Courses offered for Brazilian students -- Biochemical Engineering, BSc
University of Debrecen

Course title: Civil Law I.	**Credits: 2**
Type of classes: **lecture**, Number of hours/week: **2**	
Requirement: **exam**	
The course is in the **2**nd term.	
Prerequisites: -	
Content:	
The primary purpose of the course is to give basic knowledge about selected topics of the Hungarian and European private law. Classes deal with topics that might be useful for students establishing innovations to the market, being employed in their professional field or contracting with others for licensing, developing, researching, etc. In order to fulfill the above mentioned goals the most important topics of the course are the followings: civil law systems vs. common law systems; private law codifications in Europe; legislative competence of the European Union; legal capacity in private law; personality right protection; law of intellectual property; business associations. Classes follow the Socratic method, an interactive, participation encouraging method. By the end of the course students will have a general look at the private law system in Hungary and Europe and they can identify the most important legal problems connecting to their profession.	
Recommended readings:	
SAUTER, Wolf – SCHEPEL, Harm: *State and Market in European Union Law: The Public and Private Spheres of the Internal Market before the EU Courts*, Cambridge University Press, London, 2009. 270. p. ISBN 978-0521857758 TWIGG-FLESNER, Christian (ed.): *The Cambridge Companion to European Private Law*, Cambridge University Press, London, 2010. 380. p.ISBN 0521736153 BUSSANI, Mauro – WERRO, Franz: *European Private Law: A Handbook*, Carolina Academic Press, London, 2009. 600. p. ISBN 978-1594605550	

Course title: EU Studies	**Credits: 1**
Type of classes: **lecture**, Number of hours/week: **1**	
Requirement: **exam**	
The course is in the **1**st term.	
Prerequisites: -	
Content:	
The lectures concentrate on the economic, legal and political emergence of the European Union. The history of the European Union is an excellent example for the intensification of integration processes all over the world. Accordingly, the students on this course get an introduction to the theories and stages of the integration process. The history and making of the European Union is discussed through the main milestones paving the path for the integration. The dynamic interrelationship between the supranational and the intergovernmental character of the EU Institutions is highlighted and described in details. The influence and achievements of the EU is compared with those of the other world powers. The enlargement processes accelerating in the new millennium had an important role in the development of the various EU policies. The changes and elements of the agricultural, regional, social, environmental, etc. policies are discussed. The students get acquainted with the most important elements and parts of the Treaties of the European Union, including for example the Paris Treaty, Rome Treaties, Merger Treaty, Single European Act, Maastricht Treaty, Amsterdam Treaty, Nice Treaty and Lisbon Treaty. The aspects of the economy (internal market, competition, monetary union, energy, infrastructure, agriculture, environment), education, health care and foreign relations are also discussed in order to understand the role of the European Union as an international actor.	
Recommended readings:	
Bomberg, E. – Peterson, J. – Corbett, R. (2012): The European Union. How does it work? (New European Union Series) Oxford University Press, USA. 3rd edition. 310p. Cini, Michelle (ed.) (2009): European Union Politics. Oxford University Press, 3rd edition. 520p. Dinan, Desmond (2006): Origins and Evolution of the EU (New European Union Series). Oxford University Press, USA. 384p.	

Course title: Mathematics I	**Credits: 5+2**
Type of classes: **lecture + practice**, Number of hours/week: **4+3**	
Requirement: **exam + practical exam**	
The course is in the **1**st term.	
Prerequisites: **-**	
Content:	
Real and complex numbers, basic notions of combinatorics. The calculus of functions of one variables: limits, continuity, derivative applications and interpretations. Series in one variable with emphasis on Taylor series. An introduction to the principles and methods for solving first order ordinary differential equations. The calculus of functions of several variables with an introduction to vector calculus: limits, continuity, partial derivatives, gradients, differentials. Riemann integration, applications to area, volume, etc., and basic methods for conversion of integrals including change of variable, substitutions, partial fractions, integration by parts, improper integrals. Multiple integrals. Vector spaces, basis and dimension, rank of a system. Matrix algebra including basic algebraic operations, determinants, inversion, rank. Solution of systems of linear equations. Linear transformations, eigenvalues, and eigenvectors. Mathematics Seminar I: problem-solving seminar. The topics of the seminars follow exactly the program of the lecture.	
Recommended readings:	
D. S. Sivia, S.G. Rawlings: Foundations of Science Mathematics, Oxford Science Publication, K.A. Straud: Engineering Mathematics, Industrial Press Inc. New York, K.A. Straud: Advanced Engineering Mathematics, Palgrave MacMillan,	

Course title: Mathematics II	**Credits: 2+3**
Type of classes: **lecture + practice,** Number of hours/week: **2+3**	
Requirement: **exam + practical exam**	
The course is in the **2**nd term.	
Prerequisites: **Mathematics I**	
Content:	
Series in several variables with emphasis on Taylor series. The calculus of vector valued functions of several variables: limits, continuity, partial derivatives, gradients, differentials. Inverse and implicit function theorem. An introduction to the principles and methods for solving partial differential equations. Multiple integrals, applications to area, volume. Euclidean vector space, inner product, norm, orthogonality, orthonormal basis. Vector analysis: vector algebra and calculus, gradients, rotation, divergence, line and surface integrals, conservative fields and potential functions, Stokes, Gauss and Green's theorem. The basic concepts and methods of probability and an introduction to statistics. Elementary combinatorics, fundamentals of probability, families of discrete and continuous probability distributions. The central limit theorem. The uses of probability and statistics in engineering areas are illustrated. Mathematics seminar II: problem-solving seminar. The topics of the seminars follow exactly the program of the lecture.	
Recommended readings:	
D. S. Sivia, S.G. Rawlings: Foundations of Science Mathematics, Oxford Science Publication, K.A. Straud: Engineering Mathematics, Industrial Press Inc. New York, K.A. Straud: Advanced Engineering Mathematics, Palgrave MacMillan,	

Course title: Introduction to Physics	**Credits:3**
Type of classes: **lecture + practice**, Number of hours/week: **2+1**	
Requirement: **exam**	
The course is in the **1**st term.	
Prerequisites: -	
Content:	
Introduction to the main concepts and methods of physics: classical mechanics: kinematics and dynamics of motion, equation of motion. Heat, temperature and the statistical mechanics of an ideal gas. Ellasticity and the wave propagation in continuous media. Geometrical and wave optics. Electromagnetic forces and fields. Fundamentals of quantum mechanics and nuclear physics. Proper application of physical units of measurements and formulas. Application of physical models and mathematical tools for the description of natural phenomena.	
Recommended readings:	
1. College Physics, Openstax college, 2011, ISBN 978-1-938168-00-0, http://openstaxcollege.org/textbooks/college-physics 2. 1. Holbrow, C.H., Lloyd, J.N., Amato, J.C., Galvez, E., Parks, M.E. Modern Introductory Physics , Springer 2010, ISBN 978-0-387-79079-4 3. University Physics, Hugh D. Young, Roger A. Freedman, Pearson, 2012, ISBN 978-0-321-76219-1	

Course title: General Chemistry	**Credits: 4+1+3**
Type of classes: **lecture + seminar + practice,** Number of hours/week: **3+2+3**	
Requirement: **exam+ practical exam + practical exam**	
The course is in the **1**st term.	
Prerequisites: -	
Content:	

Topics: Classification of natural sciences, history and development of chemistry. The concept of chemical change. The SI system of units, the most important physical quantities and units. Conservation of mass and energy. Einstein's equation on mass-energy equivalence. The law of definite proportions, the law of multiple proportions, law of combining gas volumes, Avogadro's law. Development of Dalton's atomic theory and its influence on chemistry. Relative atomic and molecular weights. Amount of substance and the definition of mole. Notations for elements and compounds, symbol, empirical formula, molecular formula, structure, isomerism. Valency and oxidation number. Oxidation number in inorganic compounds. Types of chemical reactions. Latin names of compounds. Classification and structure of chemical systems. General characterization of different states of matter. The kinetic molecular theory of gases, ideal and real gases. Gas laws: Boyle's law, Charles's law, the ideal gas law. Gas mixtures, partial pressure. General characterization of liquids, surface tension, viscosity. General characterization and classification of solids. Changes of state: melting, freezing, evaporation, condensation, sublimation. Phase diagrams, critical temperature and pressure. Phase diagrams of water, sulfur and carbon dioxide. Thermodynamic temperature. Classification of multicomponent systems, properties of solutions and mixtures. Solubility and units of concentration. Vapor pressure, freezing and boiling point of solutions. Osmosis pressure. Determination of molecular weight. Thermochemical equation, heat of reaction, Hess's law. The importance of heat of formation. Heat changes characteristic of changes of state. Heat of reaction and bond energies. The direction of spontaneous chemical reactions: internal energy, enthalpy, free energy and entropy. Dependence of reaction rates on concentrations and the temperature. Order of reactions. Activation energy. Catalysts, homogeneous and heterogeneous catalytic reactions. Enzymes. Photochemical processes. The equilibrium condition and the equilibrium constant. Possibilities to shift the composition of equilibriums. Dependence of the equilibrium constant on temperature and pressure. Le Chatelier's principle. Different theories of acid-base reactions (Arrhenius, Brønsted, Lewis). Characterization of aqueous solutions, electrolytic dissociation. Strength of acids and bases. Amphoteric substances. The definition and calculation of pH. Buffer solutions and acid-base indicators. Acid-base properties of salts. Complex ion equilibria. Pearson's hard-soft theory. Solubility equilibria, solubility product. Temperature dependence of solubility. Gas-liquid and liquid-liquid equilibria. Extraction. Galvanic cells and the concept of electrode potential. Standard electrode potentials, oxidizing and reducing agents. Water as a redox system. Electrolysis, voltage needed in electrolytic cells, overvoltage. Quantitative laws of electrolysis. Galvanic cells and batteries. Experimental background of the atomic theory, discovery of the nucleus. Quantized changes in the energy states of atoms. The photon hypothesis. The Bohr model of the atom. Characteristics of electromagnetic radiation, atomic line spectra, X-ray radiation. Discovery and basic properties of subatomic particles (electron, proton, neutron). The mass defect. Isotopes. Types and properties of radioactive radiation. Laws of radioactive decay, decay series. Medical and other practical importance of radioactive isotopes. Nuclear energy, nuclear fission and fusion. The dual nature of matter. Heisenberg's uncertainty principle. Schrödinger's equation and its application for the hydrogen atom. Quantum numbers and their importance. The shape of atomic orbitals. Characterization of polyelectronic atoms. Principles of the periodic table. Electronegativity, ionization energy, electronaffinity, atomic and ionic radii and their change across the periodic table. The ionic bond. Calculation of the lattice energy. The covalent bond. Basic characteristics of the molecular orbital theory and its application for diatomic molecules. The valence shell electron pair

repulsion model. The shape of molecules, bond angles, bond orders, hybridization. Polarity of covalent bonds, polar and non-polar molecules. Metallic bonding. Intermolecular forces. Hydrogen bond and its importance in inorganic and organic chemistry. General characterization of molecular, ionic, metallic, and network atomic solids. The band theory of solids. Characteristics of insulators, semiconductors and conductors. Dielectric and magnetic properties: dia-, para- and ferromagnetic materials. Principles and application of mass spectrometry. Electromagnetic spectra, atomic and molecular spectroscopies. Principles and application of infrared spectroscopy. The chemical importance of NMR and ESR spectroscopies. Diffraction methods. Theoretical models of solid materials: band theory and its applications to metals. Superconductivity and its applications. Commercial methods of metal production.

Recommended readings:

Compulsory/Recommended Readings:

1. J. McMurray, R. C. Fay, Chemistry, Pearson Education , Inc., New Jersey, 2004.
2. S.S. Zumdahl, Chemistry, D.C. Heath and company, Lexington MA, 1993.
3. J. W. Hill, R. H. Petrucci, General Chemistry, Prentice Hall, ISBN-10:0130334456, ISBN-13: 9780130334459
4. F. A. Cotton, G. Wilkinson: Basic Inorganic Chemistry, John Villay and Sons (1976)
5. D. D. Ebbing: General Chemistry, Houghton M. Company (1984)

Course title: Organic Chemistry I.	**Credits: 4**
Type of classes: **lecture + seminar,** Number of hours/week: **2+1**	
Requirement: e**xam**	
The course is in the **2**nd term.	
Prerequisites: **General chemistry**	
Content:	
Summary of the basic phenomenon of organic chemistry. The bondsystem, nomenclatures, preparation and reaction of alkanes, alkenes, alkynes, mono- and polycyclic, homo- and hetero aromatic hydrocarbons, halogen derivatives and organometallic compounds. Visiting the seminar events is obligatory.	
Recommended readings:	
1. T. W. Graham Solomons, Craig Fryhle, Organic Chemistry, 10th Edition, ISBN-10: 0470556595; 2009; Wiley&Sons 2. Leroy G. Wade: Organic Chemistry; 8th Edition; ISBN-10: 0321768140; 2012; Pearson 3. Francis Carey, Robert Giuliano: Organic Chemistry; 8th Edition; ISBN-10: 007735477X; 2010; McGraw-Hill	

Course title: Biochemistry I.	**Credits: 2+2**
Type of classes: **lecture + practice**, Number of classes/week: **2 + 2**	
Requirement: **exam + practical exam**	
The lecture takes place in the **2nd** term, the practice in the **3**rd term.	
Prerequisites: **General Chemistry**	
Content:	
Protein structure and function; Oxygen-transporting proteins; Enzymes and mechanisms of enzyme action; Structure and function of biological membranes; Carbohydrate metabolism: glycolysis, glyconeogenesis, glycogen synthesis, glycogenolysis, pentose phosphate pathway. The citric acid cycle; Electron transport and oxidative phosphorylation; Fatty acid metabolism; Amino acid metabolism; Hormone action and metabolic control mechanisms. Biochemistry Practical: Proteins: salting-out of proteins. Purification of proteins: dialysis, gel-filtration chromatography. Quantitative determination of proteins by means of photometry. Carbohydrates: quantitative determination of the reducing sugar content of plant samples. Quantitative determination of vitamin C of different samples. Nucleic acids: experiments with RNA. Hydrolysis of yeast RNA. Detection of chemical components of RNA. Quantitative determination of phosphorus content by means of photometry.	
Recommended readings:	
1. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Biochemistry, W. H. Freeman and Company, New York, 2002. ISBN 0-7167-3051-0. 2. Lubert Stryer, Biochemistry, W. H. Freeman and Company, New York, 1988. ISBN 0-71671920-7. 3. Switzer, R. and Garrity L.: Experimental biochemistry. Theory and exercises in fundamental methods, Third edition **;**W.H. Freeman and Company New park; (1999**)** ISBN: 0-7167-3300-5 (EAN: 9780716733003) 4. Handouts	

Course title: Introduction to Cell Biology	**Credits: 3**
Type of classes: **lecture**, Number of classes/week: **2**	
Requirement: **exam**	
The course is in the **1**st term.	
Prerequisites: -	
Content:	
Skills: foundation of subsequent biological knowledge, to increase of fundamental knowledge of cell biology of students with different biological aware capacity. *Lecture:* Comparison of prokaryotic and eukaryotic cells. Endosymbiotic theory. Plant and animal cell types. The chemical basis of life. Water and its properties. Organic compounds. Carbohydrates, lipids, proteins and nucleic acids. Cellular organization. Biological membrans. Energy in living systems. Chemical reactions and energy. The energy currency of the cell-ATP. Enzymes: chemical regulators. Aerobic and anaerobic catabolism. Photosynthesis. Chromosomes, mitosis and meiosis. DNA, RNA and protein synthesis. Gene regulation. Recombinant DNA. Structure, function and significance of viruses, bacterias and fungus.	
Recommended readings:	
Villee, C.A., Solomon, E. P., Martin, C. E., Martin, D. W., Berg, L. R., & Davis, P. W (1989). *Biology.*Philadelphia: Saunders College Publishing, 27-415. ISBN 0-03-023417-4 Watson, J. D. (2008). Molecular Biology of the Gene (6th Edition). USA: Benjamin Cummings, 5-300. ISBN 978-080539592-1 Levine, M. (2010). Biology. USA: Prentice Hall. ISBN-13: 978-0133669510	

Course title: Microbial Physiology	**Credits: 4**
Type of classes: **lecture + practice**, Number of classes/week: **2+2**	
Requirement: **exam + practical exam**	
The lecture takes place in the **4**th term, the practice in the **5**th term.	
Prerequisites: **Microbiology**	
Content:	

Aim of the course:
We wish to provide an insight into the biological and physiological basis of industrially important microorganisms.

Description of the course:
General classification of microorganisms. Morphology (Prokaryotes, Eukariotes and Viruses). Flow of energy in the biological world. Classification of microorganisms by their carbon and energy sources. Cycling of matter in the biological world (carbon and oxygen cycle, nitrogen cycle, sulphur cycle). Thermodynamic concepts in the analysis of biological systems (chemical work and energy, free energy of formation of some biochemical compounds, free energy change of some biochemical reactions). Chemical energy: production, conservation and utilization in the cell (energy coupling through ATP system, energy coupling through NADP system and other coenzyme system. ATP systems. Production of ATP. Utilization of ATP. Regulation of ATP production. Transport. Respiratory-chain phosporylation. Oxidation/Reduction reactions. Photosynthesis.

Description of the practical course:
Laboratory-scale (2 L), submerged, batch fermentation of a bacteria will be monitored and analyzed. Time-profiles of carbon source consumption, oxygen uptake rate, biomass, carbon dioxid and ATP/ADP rate are determined by standard bioanalytical equipments (HPLC, GC, ion-exchange chromatography).

Recommended readings:

Literature:

Bernhard Atkinson and Ferda Mavituna: Biochemical Engineering and Biotechnology Handbook, The Nature Press, ISBN 0 333 33274 1

James Darnell, Harvey Lodish, David Baltimore: Molecular Cell Biology, Scientific American Books, ISBN 0-7167-1448-5

Wang DIC, Cooney CL, Demain AL, Dunnill P, Humphrey AE, Lilly MD: Fermentation and Enzyme Technology. John Wiley & Sons, New York, U.S.A.

Course title: Bioprocess Engineering I.	**Credits: 3**
Type of classes: **lecture**, Number of classes/week: **2**	
Requirement: **exam**	
The course is in the **4th** term.	
Prerequisites: **Microbiology**	
Content:	
Aim of the course: We wish to provide an insight into the biological and technological basics of bioengineering by teaching the major and most substantial processes and operations as well as the qualitative and quantitative nature of interactions between them. ***Description of the course:*** Economic significance of biotechnology, major products, production statistics and trends. Microbial (viral, procaryotic, yeast and fungal) growth kinetics – parameters of growth and analysis of growth data. The isolation, preservation and improvement of industrial microorganisms. Microbial stochiometry. Media for industrial fermentations. The development of inocula for industrial fermentations. Batch, fed-batch and continuous flow cultures. Multistage systems, feedback systems. The application of continuous culture in industrial processes, strain isolation and improvement. Application of fed-batch culture. Design of a fermenter. Agitation and aeration. Fluid rheology. Foaming and its control. The packed tower, the Waldhof-type, the cyclone column, the air-lift, deep-jet and rotating disc fermenter. Acetators and cavitators. Sterilization of fermenters and vessels, liquid media and gases. Aseptic operation and containment.	
Recommended readings:	
Stanbury PF and Whitaker A: Principles of Fermentation Technology. Pergamon Press, Oxford, UK. McNeil B, Harvey LM: Fermentation: a Practical Approach. IRL Press, Oxford, UK. Pirt, SJ: Principles of Microbe and Cell Cultivation. Blackwell Scientific Publications, Oxford, UK. Wang DIC, Cooney CL, Demain AL, Dunnill P, Humphrey AE, Lilly MD: Fermentation and Enzyme Technology. John Wiley & Sons, New York, U.S.A.	

Course title: Bioprocess Engineering II.	**Credits: 6**
Type of classes: **lecture + practice**, Number of classes/week: **2 + 3 hours**	
Requirement: **exam + practical exam**	
The course is in the **5**th term.	
Prerequisites: **Bioprocess Engineering I.**	
Content:	
Aim of the course: To provide additional basic knowledge in bioengineering science not discussed in Part I. In addition, via a compact lab course attached to this lecture set, we want to ensure that our student understand the most crucial and widespread techniques of bioengineering in practical terms, too. ***Description of the course*:** Fermenter instrumentation and control. Sensors. Control systems – manual and automatic control. On-line analysis. Cell morphology and its impact on product formation. The recovery and purification of fermentation products. Filtration, centrifugation, cell disruption, liquid-liquid extraction, solvent recovery, chromatography, crystallization, whole-broth processing. Effluent treatment – physical, chemical and biological treatment. Aerobic and anaerobic treatment. Fermentation economics: producing costs, market potential. Processes and operations using enzymes. Enzyme isolation. Classification of enzymes of industrial importance. Kinetics of enzymes. Enzyme reactions in homogenous and heterogeneous phase. Principles of enzyme and whole-cell based bioconversions. Enzyme immobilization. ***Description of the practical course:*** Laboratory-scale (10 L), submerged, batch fermentation of a filamentous fungus will be monitored and analyzed. Time-profiles of carbon source consumption, oxygen uptake rate, biomass, carbon dioxid and product formation rate are determined by standard bioanalytical equipments (HPLC, GC, ion-exchange chromatography). Demonstration of certain downstream processing techniques such as adsorption evaporation, filtration and dialysis. Qualitative and quantitative analysis of alcohol production by yeast.	
Recommended readings:	
Stanbury PF and Whitaker A: Principles of Fermentation Technology. Pergamon Press, Oxford, UK. McNeil B, Harvey LM: Fermentation: a Practical Approach. IRL Press, Oxford, UK. Pirt, SJ: Principles of Microbe and Cell Cultivation. Blackwell Scientific Publications, Oxford, UK. Wang DIC, Cooney CL, Demain AL, Dunnill P, Humphrey AE, Lilly MD: Fermentation and Enzyme Technology. John Wiley & Sons, New York, U.S.A.	

Course title: Basic Engineering	**Credits: 3**
Type of classes: **lecture + seminar**, Number of hours/week: **2+1**	
Requirement: **exam**	
The course is in the **1**st term.	
Prerequisites: -	
Content:	
It reviews the fundamental rules of the formal requirements of the technical drawing, the drawing of the projections, profile and sectional drawing of the components. After that it deals with the drawing of standardized machine elements and the concept of manufacturing tolerance and fitting, dimensional specification, geometrical and positioning tolerance, surface irregularity and the rules of elaboration of the workshop drawing. In seminar there are six tasks to elaborate: to elaborate the workshop drawing of different machine elements and components. Endurance technical definitions. Contact among machine elements. Elements for energy process in machine systems. Elements for material flow in machine systems: pipes, pipe fittings, tanks etc. Structural materials and their technology in chemical industry. Structure of non-ferrous metals. Iron-carbon double phased systems, crystallization and metamorphosis. Alloy steel and non-ferrous metals. Modification of based properties by annealing. Static and metallographic investigation of metals. Breaking of materials. Non-destruction tests. Notation of steel. Formation of welded bound by smelting processes. Destruction tests and non-destruction tests of welded bounds. Works of chemical machines: determination of machine, grouping. Types of energy, energy sources. Diffusion of energy in space and time. Efficiency.	
Recommended readings:	
J. H. Perry: Chemical Engineer’s Handbook, McGraw-Hill Book Company, 8. Edition, New York, 2007.	

Course title: Mechanical Engineering	**Credits: 3**
Type of classes: **lecture + seminar**, Number of hours/week: **1 + 2**	
Requirement: **practical exam**	
The course is in the **2**nd term.	
Prerequisites: -	
Content:	
The formal requirements of technical drawing, representation of projections. Text and Dimensioning on the technical drawings, rules of dimension-structures. Basic concepts of technical tolerances. Systems of relationships between the elements. Elements which forwarding energy flow within the machine-system. Elements which forwarding material flow within the machine-system: pipes, pipe-fittings, tanks, etc. Structural materials used in the chemical industry and technologies. Structure of pure metals. The Fe-C binary system, crystallization and transformation. Alloy steels, non-ferrous metals. Basic Properties modification by heat treatment. Metallic materials strength and metallographic examination. The fracture of materials. Non-destructive testing. Steel marking system, steel selection. Creating of welded joints with fusion procedures. Testing of the welded joints with destructive and non-destructive testing. Chemical machinery: concept of machine, classification, structural essence. Types of energy and energy resources. Energy flow distribution in time and space. Efficiency.	
Recommended readings:	
D.L. Goetsch, W.S. Chalk, J.A. Nelson, R.L. Rickman: Technical Drawing, ISBN: 1-4018-5760-4 B. Agrawal, C.M. Agrawal: Engineering Drawing, ISBN 978-0-07-066863-8 R.K. Bansal: A textbook of theory of Machines, ISBN 81-7008-418-0 J.S. Rao, R.V. Dukkipati: Mechanism and Machine Theory, ISBN 81-224-0426-X R.K. Sinnott: Chemical Engineering Design, ISBN 0 7506 6538 6 J.M. Coulson, J.F. Richardson: Chemical Engineering, ISBN 0 7506 4445 1	

Course title: Visits to Biotech Companies	**Credits: 1**
Type of classes: **practice,** Number of hours/week: **2**	
Requirement: **signature**	
The course is in the **3**rd term.	
Prerequisites: -	
Content:	
Aim of the course: Chemical, pharmaceutical and fermentation companies of regional or national importance will be visited upon to gain an insight into some of the production processes that occur there. In addition, the course wishes to facilitate communication between our senior students looking for a job and the companies seeking suitable applicants. ***Description of the course:*** The course will be made available in each semester, thus our students should have the opportunity to visit and look around in some of the major regional and national plants of the chemical, pharmaceutical, fermentation, food-processing and dairy industry. The following companies host our students regularly: TEVA-Pharmaceutical Co. (Debrecen), Agroferm Co. (Kaba), Borsod Brewery Co. (Bőcs), Minna Dairy Co. (Miskolc), Tokaj Trading House Ltd. (Tokaj), Research Institute for Viticulture and Enology (Eger), Richter Gedeon Pharmaceutical Works Co. (Budapest-Kőbánya), Budafok Yeast Factory (Budapest-Budafok), Dréher Brewery (Budapest-Kőbánya), Nestlé Hungary Kft. (Miskolc-Diósgyőr).	

Course title: **Introduction to Economics**	**Credits: 3**
Type of classes: **lecture**, Number of hours/week: **2**	
Requirement: **exam**	
The course is in the **1**st term.	
Prerequisites: -	
Content:	
Basic concepts and fundamental questions of economics. Ten principles of economics and the economic way of thinking. Production possibilities and the gains from trade. How markets work I: demand and supply. How markets work II: applications of the theory of demand and supply. The economy as a whole: measurement. Measuring a country's income. Measuring the cost of living. Production and growth: why some countries are rich while others are poor. Savings and investment, and the role of the financial system. Unemployment. What is money and how is it "created"? Money and inflation.	
Recommended readings:	
Compulsory readings: Mankiw, Gregory: Principles of Economics. Fifth Edition. South-Western, Mason, USA, 2009 (ISBN10: 0-324-59132-2) Recommended readings: Heyne, Paul – Boettke, Peter – Prychitko, David: The Economic Way of Thinking. Twelfth Edition. Pearson Education International, New Jersey, 2010. (ISBN-10: 0136039855)	

Course title: Management of Value Creating Processes	**Credits: 2**
Type of classes: **lecture**, Number of hours/week: **2**	
Requirement: **exam**	
The course is in the **2**nd term.	
Prerequisites: -	
Content:	
This course introduces the participants into the philosophy, the theories and the basic calculations of operations management. Seminars give opportunity to discuss the lectures and to get practice in basics of operations management through solving exercises. The most important topics of the course are: the organizational and market context of operations management; competitiveness, strategy, productivity; product design, capacity planning; process selection; facility layout; quality management; supply chains and value chains; scheduling; projects; LEAN operations.	
Recommended readings:	
Compulsory readings: Stevenson, J. William (2009): Operations Management. 10th edition. McGraw-Hill Irvin, London, ISBN 978-0-07-009177-1. Recommended readings: Beckman, Sara L. – Rosenfield, Donald Barry (2008): Operations Strategy: Competing in the 21st Century. McGraw-Hill Irvin, London, ISBN 9780071274081. Fitzsimmons, James A. – Fitzsimmons, Mona J. (2011): Service Management: Operations, Strategy, Information Technology, 7th Edition. McGraw-Hill Irvin, London, ISBN 0073403350. Krajewski, Lee J. – Ritzman, Larry P. – Malhotra, Manoj K. (2012): Operations Management: Processes and Supply Chains: Global Edition, 10/E. Pearson Higher Education, New York, ISBN 9780273766834.	