Berlin Heidelberg 2010.
- Kreith, F.; Boehm, R.F.; et. al. "Heat and Mass Transfer" Mechanical Engineering Handbook, Ed. Frank Kreith, CRC Press LLC, 1999.

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MAKFKT357M **Solidification** **6**

*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr. ROÓSZ András

Course description

Systematization of solidification processes, thermodynamic basic. Macroscopic and microscopic heat extraction. Solidification of solid solutions: nucleation, cellular and dendritic structure. Macro and micro segregation. Solidification of eutectics, peritectics and monotectics. Amorphous alloys. Special solidification processes: continuous and semi continues casting, single crystal.

Literature:

- Modell, Michael; Robert C. Reid (1974). *Thermodynamics and Its Applications*. Englewood Cliffs, NJ: Prentice-Hall. ISBN 0-13-914861-2.
- Solidification, J.A. Dantzig – M. Rappaz , EPFL Press, ISBN: 9780849382383

MAKFKT348M **Physical metallurgy fundamental of heat treatment** **6**

*Contact hours pro week:***3+0 (lectures+lab practice) /** Dr. ROÓSZ András

Course description

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.

Literature:

- 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.

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MAKFKT350M Fundamentals of metal forming 6

*Contact hours pro week:***3+0 (lectures+lab practice) /** Dr. KRÁLLICS György

Course description

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 Course description of continuum kinematics. Deformation tensors. Lagrange, Euler and logarithmic strain tensor**.** 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.

Literature:

- 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

MAKMÖT316M Fundamentals of casting and advanced technologies 8

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. MOLNÁR Dániel

Course description

Heat transfer between mould and metal. Calculation of solidification time. Solidification process of metalls and its alloys. Fluidity of metalls, flowability. Fluid dinamics of liquid metals. Shrinkage, gas porosity. Residual stresses.

Literature:

- D.M. Stefanescu et al.: ASM Handbook, Casting, Butterworth & Heinemann, 1998
- Jesper Hattel: Numerical modelling of casting processes, Technical University of Denmark, 2001
- John Campbell: Castings, University of Birmingham, 2000
- E. A. Brandes et al.: Smithells Light Metals Handbook, Butterworth & Heinemann, 1998

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MAKMÖT313M Utilization of Metal-bearing Waste Materials 8

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. TÖRÖK Béla

Course description

National and international general trend of utilization of metal-bearing waste materials. Types and characteristic of metallurgical slags (chemical and mineral compositions, physic-chemical parameters). Utilization possibilities and processing of slag from blast furnace, basic oxygen steelmaking, electric steelmaking and casting. Treatment of fine dust and sludge from iron and steelmaking processes. Advantages of utilization of ferrous and non-ferrous waste metal/scraps. Classification of steel and aluminium scraps. Recycling processes and best available techniques. Hungarian and EU-standards of metallurgical solid wastes and scraps.

MAKFKT354M Fine structure analysis 4

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. MERTINGER Valéria

Course description

Crystallography, Electron wave interaction with material, X ray interaction with material, Scanning electron microscopy I., Scanning electron microscopy II., Microprobe, Using X Ray I., Using X Ray II., Using X Ray III., Transmission electron microscopy I., Transmission electron microscopy II., Transmission electron microscopy III., Project presentation.

Literature:

- Materials and Structures, Jason Weiss, ISSN: 1871-6873 (electronic version)

MAKFKT355M Microscope aided picture analysis 4

*Contact hours pro week:***0+2 (lectures+lab practice) /** Dr. BARKÓCZY Péter

Course description

During the courses and presentations students become proficient users of the optical microscope. They become aquanted not only with the use of the machines, also with their structure and their optical basics. They get to know the basics and application of optical contrast technologies. They learn the basics of microscopic imaging. Based on these student will be able to prepare images with great quality, with appropriate exposition and contrastrate. They learn the basics for the use of digital contrast techniques and computer based image analysis. After the course students will be able to make snaps proper digital image analysis.

Literature:

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- "Introduction to Electron Microscopy". FEI Company. p. 15. Retrieved 12 December 2012.
- Antonovsky, A. (1984). "The application of colour to sem imaging for increased definition
- O'Keefe MA, Allard LF. Sub-Ångstrom Electron Microscopy for Sub-Ångstrom Nano Metrology (pdf). Information Bridge: DOE Scientific and Technical Information – Sponsored by OSTI. Retrieved 2010-01-31

MAKKEM277M Air-, Water- and Soil-protection I. 4

*Contact hours pro week:***1+1 (lectures+lab practice) /** Dr. BÁNHIDI Olivér

Course description

General characterisation of water, dissolved substances (gases and solids) and suspended materials in the water. Water pollutants. Characterisation of the water quality (BOI, KOI, dissolved oxygen, water hardness, heavy metal ions, etc.). Grouping and classification of the water pollutants and those of cleaning procedures. (primary,secondary, tertiary treatments, classification of the pollutants based on their phase and degree of dispersion). Review of gas-, and solid air-pollutants. The formation of SO_2, NO_x and CO. Air-and gas cleaning devices applied in the industry so that the emission of air-pollutants could be reduced. The most wide-spread technologies featured with reduced SO_2, No_x, CO, carbon-hydrogenes and other organic substance emission.

Phases of the soil, the chemical and mineral composition of the phases. The types and characteristics of soil. The main principles of chemical processes taking place in the soil: dissolution, protolytic processes, redox reactions, sorption and ion exchange.

Literature:

- H.Peavy-D.Rowe-G.Tchobanoglous. Environmental Engineering, McGraw-Hill Book,NY, 1985.
- H.H.Hahn. Wasserzechnologie, Springer-Verlag, Berlin-Heidelberg-New York, 1987.
- Ronald A. Bailey, Herbert M. Clark, James P. Ferris, Sonja Krause and Robert L. Strong, Chemistry of the Environment, 2002 Elsevier Inc., ISBN: 978-0-12-073461-0,Edited by: Janick F. Artiola, Ian L. Pepper and Mark L. Brusseau, Environmental Monitoring and Characterization, 2004 Elsevier Inc., ISBN: 978-0-12-064477-3

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MAKKEM278M Air-, Water- and Soil-protection II. 4

*Contact hours pro week:***1+1 (lectures+lab practice) /** Dr. BÁNHIDI Olivér

Course description

Mechanical methods of water treatment. Coagulants and flocculants and their application to water purification. Flotation procedures in the water purification. Photoflocculation. Adsorption, adsorbents and their application to water purification. Ion exchange and its application to the process of water softening and water purification. Precipitation, removal of the heavy metal ions from water. Reduction of the water hardness. Anaerobe and aerobe processes in the water purification. Lake purification. Membrane processes: reverse osmosis, ultrafiltering, elektrolytic dialysis. Basic processes of drinking water treatment and preparation. Disinfection and oxidation using chlorine and ozone. Review of a waste-water treatment plant of an industrial company. Review of the measurements and tests performed in the laboratories of the regional organisation of the Hungarian Environmental Protection Authority. Origin of dusts, their grain-size distribution, electric properties, the surface phenomena relating to them. Determination of the dust content of the atmosphere. The industrial dust precipitator devices. Wet gas prurification methods and equipment used for this purpose. The typesof the soil pollution, macro and micro-pollutants. The transformation and transport of the pollutants in the soil. The self-cleaning ability of the soil. The methods of soild decontamination. General problems of the soil protection.

Literature:

- H.Peavy-D.Rowe-G.Tchobanoglous. Environmental Engineering, McGraw-Hill Book,NY, 1985.
- H.H.Hahn. Wasserzechnologie, Springer-Verlag, Berlin-Heidelberg-New York, 1987.
- Ronald A. Bailey, Herbert M. Clark, James P. Ferris, Sonja Krause and Robert L. Strong, Chemistry of the Environment, 2002 Elsevier Inc., ISBN: 978-0-12-073461-0
- Edited by: Janick F. Artiola, Ian L. Pepper and Mark L. Brusseau, Environmental Monitoring and Characterization, 2004 Elsevier Inc., ISBN: 978-0-12-064477-3
- NicolasP.Cheremisinoff PhD. Handbook of Air Pollution Prevention and Control, 2002 Elsevier Inc. ISBN 0-7506-7499-7

MAKMÖT321M Archaeometallurgy I. 4

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. TÖRÖK Béla

Course description

Definition of archaeometallurgy as an interdisciplinary study. Connections with metallurgy, archaeology, archaeometry and materials science. Introducing some of the scientific techniques commonly used in archaeometallurgy. Archaeometallurgy of copper and its alloys. Archaeometallurgy of other non-ferrous metals (lead, tin, silver, gold). Description of ancient metalworking processes and technologies from the Bronze Age to the 18th century (smelting, refining, alloying, casting, coating and working of metals). Technological capabilities of several nations and their technical-cultural affinities. Definition and description of finds of non-ferrous metalworking such as metal tools, scrap metal, slags, residues, hearth lining, crucibles and moulds.

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Literature:

- R. F. Tylecote.: A History of Metallurgy. Second Edition, The Institute of Materials, London, 1992.
- P. T. Craddock: Early metal mining and production. Edinburgh University Press; Smithsonian
- University Press, Edinburgh, Washington, DC, 1995.
- R. F. Tylecote: The Prehistory of Metallurgy in the British Isles. Institute of Metals, London, 1986.

MAKMKT516M Quality Control 4

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. KONCZ János

Course description

The evolution and importance of product conformity certification systems. The beginnings and historical development of a uniform international certification system. State-of-art practices applied in the EU. Apart from a detailed discussion of the theoretical framework of product certification, the complete process is demonstrated through practical tasks and examples, including: sampling methods, the operation of testing instruments, the validation the results and final product conformity certification.

Literature:

- Kovács K., Veress G.: Minőségelmélet
- Veress G. és tsai.: Minőségügy alapjai
- Kemény S., Papp Z., Deák A.: Statisztikai minőség (megfelelőség) szabályozás
- Balogh, Dukáti: Minőségellenőrzés és megbízhatóság
- Parányi Gy.: Folyamatok szabályozása és fejlesztése

MAKMKT517M Quality Improvement: Practice 4

*Contact hours pro week:***0+2 (lectures+lab practice) /** Dr. KONCZ János

Course description

Problem types: analytical problem vs. diffuse problem. Approaches/modes of thinking: convergent and divergent. Techniques for fault detection and problem solving. Information retrieval, information organisation, information management and information analysis techniques. Analytical methods for the identification of potential sources of error and for problem solving. Methods for the quality improvement of corporate activity**.**

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Literature:

- Parányi Gy.: Minőséget - gazdaságosan
- Kovács K., Veress G.: Minőségelmélet
- Juran J. M.: Minőség
- Feigenbaum A. V.: Teljeskörű minőségszabályozás
- Kemény S., Papp Z., Deák A.: Statisztikai minőség (megfelelőség) szabályozás

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

SPRING SEMESTER

COURSE CODE*	COURSE NAME	CREDITS

Bachelor (BSc.) courses

MAKKEM222B **Physical Chemistry** **6**

*Contact hours pro week:***3+3 (lectures+lab practice) /** NÉMETHNÉ Dr.SÓVÁGÓ Judit

Course description

Basic concepts, Characterization of the of material systems. The basic laws of thermodynamics. Application the basic laws of thermodynamics regarding to gases, vapors, liquids, and solids systems. Thermodynamics of the mixture of phases. Equilibrium conditions of chemical reactions and phase transfer processes. Equilibria of homogeneous and heterogeneous systems. Phase diagrams of two- and multi-component systems. Rate and mechanism of homogeneous and heterogeneous chemical reactions. The main factors influencing the reaction mechanism. Transport phenomena: viscosity, diffusion, thermal conductivity and electrical conductivity. Transport phenomena in heterogeneous systems, surface and interfacial phenomena. Electrochemistry: electrolytes, thermodynamic properties of electrolyte systems, electrode processes, corrosion of electrolyte systems.

Literature:

- Prof. Dr. Bárány Sándor, Dr. Baumli Péter, Dr. Emmer János, Hutkainé Göndör Zsuzsanna, Némethné Dr. Sóvágó Judit, Dr. Báder Attila; Fizikai kémia műszakiaknak, Miskolci Egyetem; Elektronikus jegyzet; 2011: http://www.tankonyvtar.hu/hu/tartalom/tamop425/0001_1A_A3_02_ebook_fizikai_kemia_muszakiaknak/adatok.html
- Prof.Dr. Bárány Sándor, Dr. Baumli Péter, Dr. Emmer János, Hutkainé Göndör Zsuzsanna, Némethné Dr. Sóvágó Judit, Dr. Báder Attila Fizikai kémia műszakiaknak – Videó; Miskolci Egyetem; Elektronikus jegyzet; 2011:
- Berecz Endre: Fizikai kémia, Tankönykiadó, Budapest, 1980.
- P. W. Atkins: Physical Chemistry, Freeman,
- János Török, Lipót Fürcht, Tibor Bódi; PVT properties of reservoir fluids; University of Miskolc, 2012.

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

MAKKEM229B **Organic Chemistry** **4**

*Contact hours pro week:***2+2 (lectures+lab practice) /** NÉMETHNÉ Dr.SÓVÁGÓ Judit

Course description

Introduction of organic chemistry, the structure of organic compounds, electronic theory, grouping of chemical reactions in organic chemistry, isomerisation possibilities. Detailed Course description of the groups of organic compounds (nomenclature, structure, physical and chemical properties, production, practical significance, other individual characteristics): Alkanes, Alkenes, Alkynes, π-conjugated diene and electron delocalization, Aromatic hydrocarbons, Isoprenes, Halogenated hydrocarbons, Hydroxy derivatives of hydrocarbons (alcohols, phenols), Ethers and epoxides, peroxides, Carbonyl compounds: (mono-oxocompounds, dicarbonyl compounds, hydroxyl-oxo compounds, carbohydrates), Carboxylic acid and derivatives, Sulfur-containing organic compounds, Nitrogenous containing organic compounds (amines, nitrogen-containing carboxylic acid derivatives, amino acids and derivatives of biological significance, polyamides, amino-sulphonic acids etc.)., Phosphorus-containing organic compounds, Elemorganic Compounds, Carbon Acid Derivatives, Heterocyclic Compounds, Nucleosides, nucleotides and nucleic acids.

Literature:

- Organic Laboratory practice in electronic forms.
- J. Clayden, N. Greeves & S. Warren "Organic Chemistry" (Oxford University Press, 2012),
- Robert T. Morrison, Robert N. Boyd, and Robert K. Boyd, Organic Chemistry, 6th edition (Benjamin Cummings, 1992
- R.F. Dalye & S.J. Daley, Organic Chemistry, http://www.ochem4free.info.
- Kovács Kálmán, Halmos Miklós: A szerves kémia alapjai, Tankönyvkkiadó, Budapest, 1974
- Furka Árpád Szerves Kémia: Nemzeti tankönyvkiadó Zrt, 2002.
- Budapesti Műszaki és Gazdaságtudományi Egyetem Vegyészmérnöki és Biomérnöki Kar Szerves Kémia és Technológia Tanszék (Írta Hornyánszky Gábor, Poppe László, Hazai László, Nagy József, Tóth Tünde); Szerves kémiai praktikum; Elektronikus jegyzet, 2011

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MAKFKT268B **Nanotechnologies** **4**

*Contact hours pro week:***3+3 (lectures+lab practice) /** Dr.BAUMLI Péter

Course description

The system of units. The methods of nanotechnology. Specific surface area. Molar volume and molar surface area. The ratio of surface atoms. The Gibbs energy of nano-phases. The size dependence of one-component phase diagrams. Nomenclature and thermodynamic definition of interfacial energies. The mechanical definition of surface tension. Optimum shape of droplets; contact angle, adhesion energy. Characteristic values for surface tension and contact angle for different types of liquids and solids. Wettability of nano-structured surfaces; superhydrophobic surfaces. Penetration of liquids into porous solids. Adsorption and absorption. Segregation. Temperature and concentration dependence of surface tension. Marangoni convection. Nucleation. The general equation for interfacial forces. The interfacial anti-stretching force, the curvature induced interfacial force, the interfacial gradient force, the interfacial spreading force, the interfacial capillary force, the interfacial meniscus force, the interfacial adhesion force and the fluid bridge induced interfacial force. Stabilization of foams and emulsions by nano-particles. The Kirkendall effect (how to make porous nano-particles).

Literature:

- C. Brechignac, P. Houdy és M. Lahmani, Nanomaterials and Nanochemistry,

  Springer- Verlag, Berlin, Heidelberg, 2007.
- K.S. Birdi: Surface and Colloid chemistry

MAKFKT309B **Microstructure analysis** **4**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr.GÁCSI Zoltán

Course description

The practical significance of sturctural analysis. Classification of composites based on phase morpholgy. Characterization of phases are composed different types of materials. Interpretation and definition of area fraction and specific surface area of phases. Different microstructural modells. Optical microscopy methods. Using image analysis to characterize multi-phase structures. Sturcture and operation of Transmission Electron Microscope (TEM), Atomic Forece Microscope (AFM), Scanning Electron Microscope (SEM), Scanning Tunneling Microscope (STM), Energy Dispersive Spectorscopy (EDS), Wavelength Dispersive Spectroscopy (WDS). Diffraction methods: geomoteric description of crystall lattice, concept of reciprocal lattice, Bragg equation. Production and detection of X-rays. Debye-Scheerer method. Qualitative and quantitive phase analysis.

Literature:

- https://engineering.purdue.edu/ME/Research/Presentations/SiegmundME_Research2007.pdf
- Microstructural Investigation and analysis, Volume 4, B. Jouffrey, Online ISBN: 9783527606160, Print ISBN: 9783527301218, DOI: 10.1002/3527606165

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MAKKSZ231B **Basics of CAD** **3**

*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr.ERDÉLYI János

Course description

In the Part module the following operations are get to know: commands to add material (protrusion, revolved protrusion, helical protrusion, swept protrusion); commands to remove material (cutout, revolved cutout, helical cutout, swept cutout); hole (threaded, tapered, countersink, etc.), pattern (circle- rectangle shaped), rounding, chamfer, draft,mirror; move, copy between elements; additional operations. From the parts we could be created assemblies (Assembly module). In the Assembly module we can match the parts geometrically to create a virtual 3D construction. So this virtual models are suitable for engineering simulations (FEA). In the end comes the Draw/Draft module, which enables us to make 2 dimensional technical drawings from the 3D parts and assemblies.

Literature:

- http://cms.cerritos.edu/uploads/engt/autocad%20basics.pdf

MAKKEM232B **Environmental protection** **4**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr.BÁNHIDI Olivér

Course description

Basic concentps of the environment and that of the environmental protection. The base of the legislation on environmental protection. Concepts relating to the air pollution, emission sources, grouping of the air-polluting substances. The principles of the regulation relating to the emission and the most important laws and rules. The principles of the immission control. Harmful effects of the air-polluting substances. Possibilities for the emission reduction. Types of flue gas cleaning equipment. Classification of waters. Grouping the water-quality parameters, characterisation of the different classes of the water quality. Water polluting sources. The legal regulation concerning the water quality. The formation, disposal and salvage of the different types of wastes. Technologies and equipment of waste water purification. The most important ideas of soil protection and landscape protection. The evaluation of the environmental status.

Literature:

- http://www.sehn.org/pdf/Models_for_Protecting_the_Environment_for_Future_Generations.pdf
- Samuelson, Paul A., and William D. Nordhaus (2004). Economics, ch. 18, "Protecting the Environment." McGraw-Hill.

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MAKMKT214B **Quality Management, Process and System Control** **4**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr.KONCZ János

Course description

Concepts of quality and conformity. Need satisfaction in relation to quality. Quality factors of the production process. Product quality and control. Quality management systems. Quality improvement and development. Comprehensive quality management systems. Need satisfaction: social standards and social control.

Literature:

- Juran, Joseph Moses: An executive handbook, New York – London, 1989
- László Berényi: Fundamentals of quality management, Saarbrücken, 2013.
- Juran, Joseph Moses: Quality control handbook, New York - Toronto – London, 1962
- http://www3.ha.org.hk/qeh/wiser/doc/7bqt.pdf
- http://src.alionscience.com/pdf/QualityTools.pdf
- http://www.wiley.com/college/sc/reid/chap5.pdf

MAKETT238B **Energy management** **4**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. SZEMMELVEISZ Tamásné

Course description

Course topics cover the availability of energy resources, energy efficiency, energy demand, the calculation of energy efficiency factors, the potentials of conventional and non-conventional energy sources, the importance of preparing energy balance. Discussion is made on the interrelations between economy and energy consumption/supply, the role of economic indicators and performance-based economy. Energy usein the light of environmental considerations and residential energy consumption are also matters of interest.

Literature:

- Energy Management Handbook, http://www.bsr.org/reports/bsr-energy-management-handbook.pdf
- International Energy Agency: CO2 emissions from fuel combustion (IEA STATISTICS,highlights) http://www.iea.org/co2highlights/co2highlights.pdf
- Edited by Sheila Newman: The Final Energy Crisis, Second Edition, Pluto Press, 2008.
- INTERNATIONAL ENERGY AGENCY: WORLD ENERGY OUTLOOK 2OO7, China and India Insights
- Scott Bennett: Encyclopedia of Energy, Global Media, First Edition, 2007.

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MAKPOL222B **Industrial polimerisation technology** **5**

*Contact hours pro week:***2+3 (lectures+lab practice) /** Dr. MAROSSY Kálmán

Course description

Technological challenges of polymer production purity, energetics and thermodinamical issues. Radical and ionic polymerization. Industrial realization of radical and ionic polymerizations, emulsion, suspension and bulk polymerization methods. Radical polymerization products. Ionic polymerization. Polyolefin production technologies, artifical rubber production, ring opening polymerization of caprolactam, copolymerization. Technologies based on polymer analogous reactions. Preparation of policondensation polymers

Literature:

- Young, R. J. (1987) Introduction to Polymers, Chapman & Hall ISBN 0-412-22170-5
- Clayden, J., Greeves, N. and Warren, S. (2000). Organic chemistry, Oxford University Press ISBN 0198503466 pp. 1450–1466
- Cowie, J.M.G. (1991) Polymers: Chemistry and Physics of Modern Materials, Chapman and Hall, p. 4 ISBN 0849398134

MAKPOL204B **Study of polymer materials** **2**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. SZABÓ Tamás

Course description

The course introduces the categories, the manufacturers, types and properties of the most common polymeric structural materials. Shows and explains the materials produced by domestic producers trough their catalogs and material data sheets. Evaluating and explaining the different information provided by the manufacturers of specific compounds.

Literature:

- Young, R. J. (1987) Introduction to Polymers, Chapman & Hall ISBN 0-412-22170-5
- Clayden, J., Greeves, N. and Warren, S. (2000). Organic chemistry, Oxford University Press ISBN 0198503466 pp. 1450–1466
- Cowie, J.M.G. (1991) Polymers: Chemistry and Physics of Modern Materials, Chapman and Hall, p. 4 ISBN 0849398134

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MAKPOL233B **Application of polymers** **6**

*Contact hours pro week:***2+4 (lectures+lab practice) /** Dr. MAROSSY Kálmán

Course description

Listing and grouping of polymers. Structure – properties relationship and its effects on application. Processing of polymeric materials. Effects of processing parameters on product properties. Properties of plastics in light of their applications: relations between mechanical and electric properties, thermal and optical properties, resistance to external forces and conditions. Properties desing using additives, receptural development. Applications. Construction, electrotechnics, food industry, agriculture, transportation industry (automotive, aeronautics, shipobuilding etc…). Life cycle of polymer products. Recycling, environmental issues

Literature:

- Young, R. J. (1987) Introduction to Polymers, Chapman & Hall ISBN 0-412-22170-5
- Clayden, J., Greeves, N. and Warren, S. (2000). Organic chemistry, Oxford University Press ISBN 0198503466 pp. 1450–1466
- Cowie, J.M.G. (1991) Polymers: Chemistry and Physics of Modern Materials, Chapman and Hall, p. 4 ISBN 0849398134

MAKKEM212B **Organic Chemical Technologies** **3**

*Contact hours pro week:***2+1 (lectures+lab practice) /** Dr. LESKOVICS Katalin

Course Description

Compulsory subject for chemical engineering technology specialized material engineering students. Course Objectives: Giving an overview of the important chemical transformation methods, processes in organic chemistry, using as example the BorsodChem technologies. Practice oriented education, the factory visits and laboratory work helps understanding, engineering thinking acquisition.

MAKKEM235B **Organic Chemical Analysis** **2**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. MURÁNSZKY Gábor

Course description

Organic Microanalysis: Basic Methods (C, H, N, halogen determination) , qualitative and quantitative analytics of the major functional groups. UV spectroscopy of molecules: electron structure, the symmetry of the energy fields and selection rules. Chromophore and auxochrome groups. Steric conditions and effects of the solvent. Chiroptical Spectroscopy: Optical activity and chirality. Properties of polarized light and the interaction of the light with chiral systems. Infrared

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spectroscopy: the formation of the vibrational and rotational spectra. Diatomic molecules, harmonic and anharmonic oscillator model. Normal vibrations of polyatomic molecules, binding and characteristic group frequencies and the conditions for the appearance. The relationship between IR and Raman spectroscopy. Vibration nomenclature types, external and internal (structural) factors affecting the frequency of the IR bands. Mass spectrometry. Different ionization methods, single and double focusing ion detection, sensitivity, resolution power, mass range. Mass spectrometry coupling (MS-MS, GC-MS, HPLC-MS). Natural abundance of isotopes. Nuclear magnetic resonance spectrometry (NMR): relaxation, chemical shift and spin -spin coupling, their effects and their relationship to the spectrum structure. Factors influencing the chemical shifts, substituent effects. Separation methods. Migration conditions for chromatography, retention time, distribution coefficient, selectivity, capacity. Chromatography columns, column resolution. Various methods of chromatography. Gas chromatography. Liquid chromatography. Electrophoresis

MAKKEM236B **Practice of the Organic Chemical Analysis** **3**

*Contact hours pro week:***0+2 (lectures+lab practice) /** Dr. MURÁNSZKY Gábor

Course description

Organic Microanalysis: Basic Methods (C, H, N, halogen determination) , qualitative and quantitative analytics of the major functional groups. UV spectroscopy of molecules: electron structure, the symmetry of the energy fields and selection rules. Chromophore and auxochrome groups. Steric conditions and effects of the solvent. Chiroptical Spectroscopy: Optical activity and chirality. Properties of polarized light and the interaction of the light with chiral systems. Infrared spectroscopy: the formation of the vibrational and rotational spectra. Diatomic molecules, harmonic and anharmonic oscillator model. Normal vibrations of polyatomic molecules, binding and characteristic group frequencies and the conditions for the appearance. The relationship between IR and Raman spectroscopy. Vibration nomenclature types, external and internal (structural) factors affecting the frequency of the IR bands. Mass spectrometry. Different ionization methods, single and double focusing ion detection, sensitivity, resolution power, mass range. Mass spectrometry coupling (MS-MS, GC-MS, HPLC-MS). Natural abundance of isotopes. Nuclear magnetic resonance spectrometry (NMR): relaxation, chemical shift and spin -spin coupling, their effects and their relationship to the spectrum structure. Factors influencing the chemical shifts, substituent effects. Separation methods. Migration conditions for chromatography, retention time, distribution coefficient, selectivity, capacity. Chromatography columns, column resolution. Various methods of chromatography. Gas chromatography. Liquid chromatography. Electrophoresis.Practical knowledge of the analytical methods used in organic analytical chemistry.

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MAKETT242B **Combustion Theory and Thermodynamics** **4**

*Contact hours pro week:***0+3 (lectures+lab practice) /** Dr. PALOTÁS Árpád Bence

Course description

Thermodynamics (basic concepts, First Law of Thermodynamics, states and processes, system changes, entropy, thermodynamic cycles), thermal and flow properties of fluids and gases described by balance equations (balance equations, flow field and temperature distribution in continuing, applicability of Bernoulli's equation), heat transfer (convective heat transfer, heat tarnsport processes in solid objects, heat radiation), the ignition theory of gases.

Literature:

- Maximilian Lackner, Arpad Palotas, Franz Winter: Combustion: From Basics to Applications, Wiley VCH Verlag GmbH, 2013.
- Maximilian Lackner, Franz Winter, Avinash K. Agarwal: Handbook of Combustion, 5 Volume Set, Wiley VCH Verlag GmbH, 2010.
- Frank P. Incropera, David P. DeWitt, Theodore L. Bergman, Adrienne S. Lavine: Fundamentals of Heat and Mass Transfer, Wiley, 2001.
- Yeshvant V. Deshmukh: Industrial Heating: Principles, Techniques, Materials, Applications, and Design, CRC Press, 2005.

MAKETT243B **Energy sources I.** **3**

*Contact hours pro week:***1+1 (lectures+lab practice) /** Dr. SZEMMELVEISZ Tamásné

Course description

Energy reserves, energy resources, energy production and consumption – globally and at the domestic level. Fossile fuel processing, secondary energy sources. Renewable energy sources: types, characteristics and forecasted role in global energy supply. Geothermal energy. Nuclear power. Issues related to the shipping and storage of the distinctive fuel types.

Literature:

- Ralph E.H. Sims (New Zealand), Robert N. Schock (USA): Energy Supply, http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter4.pdf
- International Energy Agency: CO2 emissions from fuel combustion (IEA STATISTICS,highlights) http://www.iea.org/co2highlights/co2highlights.pdf
- International Energy Agency: CO2 emissions from fuel combustion (IEA STATISTICS,highlights) http://www.iea.org/co2highlights/co2highlights.pdf

*Codes ending with "B" are for Bachelors (BSc) level, and courses ending with "M" are for Masters (MSc) level studies

- Neil Schlager and Jayne Weisblatt, editors: Alternative Energy, Volume 1., Thomson Gale, 2006.
- Scott Bennett: Encyclopedia of Energy, Global Media, First Edition, 2007.

MAKETT234B **Refractories** **5**

*Contact hours pro week:***2+3 (lectures+lab practice) /** Dr. PÓLISKA Csaba

Course description

The students are given an overview of the classification, physical-chemical parameters and main technological applications of oxide and non-oxide materials used for refractories manufacturing. Various refractories product groups are discussed in Course description, with respect to their specific characteristics. Fitting and installation technologies of refractory insulations, linings and coatings are presented. Different refractory materials are examined in terms of strength criteria and resistance to thermal stress, with adequate measurement methods for the determination of structural characteristics and corrosion properties.

Literature:

- C. A. Schacht: Refractories Handbook, Marcel Dekker, Inc. New York, 2004.
- Gerald Routschka, Hartmut Wuthnow: Pocket Manual Refractory Materials: Design, Properties and Testing, Vulkan; 3 edition, 2008.
- Hugh O. Pierson: Handbook of refractory carbides and nitrodes: Properties, Characteristics, Processing and Applications, Noyes Publications, 1996.
- Yeshvant V. Deshmukh: Industrial Heating: Principles, Techniques, Materials, Applications, and Design, CRC Press, 2005.

MAKFKT255B **Ferrous alloys heat treatment** **2**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. VERES Zsolt

Course description

The aim of the course is the presentation of the metallurgical physical basics of the heat treatment methods. The students will learn the plan the worldwide heat treating technologies. They will learn the conventional and modern technology of the most important heat treating technologies.

Literature:

– J. R. Davis, ASM Handbook, Volume 4, Heat treating, ASM International, 1991
– G. Krauss, Principles of heat treatment of steel, ASM, Ohio, 1988, ISBN: 0-87170-100-6
– H. Chandler, Heat treater's guide, ASM, ISBN: 0-87-170-565-6

*Codes ending with "B" are for Bachelors (BSc) level, and courses ending with "M" are for Masters (MSc) level studies

MAKFKT270B **Metallography** **6**

*Contact hours pro week:***0+4 (lectures+lab practice) /** Dr. BARKÓCZY Péter

Course description

Metallographic preparation, embedding, grinding, mechanical-, chemical-, electrolytic polishing, etching (dipping-, electrolitic-, color-, precipitation-, thermal- and deep etching). Optical microscopic methods (light, dark field, interference, polarization). Inspection of the microstructure of steel, cast iron, light- and heavy metals.

Literature:

- Metallography and Microstructures, Vol. 9, ASM Handbook, ASM International, Materials Park, OH, 2005.
- Metallography: Principles and Practice, G.F. Vander Voort, ASM International, Materials Park, OH, 1999.
- "Metallographic and Materialographic Specimen Preparation, Light Microscopy, Image Analysis and Hardness Testing", Kay Geels in collaboration with Struers A/S, ASTM International 2006.

MAKFKT275B **Technology of forging** **2**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. KRÁLLICS György

Course description

Base technologies and raw materials of open die forging. Forging operation: edging, piercing, punching, fullering, swaging. Design of technological processes for the formation of cavities. Close die forging operations : billet, heating, preshaping, rough forging, finishing , trimming , final product, heat treatment. Processes for the formation of cavities. Closed die on forging with flash. Function of flash. Design for material flow and die layout. Design of die cavity filling for the intermediate operations Design for dimensional accuracy. Closed die forging tools. Die materials, reguired properties. Dies failures. Calculation of forging loads. Multipart and multistages dies. Effect of forging on microstructure . Fibrous microstructure Forging texture. Forging defects :surface marks or cracks ,caused by mistakes during formation of the initial or intermediate shapes. Inadequately filled forging due to an insufficient volume or material. Closed die forging with flash, advantages and disadvantages. Methodology for desing of tecnology and dies. Equipments for forging: Hammers, screw presses, presses controlled by stroke, hidraulic presses.

Literature:

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- Surrender Kumar : Technology of metal forming. PHI Learning Pvt. Ltd.,2008.W.F. Hosford, R. M. Caddel: Metal forming. Mechanics and Metallurgy. Camridge University press.2007
- R.Z. Valiev, T.G. Langdon: Principles of equal-channel angular pressing as a processing tool for grain refinement Prog. Mater. Sci. 51 (2006) 881–981
- Henry Ericsson Theis :Handbook of Metalforming Processes, CRC Press, 1999

MAKFKT276B Metalforming practices II. 6

*Contact hours pro week:***0+4 (lectures+lab practice) /** Dr. KRÁLLICS György

Course description

The phisical methods for exert the required force, opportunities for formal design of the forming machines. Forging machines . Kinematics and forces in such a process of forming. The open die forging and die machinery. The main parts of hammers and presses and operations. The forging machine auxiliaries . Special forging equipment. Rod and tubepresses structural design , operation, and typical operations. Rolling mills . Develop and parts of the rolling stand . Rolling mill drive. The rolling mills loadability (force and torque), security features . The rolling mill auxiliaries . Specially designed roller stands (pipe punching and pipe rolling platforms). Rod, wire and tube drawing machines. Bars and tubes drawing benches structural design and operation . Straightening equipment. Development of wire drawing machines. Unique and multistep drawing machines, slip-type drawing machines. Wire-guiding techniques. Typical methods of operation and emergency used in forming machines.

Literature:

- G. Lenard: Metal Forming Science and Practice; Elsevier, 2002
- Heinz Tschaetsch: Metal Forming Practise –Processes, Machines, Tools. Springer, 2006
- Hottinger-Baldwin Measurements: Product descriptions
- Taylan Altan: Cold and Hot Forging – Fundamentals and Applications. ASM International 2004
- Henry S. Valberg: Applied Metal Forming. Cambridge University Press 2010

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

MAKFKT277B **Metallic Materials** **3**

*Contact hours pro week:***3+0 (lectures+lab practice) /** Dr. MERTINGER Valéria

Course description

Microstrukture-technology-behaviour; Steel; Cast irons; Light alloys; Refractory material; Coper alloys; Tin,Led, Zinc brazing materials; Superalloys; Shape memory materials; Metallic glasses; Magnetic materials and husler alloys.

Literature:

- -Wiedemann: Structural materials, Open University, 1990
- -Van Vlack: Materials for engineering, Addison Wesley Publishing Company, 1982
- -Van Vlack: Elements of Materials Science and Engineering, Addison Wesley Publishing Company, 1982
- -Askeland: The science and engineering of materials, PWS Publishing Company, 1989

MAKMÖT259B **Metals Extraction and Refining** **2**

*Contact hours pro week:***1+1 (lectures+lab practice) /** Dr. KÉKESI Tamás

Course description

The methods of metals extraction from oxidic and sulphidic primary raw materials. The equilibrium conditions and implementation of carbothermic reduction. The various roasting methods of sulphidic concentrates and the principle of obtaining the metal through the matte phase. Refining of metal melts by selective oxidation or with other reagents, and the role of slag formation in the production of pure metals. The refining effect of gas flushing. The equilibrium conditions allowing the electrorefining of metals and the practically possible processes. The computing methods of determining the Gibbs free energy changes of reactions facilitating the extraction of metals. Determination of the equilibrium constant, and through this, the examination of the possibility of reactions according to the composition of the system. The experimental methods suitable for the kinetic examination of reactions and the determination and evaluation of the kinetic functions. Assessment of the factors defining the reaction rates. Determination of the equilibria in solutions serving as the basis for the processes in aqueous media. Structures of the dissolved species, and their stability and separation. The chemical conditions of the processes for metals extraction and purification in aqueous media. The processes and limitations of cathodic metals recovery from aqueous solutions. Laboratory and video demonstrations to show the application of technologies suitable for the extraction of valuable components from metalliferous wastes of practical significance.

Literature:

- Kubaschewski, O., Alcock, C.B.: Metallurgical Thermochemistry, 5th ed. Pergamon Press, Oxford, 1979.

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- Gilchrist, J.D.: Extraction Metallurgy, 2nd Ed., Pergamon Press, Oxford, 1980
- „Industrial Electrochemistry" c. könyvből /2nd ed. D. Pletcher, F.C. Walsh; Chapman & Hall, 1989/HSC Chemistry, Chemical Reaction and Equilibrium Software with extensive Thermo-chemical Database, Outokumpu Research Oy, A. Roine, 2002
- Habashi, F.: Textbook of Hydrometallurgy, Métallurgie Extractive Québec, 1999
- Habashi, F.: Textbook of Pyrometallurgy, Métallurgie Extractive Québec, 2002.

MAKMÖT305B Non-ferrous metallurgical technology 4

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. KÉKESI Tamás

Course description

The chemical fundamentals and processes of characteristic techniques of nonferrous metallurgical technologies (beneficiation of sulphidic ores, pyro- and hydrometallurgical processing of ores and concentrates). Partial and dead roasting of sulphidic primary raw materials, matte smelting and converting, reducing smelting of nonferrous metal oxides, special methods of extracting nonferrous metals, pyrorefining of raw metals, electrorefining. Technological discussion of hydrometallurgical processing of sulphidic and oxidic primary raw materials (leaching, solution purification, metals extraction). Preparation of high purity metals and the methods to produce special metal compound products. Nonferrous metallurgical technologies to process the generally significant scraps and metal containing waste materials. The possibilities of extracting the rare metals accompanying the base metals. Preparation of ultra-high purity metals and other special products.

Literature:

- Habashi, F.: Textbook of Hydrometallurgy, Métallurgie Extractive Québec, 1999
- Habashi, F.: Textbook of Pyrometallurgy, Métallurgie Extractive Québec, 2002
- Habashi, F.: Principles of Extractive of Extractive Metallurgy Volume 4 Amalgam and Electrometallurgy, Métallurgie Extractive Québec, 1998
- Gilchrist, J.D.: Extraction Metallurgy, 2nd Ed., Pergamon Press, Oxford, 1980
- „Industrial Electrochemistry" c. könyvből /2nd ed. D. Pletcher, F.C. Walsh; Chapman & Hall, 1989/HSC Chemistry, Chemical Reaction and Equilibrium Software with extensive Thermo-chemical Database, Outokumpu Research Oy, A. Roine, 2002

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MAKMÖT304B Elementary casting exercises 3

*Contact hours pro week:***0+3 (lectures+lab practice) /** Dr. MOLNÁR Dániel

Course description

Production technologies of castings. Elementary knowledge of casting- and technology planning. Determination of gating and feeding system. Examination of solidification properties. Size and volume changing during solidification and cooling. Residual stress evolution. Core and mould materials. Strength properties of moulding materials. Thermoconductivity of materials. Gas formation examination. Foundry visit.

Literature:

- Ductile iron data for design engineers, Rio Tinto Iron & Titanium, Inc. Canada, 1990
- John R. Brown et al.: Foseco Ferrous Foundryman's Handbook, Butterworth & Heinemann, 2000
- John R. Brown et al.: Foseco Non-Ferrous Foundryman's Handbook, Butterworth & Heinemann, 1994
- Ductile Iron The essentials of gating and risering system design, Rio Tinto Iron & Titanium, 2000.

MAKMÖT 273B Casting technology practices 3

*Contact hours pro week:***0+3 (lectures+lab practice) /** Dr. MOLNÁR Dániel

Course description

Course description

Safety engineering of foundries: sand preparation, moulding, furnace application, casting. Shockproof protection. Laboratory examintaion of mould and core materials, composition examination, sieve analysis, granulometry, gas-permability. Shell sand examination. Computer simulation techniques.

Literature:

- Ductile iron data for design engineers, Rio Tinto Iron & Titanium, Inc. Canada, 1990
- John R. Brown et al.: Foseco Ferrous Foundryman's Handbook, Butterworth & Heinemann, 2000
- John R. Brown et al.: Foseco Non-Ferrous Foundryman's Handbook, Butterworth & Heinemann, 1994
- Ductile Iron The essentials of gating and risering system design, Rio Tinto Iron & Titanium, 2000.

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Master (MSc.) courses

MAKFKT345M **Materials equilibria simplified** **4**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. KAPTAY György

Course description

System, phase, component. Mole fraction and phase fraction. Materials balance. Connection between state parameters (pressure, temperature, average composition) and the characteristics of the equilibrium state (number and identity of phases, their phase ratios and mole fractions). The general condition of equilibrium. Connection between the Gibbs energy of the system, the integral Gibbs energy of a phase and the partial Gibbs energy of a component. The condition of heterogeneous equilibrium. Constituents of the Gibbs energy (1st law). Inner energy. Molar volume. Entropy (2nd law). The results of a heating experiment. Standard enthalpy of elements and compounds. Temperature and pressure dependence of standard enthalpy of phases. The entropy of phases (3rd law). Temperature and pressure dependence of standard entropy and Gibbs energy of phases. Construction of one-component phase diagrams. A critical point. Gibbs energy of two-component solutions and mixtures. The ideal solution. Two-component phase diagram with ideal solutions (eutectic type and solid solution type). Real solutions (4th law). Binary phase diagrams with immiscibility and compounds.

Literature:

- MME330: Phase Equilibria in Materials (2009-10 Sem I), Dr. Krishanu Biswas, Department of Materials and Metallurgical Engineering Indian Institute of Technology, Kanpur

MAKPOL261M **Polymer study II.** **8**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. MAROSSY Kálmán

Course description

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.

Literature:

- 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

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- 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.

MAKETT276M **Energy systems** **8**

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. SZEMMELVEISZ Tamásné

Course description

An overview of the different energy systems (electricity and heat production, alternative energy production, etc). Key features, energy efficiency and environmental impacts of the respective systems. The improvement potentials of energy systems in terms of environmental and energy efficiency. Complex problem solving tasks (possibly related to the topics of each student's degree thesis) with a carefully prepared "public presentation" (addressing the peer-group and the instructor).

Literature:

- Energy Management Handbook, http://www.bsr.org/reports/bsr-energy-management-handbook.pdf
- Barrie Jenkins, Peter Mullinger: Industrial and Process Furnaces: Principles, Design and Operation, Butterworth-Heinemann, 2011.
- Franz Beneke, Bernhard Nacke, Herbert Pfeifer: Handbook of thermoprocessing technologies, Vulkan Verlag Gmbh, 2012.
- Hartmut Spliethoff: Power Generation from Solid Fuels, Springer-Verlag Berlin Heidelberg 2010.
- Kreith, F.; Boehm, R.F.; et. al. "Heat and Mass Transfer" Mechanical Engineering Handbook, Ed. Frank Kreith, CRC Press LLC, 1999.

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MAKFKT351M Simulation of deformation technologies 8

*Contact hours pro week:***1+3 (lectures+lab practice) /** Dr. KOVÁCS Sándor

Course description

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 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. Teaching method: Oral lecture with ppt presentation. Practice in the computer laboratory. Tools for the oral lecture: blackboard, color chalk, computer, video projector, metal forming equipment.

Literature:

- Dr. Dernei László: A képlékenyalakítás paramétereinek strukturája, Kézirat

MAKMÖT314M Hydro- Electrometallurgy 8

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. KÉKESI Tamás

Course description

The chemical fundamentals and processes of characteristic techniques of aqueous chemical separation (selective leaching, precipitation, phase separation, ion exchange and solvent extraction, cathodic deposition). Introducing the conventional methods and characterisitcs of selective leaching and solution purification by valid examples (alumina production, processing of dry batteries, flue dusts, sludges) and illustrating the tendencies in environmentally friendly nonferrous metallurgy (pressure leaching, bacterial leaching, neutral processes). Special methods of solution purification (cation exchange and anion exchange separations, solvent extraction). Examining the equilibria in solutions, stability of dissolved species and the modelling of their transformations. Metal extraction and recovery from aqueous solutions in conventional electrolysis systems and in divided cells applying ion exchange membranes.

Literature:

- Fathi Habashi: Textbook of Hydrometallurgy, Métallurgie Extractive Québec, 1999
- Fathi Habashi: Principles of Extractive of Extractive Metallurgy Volume 4 Amalgam and Electrometallurgy, Métallurgie Extractive Québec, 1998
- Vonatkozó fejezetek az „Industrial Electrochemistry” c. könyvből /2nd ed. D. Pletcher, F.C. Walsh; Chapman & Hall, 1989/

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- HSC Chemistry, Chemical Reaction and Equilibrium Software with extensive Thermo-chemical Database, Outokumpu Research Oy, A. Roine, 2002
- Grjotheim, K. et al.: Aluminium Electrolysis, Aluminium-Verlag, Düsseldorf, 1982.
- Waseda, Y, Isshiki, M. (Eds.): Purification Processes and Characterisation of Ultra High Purity Metals, Springer, Berlin, 2002.

MAKMÖT315M Coating Technologies 8

*Contact hours pro week:***2+2 (lectures+lab practice) /** Dr. TÖRÖK Tamás

Course description

Role and function of the coating techniques and technologies in the metallurgical processes and manufacturing of metals products in due consideration of materials saving, environmental protection, and sustainability.
Modern techniques of surface cleaning, pre-treatments of surfaces, coating technologies and the post-treatments techniques. Batch type coating technologies: physical vapor deposition (PVD), chemical vapor deposition (CVD) and other vacuum deposition techniques; thermal spaying, vitreous glassy enameling, hot dip galvanizing, electroplating and other chemical and electrochemical surface modification methods. Developing coating layers via continuous deposition techniques: thin film deposition from gases; continuous zinc coating of wire and steel sheets/plates in hot dip galvanizing lines; continuous electroplating of metals and alloys. Coating systems with organic/polymer base film forming materials: lacquering, painting, electrophoretic deposition and coil coating, powder coating.
Novel combinations of film forming materials and coating systems; novel techniques and technologies in the formation of surface layers. Quality control and testing of materials and coatings.
Laboratory exercises and plant visits and field training at industrial sites and workshops.

Literature:

- Surface Engineering, ASM Handbook, Vol.5, ASM International, Materials park, OH, 1994

MAKFKT353M Nanotechnologies I. 4

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. BAUMLI Péter

Course description:

In the course we discuss teh processing of the nanomaterials. The main topics of this course: Introduction to the colloid chemistry, and interfacial chemistry; Gaseous phase technologies: CVD, CVC, PVD, Carbon nanotube, carbon fiber preparation technologies. Preparation of the metallic nanoparticles, paramagnetic metal- oxid nanoparticles. Preparation of Metal matrix composite (MMCs)

Literature:

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- C. Brechignac, P. Houdy és M. Lahmani, Nanomaterials and Nanochemistry, Springer-Verlag, Berlin, Heidelberg, 2007.
- K.S. Birdi: Surface and Colloid chemistry

MAKFKT356M **Nanotechnologies II.** **4**

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. BAUMLI Péter

Course description:

In the course we discuss teh processing of the nanomaterials. The main topics of this course: Introduction to the colloid chemistry, and interfacial chemistry; Preparation of the metallic nanoparticles, paramagnetic metal- oxid nanoparticles by microemulsion and coprecipitation. Carbon nanotube, carbon fiber preparation technologies and its application. The modification of the carbon nanotubes. Preparation of the metallic foam by molten salt. Preparation of the metallic nanoparticles, paramagnetic metal- oxid nanoparticles. Preparation of Metal matrix composite (MMCs). Fabrication of the porous materials.

Literature:

- C. Brechignac, P. Houdy és M. Lahmani, Nanomaterials and Nanochemistry, Springer-Verlag, Berlin, Heidelberg, 2007.
- K.S. Birdi: Surface and Colloid chemistry

MAKKEM276M **Waste management** **4**

*Contact hours pro week:***2+0 (lectures+lab practice) /** ZÁKÁNYINÉ Dr. MÉSZÁROS Renáta

Course description:

Domestic waste situation and comparison with foreign examples. The legal framework for harmonization with EU. , waste incorporation of related laws. Waste types, waste management principles. Technical and technological solutions for waste management. Legislation of recovery special wastes (oils , batteries, packaging, construction and demolition waste electrical and electronic waste , etc) . Mass balances, input-output matrices, their methods of calculation. Hazardous substances and their management. Life Cycle Assessment. Waste Register. The shipping and handling methods. Licensing procedures, responsibilities of the authorities. Incineration of waste , disposal services. Environmental impact studies, the substantive requirements of the rules of procedure. Waste Treatment acceptance of public. The importance of agriculture, chemical and metallurgical technologies in waste utilization .

Literature:

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- Integrated solid waste management: engineering principles and management issues. [book]:G Tchobanoglous, H Theisen, S Vigil - 1993 - cabdirect.org
- Waste management models and their application to sustainable waste management: AJ Morrissey, J Browne - Waste management, 2004 – Elsevier
- Hazardous waste management: MD LaGrega, PL Buckingham, JC Evans - 1994 - osti.gov
- Natural systems for waste management and treatment. [book]: SC Reed, RW Crites, EJ Middlebrooks - 1995 - cabdirect.org
- What life-cycle assessment does and does not do in assessments of waste management: T Ekvall, G Assefa, A Björklund, O Eriksson… - Waste Management, 2007 - Elsevier

MAKKEM279M Impact assessment and risk assessment, environmental performance evaluation 4

*Contact hours pro week:***2+0 (lectures+lab practice) /** ZÁKÁNYINÉ Dr. MÉSZÁROS Renáta

Course description

The goals of the course: basically the analysis of environmental media, analisys of wastes and otherwise available methods for data processing from the environment to the extent that they will be able to engineer practicing. Environmental Assessment. Monitoring systems. Global , regional, local studies and their evaluation. Mathematical and statistical analysis of the measurement results. Assessment of the state of environments based on composition measurements and indicator phenomenas. Mathematical methods for evaluating the datas. Environmental Modeling : Environmental information systems. Modeling the spread of pollution. Analysis of the situation. Environmental modeling, modeling of environmental changes. Learning techniques and they use to identify and mitigate the risk of human health and the environment. Hazard identification, exposure - effect (dose / concentration-response / effect) analyzes, exposure assessment and risk characterization. The risk environment. Risk Assessment Report. Probabilistic characterization of the risk of technological systems. Examining the spread of contamination in the environment.

Literature:

- Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals, Three Volume Set [book]: R Eisler - 2010 - books.google.com
- Toxicokinetic modeling and its applications in chemical risk assessment: ME Andersen - Toxicology letters, 2003 – Elsevier

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- Uncertainties in chemical risk assessment: results of a European benchmark exercise: A Amendola, S Contini, I Ziomas - Journal of Hazardous Materials, 1992 – Elsevier
- General principles for risk assessment of living modified organisms: lessons from chemical risk assessment: A Ryan, C Sendashonga - Environ. Biosafety Res, 2003 - Cambridge Univ Press
- The perception of risk. [book]: PE Slovic - 2000 - psycnet.apa.org

MAKMÖT322M **Archaeometallurgy II.** **4**

Contact hours pro week: **2+0 (lectures+lab practice) /** Dr. TÖRÖK Béla

Course description

Archaeometallurgy of iron. Types, structures and sites of period raw materials (bog ores, meadow ores, lake ores, etc.). Description of ancient ironworking processes and technologies from the beginnings times to the 18th century (ore preroasting, charcoal burning, smelting, bloom purification, forging). Similarities and differences between the bloomery process and blast furnace process. Technological capabilities of several nations and their technical-cultural affinities. Definition and description of finds of ironworking such as iron tools, bloom fragment, slags, charcoal, furnace fragment, breast-wall, twyer. General principles, function and typological system of ancient and medieval bloomery furnaces and early blast furnaces. Physico-chemical and metallurgical processes in the bloomery furnace. Iron production, iron yield and the minimal iron content of bog iron ores regarding early medieval bloomery iron smelting.

Literature:

- R. F. Tylecote.: A History of Metallurgy. Second Edition, The Institute of Materials, London, 1992.
- P. T. Craddock: Early metal mining and production. Edinburgh University Press; Smithsonian
- University Press, Edinburgh, Washington, DC, 1995.
- R. F. Tylecote: The Prehistory of Metallurgy in the British Isles. Institute of Metals, London, 1986.

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MAKMÖT324M Examination of Finds and Experimental Archaeometallurgy 4

*Contact hours pro week:***0+2 (lectures+lab practice) /** Dr. TÖRÖK Béla

Course description

Archaeometallurgical finds include ores, slags, fragments of hearth or furnace structure, crucibles, moulds, metal stock, scrap and waste, iron or stone metalworking tools (hammers, tongs, etc) and metal tools and artefacts. Topics of the course: fieldwork methods (fieldwalking, geophysical survey), sampling, laboratory investigations including chemical (XRF, ICP, EDX, AAS, etc.) and mineral (XRD, XRPD) analysis as well as materials testing (X-ray, OM, SEM). Practice and model of making assessment report on the basis of examinations. Identification of archeometallurgical finds. Definition, basic properties and possibilities of experimental archaeometallurgy. Experimental methods (authentic or laboratory conditions). Typical examples of reconstructed smelting, forging and casting experiments.

Literature:

- M. Pollard - C. Heron: Archaeological Chemistry. Cambridge, 1996.
- S.L. Olsen: Scanning Electron Microscopy in Archaeology. British Archaeological Reports International Series 452. 1988.
- S. Macready – F. H. Thompson: Archaeological field survey in Britain and abroad. London, 1985.
- J. Bayley – D. Dungworth – S. Paynter (eds.): Archaeometallurgy. Centre for Archaeology Guidelines. English Heritage, London, 2001/1.

MAKMKT515M Quality Improvement: Theory 4

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. KONCZ János

Course description

Problem types: analytical problem vs. diffuse problem. Approaches/modes of thinking: convergent and divergent. Techniques for fault detection and problem solving. Information retrieval, information organisation, information management and information analysis techniques. Analytical methods for the identification of potential sources of error and for problem solving. Methods for the quality improvement of corporate activity**.**

Literature:

- Kovács K., Veress G.: Minőségelmélet
- Veress G. és tsai.: Minőségügy alapjai
- Kemény S., Papp Z., Deák A.: Statisztikai minőség (megfelelőség) szabályozás
- Balogh, Dukáti: Minőségellenőrzés és megbízhatóság

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies

- Parányi Gy.: Folyamatok szabályozása és fejlesztése

MAKMKT518M Conformity of Laboratory Testing Methods 4

*Contact hours pro week:***2+0 (lectures+lab practice) /** Dr. KONCZ János

Course description

The conformity of measurement and testing methods. Understanding the principles and requirements of national metrology legislation: aims, functional elements, importance. The Good Laboratory Practice (GLP) system. The conformity analysis of laboratory testing methods trough the presentation of the distinctive functional elements of the system. Practice: the implementation of applied measurement techniques and the conformity assessment of complex laboratory testing processes, based on the principles of the GLP system.

Literature:

- Kovács K., Veress G.: Minőségelmélet
- Kemény S., Papp Z., Deák A.: Statisztikai minőség (megfelelőség) szabályozás
- Kovács K. és tsai.: A termék és vizsgálat megfelelősége
- Bíró, Kreiss: Fogyasztóvédelem

*Codes ending with “B” are for Bachelors (BSc) level, and courses ending with “M” are for Masters (MSc) level studies