BULLETIN

Budapest University of Technology and Economics

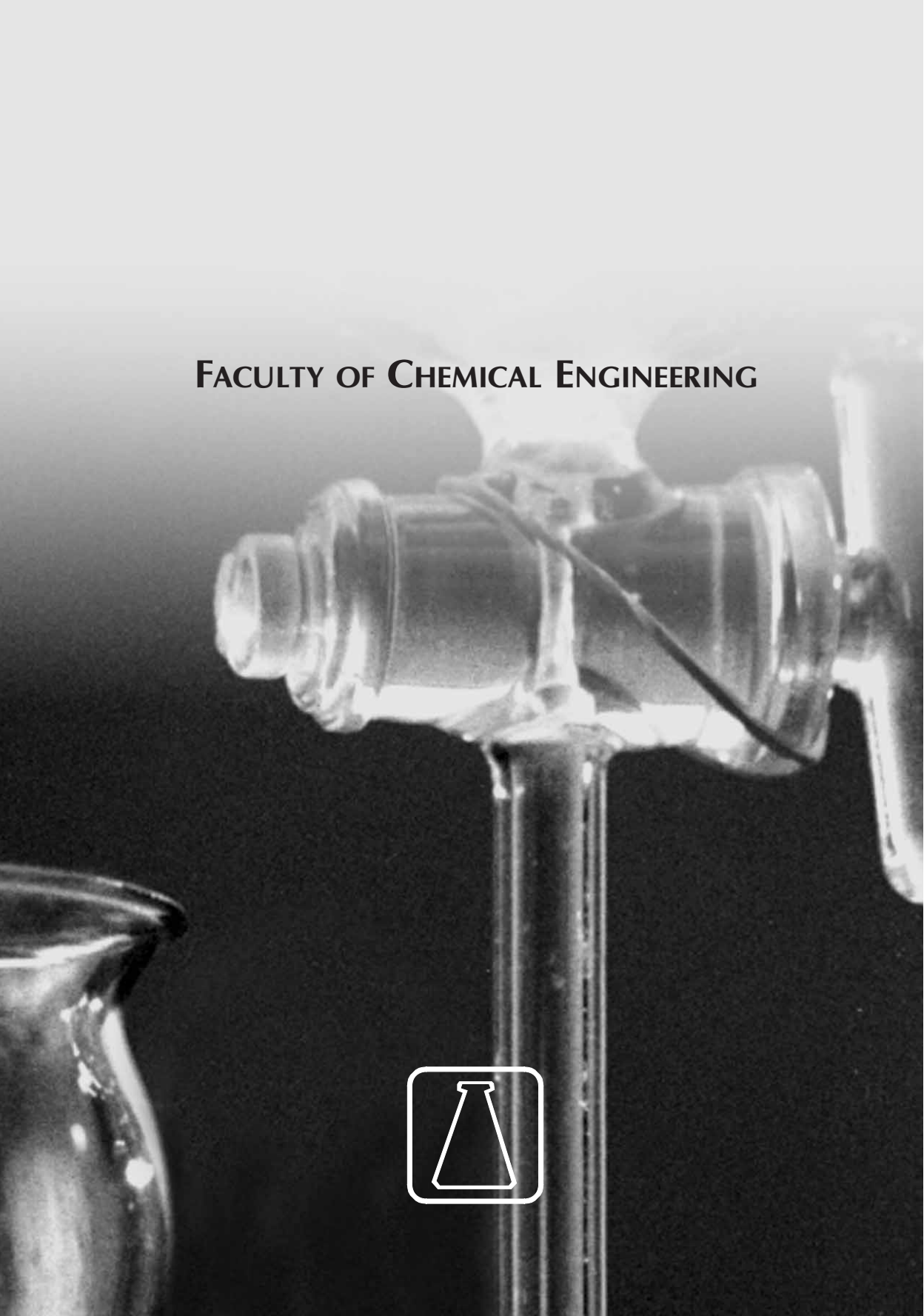
2006–2007

An ECTS Guide

Engineering Programs in English

http://www.tanok.bme.hu

Faculty of Chemical Engineering



The education of chemical engineers and chemists has a long-standing tradition in Hungary. Hungary's earliest chemistry department was established in 1763 at the Selmecbánya Mining School, the first school to offer practical instruction in the chemical laboratory. In 1769, a common department for chemistry and botany was founded at the University of Nagyszombat, which was resettled to Buda in 1777 and later to Pest.

In 1846, the Department of General and Technical Chemistry was founded at Joseph II Industrial School, one of the Budapest University of Technology and Economics's predecessor institutions. Education of chemical engineers, separate from that of mechanical and civil engineers, reaches back to the 1863/64 academic year.

Royal Joseph Polytechnic became a technical university in 1871. The academic freedom introduced by this university-level status allowed students to freely select the subjects they wished to study. However, the need for an interrelated, logical sequence of subjects soon became evident, so in 1892 a compulsory curriculum and timetable was introduced. From the foundation of the Faculty until 1948, only a four-year-term of studies, without specialisations, was offered. Following the educational reforms of 1948, the departments of Inorganic Chemical Technology, Organic Chemical Technology, and Agricultural and Food Chemistry were established. The Inorganic Chemical Technology Department is no longer a part of the Faculty because in 1952 its tasks were taken over by the University of Chemical Industry in Veszprém. Further reforms in the 1960s extended chemical engineering studies to the M.Sc. level and introduced the range of specialised studies identified below. A Ph.D. program has also been established. Studies in English at the Faculty of Chemical Engineering began in the 1985/86 academic year.

Students receive a thorough introduction to areas basic to chemical engineering before they begin their specialisations in the fifth semester. Courses in each of the following branches are available to students at all levels:

- Analytical and Structural Chemistry
- Chemical and Process Engineering
- Industrial Pharmaceutics
- Polymer Technology
- Textile Technology
- Material Science

The Faculty of Chemical Engineering aims for its students to acquire a profound theoretical knowledge in mathematics, physics and physical chemistry. It also aims to have its students experience, during their studies, all the types of tasks that chemical engineers encounter in their practical everyday work. Students will acquire up-to-date laboratory skills, get acquainted with the machines and apparati used in the chemical industry, know the principles needed for their optimal operation, and develop expertise in a more specific technology within the chemical, food and light industries. In the framework of industrial training, students will learn to carry out technological design and solve research problems in the preparation for their diploma projects.

Graduates of this Faculty will be versed in:

- The operations and personnel involved in chemical processes on an industrial scale,
- The development of the technology and products of industrial chemical processes,
- The design of industrial chemical processes,
- How a chemical product or application is introduced into the national economy, and
- The elaboration of new chemical processes, operations and technologies.

A three-year Ph.D. program is also available in all majors offered by the Faculty.

Departments

Agricultural Chemical Technology,
Biochemistry and Food Technology,
Chemical Technology,
Chemical Unit Operations,
General and Analytical Chemistry,
Inorganic Chemistry,
Organic Chemical Technology,
Organic Chemistry,
Physical Chemistry,
Physics,
Plastics and Rubber Technology.

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Course Director: Prof. Dr. András Grofcsik
Program Co-ordinator: Mrs. Ágnes Kormos

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Curriculum of B.Sc. Subjects

Subject			Working hours / semester								Requisites
Name	Code	Credits	1	2	3	4	5	6	7	8	
English Language I	BMETKGTB101	2	4								
English Language II	BMETKGTB201	2		4							
English Language III	BMETKGTB301	2			4						
English Language IV	BMETKGTB401	2				4					
Mathematics I	BMETE90AX00	6	6								
General Chemistry	BMEVESEA101	3	3								
General Chemistry Calculations	BMEVESEA102	2	2								
General Chemistry Practice	BMEVESEA103	4	4								
Computer Mathematics	BMEVEAAA101	4	4								
Mechanical Engineering	BMEVEVMA101	5	5								
Micro- and Macroeconomics	BMEGT30A001	4	4								
Business Law	BMEGT55A001	2	2								
Mathematics II	BMETE90AX02	6		6							BMETE90AX00
Physics 1 Mechanics	BMETE14AX03	3		3							BMETE90AX00
Inorganic Chemistry	BMEVESEA207	2		2							BMEVESEA101, 102
Inorganic Chemistry Practice	BMEVESEA208	4		4							BMEVESEA101,102,103
Organic Chemistry I	BMEVESKA202	5		5							BMEVESEA101
Chemical Technology	BMEVEKTA202	5		5							BMEVESEA101
Management	BMEGT20A001	4		4							
Physics 1 Electrodynamics	BMETEAX04	2			2						BMETE90AX14, BMETE14AX03
Physics Practice	BMETEAX05	2			2						BMETE14AX03, BMETE90AX14
Organic Chemistry II	BMEVESKA303	5			5						BMEVESKA202
Analytical Chemistry	BMEVEAAA302	5			5						BMEVESEA207 OR 204 BMEVESKA202
Physical Chemistry I	BMEVEFKA304	5			5						BMETE90AX02, BMEVESEA101
Plastics	BMEVEMGA306	5			5						BMEVESKA202
Organic Chemical Synthesis Practice	BMEVESKA307	5			5						BMEVESEA103, 102 BMEVESKA202
Analytical Chemistry Practice	BMEVEAAA403	4				4					BMEVEAAA302, BMEVESEA208 OR BMEVESEA205
Physical Chemistry II	BMEVEFKA405	4				4					BMEVEFKA304
Medicines	BMEVESTA403	3				3					
Colloid Chemistry	BMEVEFKA409	2				2					BMEVEFKA304
Environmental Chemistry and Technology	BMEVEKTA403	4				4					BMEVESEA207, BMEVESKA303, BMEVEKTA202
Organic chemical technology	BMEVESTA409	6				6					BMEVESKA202, BMEVEVMA101
Chemical Unit Operations I	BMEVEVMA411	6				6					BMETE90AX02, BMEVEVMA101
Biochemistry	BMEVEBEA502	2					2				BMEVESKA303
Physical Chemistry Practice	BMEVEFK506	4					4				BMEVEFKA405, BMETE14AX05
Process control	BMEVEBMA504	5					5				BMEVEVMA411
Industrial catalysis	BMEVEKTA501	2					2				BMEVESKA202, BMEVEKTA202, BMEVEFKA304
Chemical unit operations II	BMEVEVMA512	6					6				BMEVEVMA411
Quality Management											
Branch		6					6				
Complex and Organometallic Chemistry	BMEVESEA606	2						2			BMEVESEA207, BMEVESKA202
Safety engineering	BMEVESTA601	2						2			BMEVEVMA101, BMEVESEA101
Chemical unit operations practice	BMEVEVMA613	3						3			BMEVEVMA512
Elective		8						8			
Project work		4							4		
Branch		7							7		
Thesis		15							15		
Elective		30								30	

Curriculum of B.Sc. Branch Subjects

Subject			Working hours / semester								Requisites
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Branch of Analytical and Structural Chemistry											
Analytical Chemistry and Spectroscopy Practice	BMEVEAAA604	3						3			BMEVEAAA302, 403 BMEVEAAA512
Elemental Analysis	BMEVEAAA507	3					3				BMEVEAAA403
Chemical and Biosensors	BMEVEAAA708	3							3		BMEVEAAA403
Chromatography	BMEVEAAA611	3						3			BMEVEAAA403
Organic Structure Analysis	BMEVEAAA512	4					4				BMEVESKA303
Structural Chemistry	BMEVEFK708	4							4		
Organic Chemistry III	BMEVESK504	2					2				
Planning and Evaluation of Experiments	BMEVEVMA606	3						3			
Branch of Chemical and Process Engineering											
Hydrocarbons and Catalysis Practice	BMEVEKTA505	3					3				
Hydrocarbon Technology	BMEVEKTA506	3					3				
Processes	BMEVEVMA605	5						5			
Planning and Evaluation of Experiments	BMEVEVMA606	3						3			
Environment Friendly Processes	BMEVEVMA607	4						4			
Computer Aided Process Control	BMEVEVMA608	4							4		
Chemical Production Control											
Branch of Industrial Pharmaceutics											
Organic Structure Analysis	BMEVEAAA512	4					4				BMEVESKA303
Organic Chemistry III	BMEVESKA504	2					2				
Organic Chemistry Practice II	BMEVESKA605	5						5			
Process Planning II	BMEVESTA702	1							1		
Pharmaceutical technology	BMEVESTA704	2							2		
Unit Processes in Drug Synthesis Practice	BMEVESTA705	4							4		
Unit Processes in Drug Synthesis	BMEVESTA606	2						2			
Technology of Pharmaceutical Materials	BMEVESTA607	3						3			
Basic Processes in Industrial Organic Chem.	BMEVESTA508	2					2				
Branch of Material Science											
Physical Chemistry of Interfaces	BMEVEFKA603	3						3			
Functional and Intelligent Materials	BMEVEFKA707	5							5		
Methods in Material Science	BMEVEMGA501	2					2				
Methods in Material Science Practice	BMEVEMGA502	3					3				
Material Science Practice	BMEVEMGA603	3						3			
Polymer Physics	BMEVEMGA511	3					3				
Structural Materials	BMEVEMGA613	4						4			
Branch of Polymer Technology											
Methods in Material Science	BMEVEMGA501	2					2				
Chemistry and Technology of Macromolecules	BMEVEMGA504	2					2				
Machines and Tools for Plastic Processing	BMEVEMGA705	6							6		
Plastic Processing	BMEVEMGA608	7						7			
Polymer Physics Practice	BMEVEMGA509	3					3				
Polymer Additives	BMEVEMGA610	2						2			
Polymer Physics	BMEVEMGA511	3					3				
Branch of Textile Technology											
Methods in Material Science	BMEVEMGA501	2					2				
Chemistry and Technology of Macromolecules	BMEVEMGA503	2					2				
Fiber Polymers	BMEVEMGA512	2					2				
Chemistry of Dyes and Tensides	BMEVEMGA514	2					2				
Colorimetry	BMEVEMGA515	2					2				
Textile Chemistry Practice	BMEVEMGA716	3							3		
Textile Technology I	BMEVEMGA617	7						7			
Textile Technology II	BMEVEMGA718	3							3		
Textile Mechanical Technology	BMEVEMGA619	2						2			

Curriculum of M.Sc. Subjects

Subject			Working hours / semester				Requisites
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	
General Subjects							
Physical Chemistry	BMETKVEPM10	6	7				
Colloid Chemistry	BMETKVEPM11	2	2				
Quantum-Chemistry	BMETKVEIM10	2	2				
Analytical Chemistry	BMETKVEGM10	2	2				
Chemical Unit Operations III	BMETKVECM10	6	7				
Mathematics	BMETKTEMM10	4	4				
Organic Chemistry	BMETKVEOM10	5	5				
Sum:		**27**					
Analytical Chemistry	BMETKVEGM20	5		6			
Chemical Technology	BMETKVETM20	5		5			
Organic Chemistry Practice	BMETKVEOM20	5		7			
Radiochemistry	BMETKVETM21	4		4			
Management	BMETKVEM205	3		3			
Elective Subject	BMETKVE...	4		4			
Sum:		**26**					
Chemical Process Control	BMETKVECM30	4			5		
Solid-State Chemistry	BMETKVEGM30	3			3		
Industrial Planning	BMETKVEM303	3			4		
Branch	BMETKVEXM30	10			10		
Thesis	BMETKVEXM31	3			4		
Elective Subject	BMETKVE...	4			4		
Sum:		**27**					
Elective Subject	BMETKVE...	4				4	
Thesis	BMETKVEXM40	27				30	
Sum:		**31**					
M.Sc. Total:		**111**					

Curriculum of M.Sc. Branch Subjects

Subject			Working hours / semester			Requisites
Name	**Code**	**Credits**	**1**	**2**	**3**	
Branch of Industrial Biological and Food Technology						
Food Industries	BMETKVEBM30	2			2	
Nutrition and Feeding	BMETKVEBM31	4			4	
New Developments in Some Biotechnological Industries	BMETKVEAM30	2			2	
Food Microbiology and Hygiene	BMETKVEAM31	2			2	
Branch of Industrial Organic Synthesis						
Development of Organic Chemical Technologies	BMETKVESM30	5			5	
Computer Aided Design in Chemical Engineering	BMETKVTEM30	5			5	
Branch of Industrial Pharmaceutics						
Synthesis of Bioactive Substances	BMETKVESM31	5			5	
Medicinal Chemistry	BMETKVESM32	5			5	
Branch of Polymer Technology						
Manufacture of Industrial Polymers	BMETKVERM30	1			1	
Polymer Physics	BMETKVERM31	1			1	
Degradation and Stabilisation of Polymers	BMETKVERM32	2			2	
Advanced Polymer Chemistry	BMETKVERM33	2			2	
Theory of Polymer Processing	BMETKVERM34	1			1	
Laboratory Practicals for Polymer Technology and Application	BMETKVERM35	3			3	
Branch of Textile Technology						
Theory of Textile Chemical Technology	BMETKVERM36	3			3	
Polymer Physics	BMETKVERM37	1			1	
Chemical Technology of Textiles	BMETKVERM38	6			6	

Curriculum of M.Sc. Subjects
Elective Subjects

Subject				Subject			
Name	**Code**		**Credits**	**Name**	**Code**		**Credits**
Microbiology	BMETKVEAMX0		2	Process Design and Economy	BMETKVETMX4		2
Microbial Genetics	BMETKVEAMX1		2	Topics in Inorganic Chemistry	BMETKVEIMX0		2
Microbial Metabolism and Regulation	BMETKVEAMX2		2	Inorganic Polymers	BMETKVEIMX1		2
Enzymology and Enzyme Engineering	BMETKVEAMX3		2	Theoretical Chemistry	BMETKVEIMX2		2
Environmental Biotechnology	BMETKVEAMX5		2	Advanced Mathematics	BMETKTEMMX0		2
Flow Injection Analysis	BMETKVEGMX0		2	Mathematical Programming	BMETKTEMMX1		2
Chemical and Biosensors	BMETKVEGMX1		2	Probability	BMETKTEMMX2		2
Compositional and Structural Analysis of Solids	BMETKVEGMX2		2	Modern Synthetic Methods in Organic Chemistry	BMETKVEOMX0		2
Biochemistry	BMETKVEBMX0		2				
Food Chemistry	BMETKVEBMX1		2	Organic Stereochemistry	BMETKVEOMX1		2
Food Technology	BMETKVEBMX2		2	Drug Formulations	BMETKVESMX0		2
Biometry	BMETKVECMX0		2	Chemistry of Dyes and Surfactants	BMETKVESMX1		2
Chemical Industrial Energetics	BMETKVECMX1		2	Organic Chemical Technology	BMETKVESMX2		2
Chemical Systems Engineering	BMETKVECMX2		2	Organo-Phosphorus Chemistry and its Synthetic Use	BMETKVESMX3		2
Statistical Process Control	BMETKVECMX3		2				
Chemical Reactors	BMETKVECMX4		2	Dynamic Systems in Chemistry	BMETKVEPMX0		2
Chemical Technology of Nuclear Power	BMETKVETMX0		2	Plastics in Engineering	BMETKVERMX0		2
Industrial Catalysis	BMETKVETMX1		2	Structure and Properties of Plastics	BMETKVERMX1		2
Corrosion and Corrosion Protection	BMETKVETMX2		2	Introduction to Polymer Technology	BMETKVERMX2		2
Environment Polluting Materials	BMETKVETMX3		2				

Description of B.Sc. Subjects

General Subjects

Mathematics I

BMETKTE90AX00

Dr. Béla Nagy

Real numbers. Complex algebra. Vector algebra. Elementary operations on sets. Series of numbers. Functions of one variable. Differentiation. Rules of differentiation. Newton's method. Applications of differentiation. Integration. Definite integral, indefinite integral. Properties and evaluation of the definite integral. Techniques of integration. Applications of the definite integral.

General Chemistry

BMEVESEA101

Dr. Tamás Veszprémi, Dr. József Réffy

Concepts of general chemistry. Physical states and the laws of gaseous and liquid states. Basic concepts of chemical processes. Stoichiometry. Laws of mixtures and solutions. Fundamentals of thermochemistry and electrochemistry. Chemical equilibria. Properties of electrolytes and pH. Electrolysis, galvanic cells and batteries. Fundamental concepts of colloid systems. Laws of solid state. Types and rates of chemical reactions. Laws of microparticles. Structure of atoms and molecules. Chemical bonds.

General Chemistry Calculations

BMEVESEA102

Dr. Tamás Veszprémi, Dr. József Réffy

Chemical calculations of units, concentrations, and the laws of gases and solutions. Stoichiometry. Redox reactions. Thermochemistry. Chemical equilibrium. Electrochemistry.

General Chemistry Practice

BMEVESEA103

Dr. Tibor Pasinszki, Dr. Dénes Szieberth

Laboratory devices. Basic laboratory operations. Crystallisation. Simple preparation of precipitates and filtration. Working with acids and bases. Distillation. Sublimation. Measurement of density. Classical determination of molecular mass. Electrochemistry. Buffer solutions, indicators and measurement of pH. Preparation of simple inorganic compounds.

Computer Mathematics

BMEVEAAA101

Dr. Zsolt Meszéna

Processing measured data. Graphs. (Excel, Matlab): Solving sets of linear equations; Linear regression; Graphs of functions with 2 independent variables; Optimisation, solution of nonlinear algebric equations; Solving ordinary differential equations; Functions evaluated with a macro; Programmed spread-sheeting: Filtering measured data, automatic data evaluation. Word processing, presentations: Equation Editor; Chemical structures; Handling long documents; PowerPoint presentations. Www, Html: Editing a home page.

Mechanical Engineering

BMEVEVMA101

Dr. Attila Verba , Péter Epacher

Statics of rigid and elastic bodies. Materials of mechanical structures. Machine elements: fasteners, seals, vessels, pipes and pipes equipments, bearings, couplings, chan, belt, V-belt driving.

Fluid mechanics, flow in pipes. Operation, performance and maintenance of pumps used to convey fluids. Operation of fans. Selection, operation and maintenance of blowers and compressors. Vacuum pumps.

Handling and transportation of solids in bulk. Characteristics of solids. Fluidization. Storage in silos. Pneumatic conveying. Belt and screw conveyors and bucket elevators. Fundamentals of crush theory.

Laboratory exercises: Measurement of revolution per minute, measurement of pressure, measurement of flow-rate and velocity. (5 credits)

Micro- and Macroeconomics

BMEGT30A001

Dr. Edit Romvári

Selected topics and analytical techniques in macro, micro, economics tailored for engineering students. Microeconomics. Basic economic concepts and analytical tools. Scarcity, choice, opportunity cost. How the product market works? Consumer choice. Business goal and forms. Basics of accounting and finance. Cost and profit. Competition and market form. Macroeconomics. Government policy and business. GDP, inflation, unemployment. Fiscal and monetary policy: tools and effects. Economic growth and productivity. Exchange rate and exchange rate policy.

Business Law

English Language I

BMETKGTB101

Staff

Students learn to communicate effectively both verbally and orally. Vocabulary improvement is emphassed. Grammar instruction focuses on use and includes verb tenses, the sequence of tenses, auxiliary verbs, voice, non-finite verb forms, sentence structure, word order, and indirect speech.

Mathematics II

BMETE90AX02

Dr. Béla Nagy

Linear equations. Matrices and determinants. Linear spaces. Linear operators and matrices. Numerical series. Function series. Power series, Taylor and Fourier series. Sets. Differential calculations for multivariable functions. Integral calculations, surface and volume integral.

Mathematical statistics

BMETE90AX14

Dr. Márta Lázi-Láng

Probability and combinatorics. Variables. Density function. Discrete and continuous distributions, applications. Poisson law. Multidimensional distribution. Stochastic processe. Conditional distribution. Estimation. Statistical assembly. Estimation. Chi square an t distribution. Statistical probes.

Physics 1 Mechanics

BMETE14AX03

Dr. Zoltán Noszticzius, Dr. József Verhás

Vectors.Time dependent quantities, rate of changes, average rate. Mechanics: mass point, rigid body, translation, rotation. Reference systems, coordinate systems. Mass point kinetics.

Axioms of dynamics. Mechanics of the extended bodies.Linear and angular momentum. Work and energy. Rigid body, elastic body. Fluids.

Inorganic Chemistry

BMEVESEA207

Dr. Tamás Veszprémi, Dr. József Réffy

General characterisation of elements. Non-metal elements, metals, transition metals, and f-elements. Classification and general characterization of compounds: hydrides, halides, oxides, sulphides, sulphates, carbonates, and nitrates.

Inorganic Chemistry Practice

BMEVESEA208

Dr. Tibor Pasinszki, Dr. Dénes Szieberth

Preparation and properties of inorganic compounds. Solubility of elements and inorganic compounds in acid and base. Characteristic reactions of cations and anions of main group and transition metal elements. Qualitative analysis. Combined separation and purification procedures.

Organic Chemistry I

BMEVESKA202

Dr. Péter Huszthy, Dr. Lajos Novák

n the course of these studies the students get acquainted with the synthesis, structure and reactions of saturated and unsaturated hydrocarbons, aromatic hydrocarbons, halogen compounds, alcohols, phenols, ethers, nitro compounds, amines, aldehydes, ketones, carboxylic acids and their derivatives. They learn the fundamentals of organic reaction mechanism: SR, SN1, SN2, E1, E2, E1cb, SEAr, SNAr, AdE, AdN. Nomenclature of organic compounds, fundamentals of stereochemistry (Cahn-Ingold-Prelog convention, specifying E/Z and R/S isomers etc.) are also made familiar for the students.

Chemical Technology

BMEVEKTA202

Dr. Antal Tungler, Dr. György Pátzay, Dr. Gábor Széchy

Definition, role, characteristics of chemical technologies, industrial branches using chemical technologies, characteristics of the chemical industry, classification of chemical products, inorganic chemical technologies, basic concepts of energy production, energy sources, coal, crude oil, natural gas, nuclear energy, renewable energy sources. Burning technology. Water treatment technologies. Hydrocarbon production and technology. Fuels and raw materials for the chemical industry.

Management

BMEGT20A001

Dr. Tamás Koltai

Basic functions of management: management accounting, cost behaviours and break-even analysis, product mix analysis, inventory control, forecasting, and scheduling problems.

English Language II

BMETKGTB201

Staff

Students learn to transfer their knowledge of grammar to everyday and professional use. Special emphasis is placed on listening for the purpose of understanding lectures, on reading textbooks, and on improving reading and writing skills required during the student's university studies.

Physics 1 Electrodynamics

BMETE14AX04

Dr. Zoltán Noszticzius, Dr. József Verhás

Electrostatics.electric voltage, electric potential. Surface (2D) charge distributions. Dipole momentum. Magnetostatics. Stationary fields and direct current. Kirchhoff's laws. Direct current and its magnetic field .Alternating current. Capacity and inductance. Rapidly changing electric fields and electromagnetic waves.

Physics Practice

BMETE14AX05

Dr. Mária Wittmann

Introduction: evaluation of measurements; DC and AC circuits. Control of electric current and voltage. Resistance measurement, compensation. Alternating current. Semiconductors. Temperature measurement. Logical circuits. Dynamical systems. Optics

Organic Chemistry II

BMEVESKA303

Dr. Péter Huszthy, Dr. Lajos Novák

Synthesis and reactions of carbonic acid derivatives, diazomethane, azo, diazo, diazonium and related compounds, sulfur and phosphorus compounds, unsaturated acids (e.g. arachidonic acid), lipids, terpenes and the steroids, substituted acids (halo, hydroxy, oxo, amino acids), peptides and proteines, carbohydrates, five and six membered heterocycles, nucleic acids. Some heterocyclic derivatives with biochemical activity. Stereochemistry: Emil Fischer (d/l) convention in structure determination of ?-amino acids and sugars. Stereo controlled synthesis, prochiral centers and surfaces. Methods for enantiomeric separation.

Analytical Chemistry

BMEVEAAA302

Dr. Róbert Gyurcsányi

Fundamentals of chemical analysis: sampling and sample preparation, separation techniques, and error calculations. Evaluation of analytical data. Gravimetric methods of analysis. Titrimetric methods of analysis: precipitation, acid-base, complex formation, and oxidation-reduction titrations. Theory and applications of instrumental analytical methods: potentiometry, voltammetry, conductometry, thermal analysis, liquid and gas chromatography, flame photometry, atomic absorption spectrometry, ultraviolet, visible and infrared molecular spectroscopy.

Physical Chemistry I

BMEVEFKA304

Dr. András Grofcsik

Thermodynamics: Characterization of thermodynamic systems. Internal energy, the first law of thermodynamics. Enthalpy, thermochemistry. Ideal and real gases. Entropy, the second law of thermodynamics. Gibbs free energy and Helmoltz free energy. One component phase equilibria. Thermodynamics of solutions, the chemical potential. Two

component liquid-vapor and solid-liquid equilibria, phase diagrams. Distribution equilibrium. Chemical equilibrium.

Structure: Quantum mechanics. Structure of atoms. Energy levels of molecules. Computational chemistry. Optical spectroscopy. Photochemistry and photobiology. Structure of nuclei. Nuclear magnetic resonance. Structure of solids and liquids. X ray diffraction.

Plastics

BMEVEMGA306

Dr. Viktória Vargha

Definitions, classes of plastics, most important properties. Radical polymerization. Polycondensation, cross-linked polymers. Models of polymer physics. Polymer solutions. Phases and physical states. Behaviour of solid polymers, rubber elasticity. Uniaxial deformation, tensile testing, necking. Fracture, brittle and ductile failure. Relationship of molecular and macroscopic structure. Crystalline polymers. Melting, crystallization, polymorphism. Correlation between crystalline structure and properties. Structure of amorphous polymers. Polymer blends and composites. Physical states and processing modes. Machining. Application of plastics. Type and cause of degradation. Types of additives. Plastics and the environment. Plastics based on natural resources. Biodegradable polymers. Lab practice demonstrating the most important processing technologies and quality control methods.

Organic Chemical Synthesis Practice

BMEVESKA 307

Dr. László Poppe

During this course the students learn the principles of experimental organic chemistry, the ways of safe handling and disposal of chemicals, the fast identification of the synthetized compounds and the organic chemistry literature searching. The students make themselves familiar with the function of the equipment used in the laboratory, the most important procedures to prepare, separate and purify organic compounds (crystallization, distillation both at atmospheric and reduced pressures, steam distillation, extraction, drying, thin layer and column chromatographies etc.). All these help to deepen their knowledge in organic chemistry and get acquainted with the properties of organic materials.

Technical English

Staff

Course dealing with the problems, principles and techniques of presenting technical information. It includes reports, proposals, procedures, manuals and technical articles.

Analytical Chemistry Practice

BMEVEAAA403

Dr. Róbert Gyurcsányi

Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of different inorganic ions. Determination of inorganic and organic compounds using various instrumental analytical (potentiometry, conductometry, liquid-, gas- and thin layer chromatography, flame photometry, atomic absorption spectrometry, fluorimetry, ultraviolet/visible spectroscopy, flow injection analysis) methods.

Physical Chemistry II

BMEVEFKA405

Dr. András Grofcsik

Transport processes: Thermodynamic driving forces. Laws of diffusion. Heat conductance. Viscosity. Reaction kinetics: Homogeneous reactions. First order and second order reactions. Equilibrium reactions. Consecutive and parallel reactions. Temperature dependence of reaction rates. Reactors. Kinetics of heterogeneous reactions. Electrochemistry: Equilibrium in electrolytes. Thermodynamics of galvanic cells. Electrode potentials. Conductivity of electrolytes. Kinetics of electrode processes.

Medicines

BMEVESTA403

Dr. Ferenc Faigl

The subject gives a breaf introduction to the medicinal chemistry and pharmacology. The fundamental pharmacological definitions and ideas as well as a historical outline of drug discovery and design are presented. Selected examples of drug action at some common target areas demonstrate the importance of the special receptor-drug interactions and the improtance of chemical modifications of the leading molecules to produce highly selective medicines. Typical examples are also discussed for drug metabolism including several organic chemicals and solvents which are important for the organic chemists.

Colloid Chemistry

BMEVEFKA409

Dr. Zoltán Hórvölgyi

Short history of colloid chemistry: from colloids to nanotechnology. Classification of colloid systems. Interfaces, surface tension. Curved surfaces, capillarity. Surface tension of solutions. Adsorption, adsorbents. Solution of macromolecules. Micelles and membranes. Biological aspects of colloids. Dispersions, micro- and macroemulsions, foams. Particle size measurements. Rheology.

Environmental Chemistry and Technology

BMEVEKTA403

Dr. Gábor Bajnóczy

Properties of pollutants. Methods for avoiding the formation of pollutants. Waste treatment technologies. Hazardous materials. Air pollution. Water quality. Waste water treatment. Important regulations concerning environmental protection.

Organic Chemical Technology

BMEVESTA409

Dr. György Keglevich, Dr. Péter Bakó

The subject shows the typical fields, equipment and transformations of the organic chemical industry. The relevant fields discussed are: C1-, C2- and C3- intermediates, as well as aromatic substrates; detergents, washing powders and environmental considerations; pesticides, such as insecticides, fungicides and herbicides, toxicity and environment; features of the pharmaceutical industry, typical syntheses and technologies illustrated by the examples of some drugs selected; principles of green chemistry, environmental-friend considerations; characteristics of the plastic and rubber industry, recycling of thermoplastics; the textile and dye industry, natural and synthetic dyes.

In the framework of the laboratory practice, the students get acquainted with typical organic chemical transformations (eg. oxidations, hydrogenations, esterifications, Friedel-Crafts reactions, diazotation and coupling) carried out in suitable reactors, such as stirred tank reactor, tube reactor, autoclave, cascade reactor, ball- and tube mill and Mettler-Toledo intelligent reactor. Operation of the reactors should be optimized by studying the effect of the technological parameters, such as temperature, pressure and stirring. The reaction mixtures are analysed by up-to-date techniques.

Chemical Unit Operations I

BMEVEVMA411

Dr. Endre Rév, Dr. Géza Havas

Unit Operations of Chemical Engineering. Continuity equations, mass balance, component balance, energy equation, momentum balance, equations of motions, transport equations, equations of state, equilibrium, chemical kinetics. Fluid mechanics, concepts of fluid behaviour, steady flow, rheology, viscosity, boundary-layer formation, friction factor. Navier-Stokes, Euler and Bernoulli equations. Transportation of fluids. Hydrodynamic models, flow in pipes and channels, pressure flow through equipment, pressure drop across packed towers. Mechanical unit operations: Mixing, sedimentation, thickeners, filtration. Electrical and magnetic methods, centrifugal separation, fluidisation, pneumatic transport, gas cleaning, cyclones. Flow of heat, conduction, convection, radiation. Rate of heat transfer, heating and cooling: viscosity correlation. Dimensional analysis. Heat transfer of condensation, steady and unsteady- state heat transfer. Heat transfer in shell and tube heat exchangers. Evaporation, boiling point rise. Standard and multiple-effect evaporators, vapour compression. (5 credits)

Biochemistry

BMEVEBEA503

Dr. András Szarka

Principles of bioenergetics. Enzymes. Energy sources and main metabolic pathways of living organisms. Carbohydrate metabolism. Lipid metabolism. Protein and amino acid metabolism. Metabolism of nucleotides. Integration of metabolism. Generation and storage of metabolic energy. Citric acid cycle. Genetic information (storage, transmission and expression). The central dogma of molecular biology. Alcohol and drug metabolism. The regulation of metabolic pathways.

Physical Chemistry Practice

BMEVEFKA506

Dr. János Bódiss

Measurement of temperature, pressure and flow rate.

One component phase equilibrium. Temperature dependence of dissociation equilibrium constant. Calorimetry. Electrochemical cells, lectrode kinetics. Determination of order of reaction and rate constant. Determination of diffusion coefficient. Measurement of viscosity.

Chemical Process Control

BMEVEVMA504

Dr. Péter Mizsey

Aims of the chemical process control. Areas and methods of process control, feed forward control, feed back control. Mathematical basics, dynamic behaviours. Transfer function, frequency function. Model and modelling of chemical units and process from control point of view. Stability, its definitions in time, frequency, and Laplace domain. Controllers, controller algorithms, different controls and their characterizations. Controller tuning. Actuators, control valves. Basic controls: level, flow, pressure, temperature controls. Cascade controls. Control of multivariable processes. Interaction among control loops. Examples and solutions for the control of chemical units and processes. (2 credits)

Industrial catalysis

BMEVEKTA501

Dr. Antal Tungler

Thermic and catalytic reactions. Energy relations in a catalytic reaction. Theory of transitional metal complex catalysis, homogeneous catalytic processes in the industry. Adsorption, isotherms, adsorbed state of molecules, chemistry of chemisorption. Theories of heterogeneous catalysis. Alloy catalysis, surface chemistry, investigation of single crystalls. Selectivity in heterogeneous catalysis. Catalyst types. Investigation of catalysts, basic catalytic kinetics. Design and development of catalysts. Catalyst preparation (Raney-nickel, Pt/alumina, zeolites). Supports, poisons. Catalytic reactors. Industrial processes: oxidation, hydrogenation, hydroformylation. Catalytic processes in environmental protection: exhaust gas purification, fuel cells.

Chemical unit operations II

BMEVEVMA512

Dr. Endre Rév

Characterization and calculation of liquid-liquid and gas-liquid-liquid equilibria. Equilibrium ratio, vapor tension, Antoine equation, Raoult-Dalton equation, relative volatility, bubble-point calculations, phase distribution calculations. Use of binary phase plots and equlibrium plots, use of ternary phase plots. Single stage equilibrium distillation and flash. Simple distillation. Rayleigh equation, vapor consumption. Steam distillation. Continuous multistage distillation. Reflux ratio. MESH equations. CMO. Upper and lower operating lines. Q-line. Graphical determination of the theoretical number of stages. Graphical determination of the minimum number of theoretical stages. Fenske equation. Minimum reflux ratio, graphical construction. Relations between number of stages, reflux ratio, and product purity. Plates and packings. Stage efficiency, HTU, NTU, HETP. Column capacity. Batch rectification with constant reflux ratio and with constant purity. Azeotropic and extractive distillation methods. Pressure swing distillation. Absorption. Kremser-Souders-Brown equation. Liquid extraction. Equilibrium ratio, distribution ratio, and phase ratio. Simple extraction. Repeated extraction. Perkolation. Continuous countercurrent multistage extraction. Counter-solvent extraction. Devices. Computation with constant equilibrium ratio, graphical constraction with constant phase ratio and with non-constant phase ratio. (3 credits)

Quality Management

Advanced topics covering the main functions of production management, organisational behaviour, quality control, and the principles of team work organisation. A strong background in statistics and operational research is required.

Complex and Organometallic Chemistry

BMEVESEA606

Dr. Tibor Pasinszki

General characterisation of coordination compounds. Structure, stability and bonding of complex compounds. General characterisation of organometallic compounds. Specific reactions and general synthetic methods. Fundamentals of homogen catalysis. Applications of organometallic compounds.

Safety Engineering

BMEVESTA601

Dr. László Farkas, Dr. István Csontos

Occupational safety, workers' protection. Employer-employee connections and responsibilities. Fire and explosion hazards. Emergence of brisance and explosion. Substances liable to auto-ignition and peroxide formation. Principles and practice of fire and explosion prevention in case of various ignition sources Transport and storage of hazardous substances. R and S phrases. Material Safety Data Sheet. Transport and storage of incompatible substances. Safety engineering and proprietary approach. Insurance of industrial plants. Special requirements of work with high pressure vessels. Definition of poisoning. Permitted exposure limit (PEL), threshold limit value (TLV), maximum workplace concentration (MAK). Poison categories. Lethal dose, lethal concentration. Toxic substances classified by effect type. Risks of toxic substances in lab, industry and environment. Protection against toxic substances. Definition of a disaster. Noteworthy disasters in the chemical industry. Analysis and assessment of biological risks. Prevention of infection - general considerations, methods.

Chemical Unit Operations Practice

BMEVEVMA613

Dr. Endre Rév, Dr. Géza Havas

Laboratory practice with pilot-scale apparatus (evaporators, heat exchangers, mixers, filters, gas absorption, distillation, rectification, extraction etc). (3 credits)

Department of Chemical Unit Operations

Chemical Systems Engineering

BMETKVECMX2

Dr. Endre Rév

Basic ideas of chemical systems. Models; the modelling and simulation of systems. Technological and signal flow graphs. Flow sheeting. Methods of cost estimation. Analysis and synthesis of chemical systems and technologies. Methods of synthesis. Computer- aided process design. Exercises in program development for simulation and flow sheeting; use of professional program packages and flow sheet simulators. (2 credits)

Description of M.Sc. Subjects

General Subjects

Physical Chemistry

BMETKVEPM10

Dr. Ferenc Billes

Spectroscopic determination of molecular structure using Mössbauer, rotational and vibrational spectra. Rules of selection in infrared and Raman spectra. Electronic and photoelectronic spectroscopy. Molar refraction and optical rotatory power. Electron, neutron, and x-ray diffraction. Magnetic properties of materials; ESR, NMR spectra. (6 credits)

Colloid Chemistry

BMETKVEPM11

Dr. Tamás Szekrényessy

Colloidal state. Phenomena in dispersions: sedimentation, diffusion, osmosis, optical properties, particle size and shape. Preparation and aging. Stability and its interpretation. Interfaces, wetting, adsorption, and curved surfaces. Association colloids and the properties of surfactant solutions. Emulsions, micro emulsions, and foams. Porous structures. (2 credits)

Quantum-Chemistry

BMETKVEIM10

Dr. Tamás Veszprémi

Experimental background of quantum mechanics. Heisenberg's principle of uncertainty. Operators. Schrödinger's equation. Born-Oppenheimer theorem. Perturbation theory and the variation method. Eigenvalue problem of the hydrogen atom. Slater determinant. Multielectronic atoms and the Hartree-Fock method. Configuration interaction. Fundamentals of the MO theory. Hartree-Fock-Roothan method. Chemical bonds and the quantum mechanical interpre- tation. Bonding and anti bonding MOs. Hueckel method. Applications. (2 credits)

Analytical Chemistry

BMETKVEGM10

Dr. Klára Szepesváry

Introduction to automatic and mechanised analysis. Development of process control and laboratory analysers. Industrial process analysers. Continuous on-line process control. Analytical chemometrics: the characterisation of materials and chemical metrology. Theoretical description of analytical chemical procedures. Computer aided analysis. Data representation. (2 credits)

Chemical Unit Operations III

BMETKVECM10

Dr. András Deák Dr. Béla Simándi

Chemical reaction engineering (general principles of reactor design). Classification of reactors and choice of reactor type. Chemical equilibria. Ideal reactors: batch reactors, tubular reactors and continuous stirred tank reactor. Design work: (seminar): Design problems of batch-, tubular- and continuous stirred tanks. Laboratory practice: rectification, batch distillation, tubular reactor, tank reactor etc. (6 credits)

Mathematics

BMETKTEMM10

Dr. Dénes Petz

Selected topics on differential equations and vector calculus. (4 credits)

Organic Chemistry

BMETKVEOM10

Dr. Lajos Novák

Advanced course on stereo chemistry, frontier orbitals, and organic reactions. Cyclo-additions and rearrangements. Electrophilic and nucleophilic aromatic substitution reactions. Addition and elimination reactions. Stereo controlled synthesis. Reactions with radical mechanisms. (5 credits)

Analytical Chemistry

BMETKVEGM20

Dr. Klára Szepesváry

Methods of structure analysis in analytical chemistry. Analysis of real samples. Laborat- ory practices in sample analysis, preparation, and evaluation. Automatic analytical methods. (5 credits)

Chemical Technology

BMETKVETM20

Dr. Ferenc Tátrai

Mathematical models for describing the steady state of different operational units. Correct definition of the flowsheet problem. Optimisation of material and energy balance constraints. Estimation of parameters in chemical engineering systems. Methods of regression and the correction of data error. Heterogeneous reactions. Catalyst deactivation. Reaction and the atomic matrix concept. (5 credits)

Organic Chemistry Practice

BMETKVEOM20

Dr. László Poppe

Preparation of complex organic compounds in a multistep process. Separation of mixtures of organic compounds using thin layers, low pressure columns, and vacuum chromatogra- phy. Applications of spectroscopic methods in qualitative organic analysis. Using journals, reference works on synthetic procedures, and advanced textbooks. Molecular modelling and calculation. (5 credits)

Radiochemistry

BMETKVETM21

Dr. György Pátzay

Elementary structure of matter and the fundamental particles which build up the nucleus. Isotope effects. Concept of radio activity and kinetics. Spontaneous radioactive transformations. Interaction of radiation with matter. Nuclear reactions. Fission and nuclear reactors. Laboratory practices in dosimetry and protection. Nuclear measurement techniques. Detectors. Systematic and accidental errors. Analytic and medical applications. (4 credits)

Management

BMETKVEM205

Dr. Tamás Koltai

Advanced topics covering the main functions of production management, organisational behaviour, quality control, and the principles of team work organisation. A strong background in statistics and operational research is required. (3 credits)

Chemical Process Control

BMETKVECM30

Dr. Ferenc Billes Dr. Péter Mizsey

Information theory, signal analysis, and signal-to-noise improvement. Analogous systems: operational amplifiers, lock-in amplifiers, boxcar integrators, photon counters, and their applications. Digital systems: analog/digital and digital/analog conversions, data acquisition, memories, processor units, displays, and networks. Techniques for controlling chemical engineering processes, reactors, fermentors, and gas tanks. (4 credits)

Solid-State Chemistry

BMETKVEGM30

Dr. György Pokol

Fundamental concepts of the structure of solids; liquid crystals and the concepts of crystallography. Methods of investigation. Physical (mechanical, optical, electric, magnetic) properties; changing these properties by grinding and modification. Chemical reac- tions of solid substances. Decomposition of solids. Selected examples of solid-melt and solid-solid reactions supplement the theory. (3 credits)

Industrial Planning

BMETKVEM303

Staff

Integrated application of basic, engineering, and economic studies. Summarises the practical process and equipment design methodology; covers decision making and plant profitability evaluation. Student groups work on a department specified practical industrial problem. Their reports are validated by industrial experts. (3 credits)

Branch of Industrial Biological and Food Technology

Food Industries

BMETKVEBM30

Dr. András Salgó

Main characteristics and trends in the food industry. Food technologies as reflected by operation theory. Modern bread manufacturing. Extrusion in the processing of cereals. Biochemistry of meat. PSE meats and problems connected with their processing. Proteins supplementing or replacing meat. Product and process development in the confectionery industry. (2 credits)

Nutrition and Feeding

BMETKVEBM31

Dr. András Salgó

Energy, nitrogen, vitamin, and mineral sources. Essential food and feed compounds and physiological requirements. Process of digestion. Methods for determining the bio- logical value of foods and feeds. Principles of food and feed formulation. Production at the lowest cost. (4 credits)

Food Microbiology and Hygiene

BMETKVEAM31

Dr. Ágnes Suhajda

The scope of food microbiology. Microorganisms and food materials, growth and survival of microbes in foods. Fermented and microbial foods. Microbiology of primary food commodities. Foodborne illnesses, public health. Methods for the microbiological examination of foods. (2 credits)

Branch of Industrial Organic Synthesis

Development of Organic Chemical Technologies

BMETKVESM30

Dr. László Hegedus

Overview of the development of organic chemical technologies; consideration of chemical and operational aspects and also the economy and the efficiency of the development. Complex relations and the dynamic interaction of preparation, production, and marketing. (5 credits)

Computer-Aided Design in Chemical Engineering

BMETKVETM30

Dr. Ágnes Széchy

Using CAD to design chemical processing systems. Physico-chemical data banks and property estimation methods. Database management systems. Flowsheet systems and recent advances in flowsheet methods. Profitability and cost estimation in chemical processing systems. Process synthesis, heat exchanger networks, distillation sequences. Case studies and their use in chemical engineering. (5 credits)

Branch of Industrial Pharmaceutics

Synthesis of Bioactive Substances

BMETKVESM31

Dr. István Bitter

Principles of modern synthesis used to build complicated structures. Large scale production of some important pharmaceuticals. Designing and developing drugs. Laboratory exercises in preparing drugs and experiments to characterise their pharmaco-kinetic behaviours. (5 credits)

Medicinal Chemistry

BMETKVESM32

Dr. László Toke

How medicines work. Pharmaco-kinetic parameters and the possible side effects of drugs in a "structure-pharmacological action" arrangement. Quantitative aspects of drug design. (5 credits)

Branch of Polymer Technology

Manufacture of Industrial Polymers

BMETKVERM30

Dr. Viktória Vargha

Manufacture of petrochemistry, synthesis of monomers. Relations between structure, properties and manufacturing conditions of polymers. Latest technologies for the preparation of commodity plastics - PE, PP, PVC, PS - other thermoplastics - acrylics, polyamides, polyesters (PET, PBTP) and thermosets - unsaturated polyesters, phenoplasts, aminoplasts, epoxies and polyurethanes. Environmental aspects of polymer manufacture. (1 credit)

Polymer Physics

BMETKVERM31

Dr. Viktória Vargha

Relationship between macroscopic properties and molecular structure. Conformation theory of polymer chains. Kinetics and thermodyna- mics of highly elastic deformation. Interpretation of the glassy state. Crystalline state of polymers. Multi-component systems and composites. (1 credit)

Degradation and Stabilisation of Polymers

BMETKVERM32

Dr. Béla Pukánszky

Decomposition reactions in polymers under the influence of factors such as heat, light, high energy radiation, oxygen, ozone, and mechanical forces. Possible means of protection. Thermal degradation; oxidative processes and antioxidants; mechanical degradation. Effects of sunlight and light stabilisers. Bio-degradation. Degradation and stabilisation of PVC. Burn and flame retardants. Accelerated aging tests and their validity. (2 credits)

Advanced Polymer Chemistry

BMETKVERM33

Dr. Viktória Vargha

Synthesis and properties of newly developed special purpose polymers. Theory of polymerisation processes. Liquid crystalline polymers; water-soluble plastics; conductive polymers; plastics with extra high strength and heat stability; photosensitive materials. (2 credits)

Theory of Polymer Processing

BMETKVERM34

Dr. Béla Pukánszky

Theoretical basis of the main polymer processing operations of extrusion, injection moulding, and calendering.

Laboratory Practicals for Polymer Technology and Application

BMETKVERM35

Dr. Viktória Vargha

Determining the reaction kinetics of macro- molecular processes and the physical and rheological characteristics of plastics using modern industrial methods. (3 credits)

Branch of Textile Technology

Theory of Textile Chemical Technology

BMETKVERM36

Dr. Judit Borsa

Complicated interphase processes in textile chemical technology. Occurrence and effects of sorption, diffusion, chemisorption, reactive processes, dissolution, dispersion, emulsification, penetration, and swelling during preparation, bleaching, dyeing, printing, and finishing. (3 credits)

Polymer Physics

BMETKVERM37

Dr. Béla Pukánszky

Fundamental relationships between the structural, technological, and wear characteristics of fibrous materials. Structural changes that occur during processing. Super molecular structure of fibrous materials. Their thermodynamic, deformational, and electric properties; testing these properties; their influence on how the materials can be used. (1 credit)

Chemical Technology of Textiles

BMETKVERM38

Dr. Emília Csiszár

Structure, reactivity and other characteristics of natural and man-made fibres. Chemical and technological characterisation of dyes and pigments with regard to their interaction with fibres. Preparation, bleaching, dyeing, printing and finishing technology of textiles. (6 credits)

Description of M.Sc. Elective Subjects

Department of Agricultural Chemical Technology

Microbial Genetics

BMETKVEAMX1

Dr. András Holczinger

Introduction to the history of microbial genetics. Fundamental concepts of molecular genetics: bacterial cell, DNA replication, restriction endonucleases, the polymerase chain reaction and sequence analysis. Genetic recombination and crossing over.Genetic information transfer systems: transformation, transduction, conjugation. Transcription and translation, the genetic code. RNA synthesis (promoters, prokaryotic, and eukaryotic genes). Protein synthesis and the genetic code of suppressive mutation; antibiotics and protein synthesis. Biological regulations of induction, repression, feedback inhibition, and attenuation. Molecular basis of mutation. Improvements of industrial strains by mutation; genetic engineering; invitro mutagenesis; transposons and transposon mutagenesis. (2 credits)

Microbial Metabolism and Regulation

BMETKVEAMX2

Dr. Bálint Kupcsulik

Aspects of the microbial intermediary meta- bolism: transport processes, carbohydrate metabolism, nitrogen and sulphur metabolism, and the synthesis of macromolecules including proteins and nucleic acids (RNA and DNA). Regulation at all levels of the hierarchy of metabolism; regulation of enzyme activity; regulation of transcription and translation. Regulation of overall growth and cell division; representative examples of morphogenetic processes. (2 credits)

Enzymology and Enzyme Engineering

BMETKVEAMX3

Dr. Katalin Réczey

Structure and function of enzymes. Bio- synthesis of microbial enzymes. Fermentation, isolation, and purification of enzymes. Immobilisation of enzymes and their properties. Enzyme reactors and reactor kinetics. Application of free and immobilised enzymes. (2 credits)

Environmental Biotechnology

BMETKVEAMX5

Dr. Andrea Jobbágy

Basic parameters of biodegradation, biological elimination of pollutants. Environmental importance and measurement of biodegradability. Influence of the quality and concentration of the substrate to be removed, of the biomass and of the type of the electronacceptor available. Application of biodegradation processes in the development of environmental biotechnologies. Spontaneous and controlled biodegradation in the sewer and storage systems. Applied biodegra- dation in wastewater treatment. Basics of modelling biodegradation processes. (3 credits)

Department of General and Analytical Chemistry

Flow Injection Analysis

BMETKVEGMX0

Dr. György Pokol

Aspects and trends of the analytical methods of continuous flow. Principles and the trends of flow injection analysis. Flow-through detectors, most frequently used in flow injection analysis. Examples of the capability of the technique of flow injection. (2 credits)

Chemical and Biosensors

BMETKVEGMX1

Dr. Klára Tóth

Basic concepts and principles informing the design and use of chemical and biosensing devices and systems; Signal transducers with special emphasis on electrochemical and optical transducers; Development of bioselective layers (immobilization strategies, patterning and types of biological components used); Applications of chemical and biosensor-based instrumentation in the medical, bioprocess, and environmental fields. (2 credits)

Compositional and Structural Analysis of Solids

BMETKVEGMX2

Dr. György Pokol

Basic features of the solid phases. Phase diagrams, crystal structures, polymorphism, solvates. Methods of investigations: thermal analysis (thermogravimetry, differential scanning microscopy), X-ray diffraction, scanning electron microscopy with energy dispersive analyzer. Examples will be selected from real-life problems. (2 credits)

Department of Biochemistry and Food Technology

Biochemistry

BMETKVEBMX0

Dr. Radomir Lásztity

More advanced biochemistry for students specialising in pharmaceuticals, pesticides, biology, and the food industry. Protein structure and function, biological membranes, bioregulation, the function of organs and their biochemistry. (2 credits)

Food Chemistry

BMETKVEBMX1

Dr. András Salgó

Aimed at students specialising in biology and the food industry. Chemical composition of foods; changes during the technological processes. Colouring materials, phenols, natural flavouring substances, water- and fat- soluble vitamins and their changes. (2 credits)

Food Technology

BMETKVEBMX2

Dr. Ferenc Örsi

For students specialising in the food industry. Advanced instruction in selected food technologies. Newer solutions in technology, food preservation, food flavouring, packaging; new types of food. (2 credits)

Department of Chemical Unit Operations

Biometry

BMETKVECMX0

Dr. Sándor Kemény

Brief review of basic applied statistics; development of the analysis of variance as a technique for interpreting experimental data. Generalised likelihood ratio principle, completely randomised design, nested designs, orthogonal contrasts, multiple comparisons, randomised block designs, Latin squares, factorial designs, 2n designs, fractional factorials, confounding, and an introduction to response surface methodology. Applications are emphasised. (2 credits)

Chemical Industrial Energetics

BMETKVECMX1

Dr. Endre Rév

Basic ideas and laws of thermodynamics. Energy supply of chemical plants. Work and heat. Heat engine and the heat

pump. First and second order of methods for improving energetics. Saving energy by heat integration. Economics. Computer-aided energy conservation. (2 credits)

Chemical Systems Engineering

BMETKVECMX2

Dr. Zsolt Fonyó

Basic ideas of chemical systems. Models; the modelling and simulation of systems. Technological and signal flow graphs. Flow sheeting. Methods of cost estimation. Analysis and synthesis of chemical systems and technologies. Methods of synthesis. Computer- aided process design. Exercises in program development for simulation and flow sheeting; use of professional program packages and flow sheet simulators. (2 credits)

Statistical Process Control

BMETKVECMX3

Dr. Sándor Kemény

Stability and capability. Control charts for variables and attributes. Process capability indices. Assessment of measurement system. Acceptance sampling. Reducing variability by designed experiments. (2 credits)

Chemical Reactors

BMETKVECMX4

Dr. Béla Simándi

Principles of chemical reactor design and analysis. Reactors for complex reactions and two-phase reactions. Non-ideal reactor models; tracer response analysis; determination of the expected extent of reactions. Review of ideal reactor types. Complex homogeneous reactions and reactor performance; definition of selectivity; reversible, consecutive and parallel reactions. Heterogeneous systems: gas-solid, liquid-solid, gas-liquid, and liquid-liquid reactions and the selection of appropriate reactors. Design of non-ideal reactors. Residence time distributions, models for non-ideal reactors. (2 credits)

Department of Chemical Technology

Chemical Technology of Nuclear Power

BMETKVETMX0

Dr. György Pátzay

Detailed discussions of the nuclear power industry, nuclear power reactors, and nuclear fuel materials. Burn-up processes and the reprocessing of irradiated fuel. Nuclear fuel cycles and the international fuel system. Radioactive waste management and reactor construction materials in relation to chemical technology and safety. Subject is taught so that it is understandable by students who are not studying chemical engineering. (2 credits)

Industrial Catalysis

BMETKVETMX1

Dr. Antal Tungler

Theoretical aspects of heterogeneous catalysis and catalysts, including adsorption, kinetics, and solid materials. Types of catalysts and supports; their uses. Poisoning. Catalytic processes and economics. (2 credits)

Corrosion and Corrosion Protection

BMETKVETMX2

Dr. György Pátzay

Definition of corrosion. Corrosion prevention: using scientific methods and principles to control corrosion damage economically and safely. Methods of corrosion control: material selection; proper design techniques; the use of coatings, electrochemical methods, and corrosion inhibitors. (2 credits)

Environment Polluting Materials

BMETKVETMX3

Dr. Gábor Bajnóczy

History and structure of the atmosphere. Air pollutants such as carbon monoxide, nitrogen oxides, sulphur oxides, photochemical oxidants, and particulates. Birth and fate of air pollutants; their behaviour in the atmosphere; their effects on plants, humans, and matter. Climatic effects of air pollutants: greenhouse effect, temperature inversion, and photochemical smog. Water pollutants: organic materials with high oxygen demands, mineral oil, detergents, eutrophication, pesticides, and heat. Pollution by nuclear plants. Effects of pollution on historic monuments. (2 credits)

Process Design and Economy

BMETKVETMX4

Dr. Ágnes Széchy

Chemical Process categories: continous, bath- semicontinous. Computer Aided Design: Model, algorithm, software, user interface. Flowsheeting categories: sequential modular, equation oriented, simultaneous. Data basis. Design, simulation. Cost Determination. Economic Analysis Methods: Rate of Return on Investment, Discounted Cash Flow, Net Present Worth, Annualized Cash Flow. Program Packages: PPDPACK, HYSIM, CAPCOS. Case studies. Future trends. (2 credits)

Department of Inorganic Chemistry

Topics in Inorganic Chemistry

BMETKVEIMX0

Dr. László Nyulászi

Theory of formation of chemical bonds between different atoms. Formation of complex compounds. Main group metal chemistry. Synthesis of some practically important organometallic compounds. (2 credits)

Inorganic Polymers

BMETKVEIMX1

Dr. László Nyulászi

Characterisation of polymers. Comparison of organic and inorganic polymers. Inorganic polymers of practical importance. Silicones. Production of raw material and oligomers. Use of silicones. (2 credits)

Theoretical Chemistry

BMETKVEIMX2

Dr. László Nyulászi

Axioms of quantum mechanics. Approximation of the solution of the Schrödinger equation. HF method. Treatment of electron correlation. Applications in chemistry. Characterisation of potential energy surfaces. Structures and chemical bonding. Computational chemistry. Mechanical Engineering for the Chemical Industry. 2 credits)

Institute of Mathematics

Advanced Mathematics

BMETKTEMMX0

Vector fields, vector-vector functions. De- rivative as a linear operator. Jacobian matrix. Stoke's generalised theorem and its application. Special differential equations. (2 credits)

Mathematical Programming

BMETKTEMMX1

Linear programming; elements of dynamic programming, the calculus of variation, and the theory of games. (2 credits)

Probability

BMETKTEMMX2

Elements of combinatorics, sets, events, and operation. Definition of probability and the basic theorems. Random variables and their distribution: binomial, exponential, gamma, Poisson, and normal distribution. Distribution and density function and characteristic functions. Law of large numbers and some limiting theorems. (2 credits)

Department of Organic Chemistry

Modern Synthetic Methods in Organic Chemistry

BMETKVEOMX0

Dr. Lajos Novák

Review of modern theories and practical synthetic methods emphasising recent advances. Concepts used in designing an organic synthesis today. (2 credits)

Organic Stereochemistry

BMETKVEOMX1

Dr. Mihály Nógrádi

Up-to-date information on molecular symmetry, chirality, and stereo isomerism; developments in stereo controlled and asymmetric synthesis. (2 credits)

Department of Organic Chemical Technology

Drug Formulations

BMETKVESMX0

Dr. György Marosi

Theoretical foundations and technologies of manufacturing pharmaceutical products from pharmacons. Administration of drugs, dosage, pharmaco-kinetics, compatibility tests, stability of pharmaceutical products. Technologies of sterile products, tablets, injections, infusions, ointments, solutions, and encapsulation. (2 credits)

Chemistry of Dyes and Surfactants

BMETKVESMX1

Dr. András Vígh

Comprehensive survey of dyes in dying and printing processes for fibrous materials. Applications of chemical and physico- chemical characteristics; principles for the practical application of dyes. Chemistry, characterisation, and application of surface- active agents. General characterisation of surfactants and their chemical structure. Classification of surfactants by their chemical nature and technological effects. Physio- chemical characteristics of surfactants in aqueous solutions. Practical applications of surfactants in washing, wetting, and dispersing agents. (2 credits)

Organic Chemical Technology

BMETKVESMX2

Dr. Elemér Fogassy

Selected technologies from the heavy chemical industry which produce organic intermediates. Depending on the students' needs, the course also covers catalytic or non-catalytic processes in the fine chemical industry. (2 credits)

Organo-Phosphorus Chemistry and its Synthetic Use

BMETKVESMX3

Dr. György Keglevich

Structure and reactivity of different classes of organo-phosphorous compounds in organic synthesis; their reaction mechanisms and use in versatile organic synthesis. Chemistry of phosphorous heterocycles; role of phosphorous compounds in everyday and household life. (2 credits)

Department of Physical Chemistry

Dynamic Systems in Chemistry

BMETKVEPMX0

Dr. Miklós Zrínyi

Dynamic, conservative, explosive, and dissipative systems in chemistry. Attractors and bi-furcations. Continuously fed, stirred, tank reactor. Belousov-Zhabotinsky reaction: chemical oscillation and waves. Reaction-diffusion systems and pattern formation. (2 credits)

Department of Plastics and Rubber Industries

Plastics in Engineering

BMETKVERMX0

Dr. Béla Pukánszky

Properties and manufacture of engineering thermoplastics and thermosets. Design with engineering plastics. Mechanical, thermal, and electrical properties. Environmental considerations. Design of moulded parts. Possibilities of CAD. (2 credits)

Structure and Properties of Plastics

BMETKVERMX1

Dr. Béla Pukánszky

Relationship of structure to thermal and mechanical, chemical, and electrical and optical properties. Limitations of theoretical calculations. Use of other empirical or semi-empirical formulas. 2 credits)

Introduction to Polymer Technology

BMETKVERMX2

Dr. Viktória Vargha

Fundamentals of polymer processing. Basic rheological equations. Extrusion, injection moulding, calendering, and blow moulding. (2 credits)

ENVIRONMENTAL ENGINEERING

a new M.Sc. degree granted by the Budapest University of Technology and Economics

One of the biggest and most reputed institutions of this kind in Europe, the Budapest University of Technology and Economics has educated generations of engineers since its foundation in 1782.

Its eight faculties of different engineering disciplines, sciences, economics and humanities actively participate in environmental education granting among others postgraduate degrees from 1974 onwards.

The aim of the course is to provide:

- Knowledge to identify and describe negative environmental and ecological changes and provide technological solution for the remediation
- Give solutions to manage natural resources and prevent pollution to help sustainable industrial and social development.

Due to a well selected set of fundamental and general science subjects a wide variety of B.Sc. engineering and science degrees can serve as prerequisite for the admission to the M.Sc. course.

The Budapest University of Technology and Economics disposes of highly developed training facilities: laboratories, pilot plants, computer network and a wide system of international relations - among others co-operative environmental engineering education program in English with the Brandenburgische Technische Universität (Cottbus, Germany).

During the (at least) 4 semesters of the education period, actually an MSc degree is to be granted in the specialisation branch of:

- Environmental technology

with special focus on applied environmental science and technology aspects.

The curricula are conceived carefully to meet the needs and challenges of the actual career opportunities in both developed and developing countries.

The curriculum (see tables) is of modular structure consisting of the following modules:

- science; economics and humanities 30%
- specialised core subjects 59%
- differentiated professional knowledge 11%
  (to be composed individually out of a more than four times bigger number of offered subjects)

The program is organised in the credit system (of English and US traditions) providing a relatively high degree of free subject selection.

The condition of obtaining an MSc degree is the fulfilment of the total of 120 credit points including:

- comprehensive final exams and
- defence of an individual MSc thesis

Budapest University of Technology and Economics
Faculty of Chemical Engineering
Environmental Engineering
H-1111 Budapest, Hungary

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Curriculum of M.Sc. Subjects

Subject			Working hours / semester				Requisites
Name	Code	Credits	1	2	3	4	
Environmental Chemistry	BMETKVETM10	2	2+0+0				
Air Pollution Control	BMETKGEVM10	2	2+0+0				
Water Quality Management	BMETKEOVM10	2	2+0+0				
Noise, Vibration and Electromagnetic Protec.	BMETKKVM104	2	2+0+0				
Waste Water Treatment Techn.	BMETKVECM1	2	2+0+0				
Environmetal Analysis	BMETKVEGM11	6	5+0+0				
Waste Management and Hazardous Wastes I	BMETKVECM12	2	2+0+0				
Waste Management and Hazardous Wastes II	BMETKVECM20	3		2+0+0			
Compulsory Subjects of Branch	BMETK	9/6/3	6+0+0	4+0+0	2+0+0		
Compulsory Optional Subjects of Branch	BMETK	3/3/6	2+0+0	2+0+0	4+0+0		
Environmental Process Engineering	BMETKVECM21	4		2+1+3			
Soil Protection	BMETKVEAM20	2		2+0+0			
Environmental Economics and Law I	BMETKKVM204	3		2+0+0			
Environmental Economics and Law II	BMETKKVM301	3			2+0+0		
Modelling and Analysis of Environ. Systems I	BMETKEOVM20	3		2+0+0			
Modelling and Analysis of Environ. Systems II	BMETKEOVM30	3			2+0+0		
Environmental Analysis Lab. Pr.	BMETKVEGM21	6		0+0+6			
Quality Assurance (ISO, TQM)	BMETKKVM303	2			2+0+0		
Environmental Health	BMETKKVM304	2			2+0+0		
Nuclear Environ- mental Protection	BMETKKVM305	3			2+0+1		
Environmental Remediation	BMETKEOVM31	2			2+0+0		
Transport Processes I	BMETKVECM31	3			2+0+0		
Transport Processes II	BMETKEOVM40	3				2+0+0	
Environmental Impact Assesment and Audit.	BMETKKVM402	3				2+0+0	
Thesis Project I-II	BMETKVEXM30	3			0+3+0		
Thesis Project I-II	BMETKVEXM41	24				0+0+28	
Total credit point							
Hours pro week							

Curriculum of M.Sc. Branch Subjects

Subject		
Name	Code	Credits
Compulsory Subjects		
Equipment of Environmental Protection	BMETKGEVMX0	3
Environmentally Sound Design	BMETKGEIMX0	3
Energy Production and Environment	BMETKGEKMX0	3
Environmental Effects of Electrical Systems	BMETKKVMX04	3
Environmental Biotechnology	BMETKVEAMX5	3
Water Chemistry and Technology	BMETKVETMX5	3
Compulsory Optional Subjects		
Environmental Benign Process Design	BMETKVECMX5	3
Industrial Air Pollution Control	BMETKGEVMX1	3
Mechanical Vibrations	BMETKGESMX0	3
Environmentally Sound Combustion	BMETKGEKMX0	3
Equipment in Waste Water Treatment	BMETKGEAMX0	3
Protection of the Built Environment	BMETKKVMX14	3
Architectural Environmental Planning	BMETKKVMX15	3
Electric Vehicle Systems	BMETKKVMX16	3
Environment Oriented Optimization of Transport Processes	BMETKKVMX17	3
Fuels for Internal Combustion Engines	BMETKKVMX18	3
Environmental Protection in Air Transport	BMETKKVMX19	3
Antipollution Electrotechnologies	BMETKKVMX20	3
Technical Acoustics	BMETKGEAMX1	3
Noise Control	BMETKGEAMX2	3

Description of Compulsory Subjects

Environmental Chemistry

BMETKVETM10

Dr. Gábor Bajnóczy

History and structure of the atmosphere. Air pollutants such as carbon monoxide, nitrogen oxides, sulphur oxides, photochemical oxidants and particulates. Birth and fate of air pollutants; their behaviour in the atmosphere; their effects on plants, humans, and matter. Climatic effects of air pollutants: greenhouse effect, temperature inversion, and photochemical smog. Water pollutants: organic materials with high oxygen demand, mineral oil, detergents, eutrophication, pesticides, and heat. Pollution by nuclear plants. Effects of pollution on historic monuments. (2 credits)

Air Pollution Control

BMETKGEVM10

Dr. Endre Kovács Dr. Mária Ötvös

Methods of regulation in air pollution. Emission of pollutants and standards. Adverse effects of atmospheric pollutants. Methods for reduction air pollution emission. Technologies (secondary reduction methods) for the reduction of sulphur- and nitrogen dioxide. Standards, air quality trends and agreements for the protection of the atmosphere. (2 credits)

Water Quality Management

BMETKEOVM10

Dr. László Somlyódy Dr. Kálmán Buzás

The quality of waters: terminology, classification of water quality. Classification systems of surface waters. Main components and parameters. Sampling and analytical techniques. Emissions and transmissions of pollutants: sources and transport processes. Water quality problems of highest importance: organic matters pollution, eutrophication, bacteriological problems, toxic pollution. Modelling of oxygen household and eutrophication. Quality problems of subsurface waters. Theories and practical methods of water quality management. (2 credits)

Noise, Vibration and Electromagnetic Protection

BMETKKVM104

Dr. Norbert Szedenik

Basic knowledge of acoustics and vibration theory. The effects of noise and vibration on human beings. Subjective parameters. The basis of noise and vibration protection. Vibration of electrical machines. Fundamentals in measurement technology. The principle of electromagnetic compatibility. The origin and coupling of electrical noises and overvoltages. The possibilities of the protection against electrical disturbances. (2 credits)

Waste Water Treatment Technologies

BMETKVECM11

Dr. Pál Miháltz

Water quality control and treatment technology. Origin, quantity and quality of waste waters. Classification of treatment processes, their development and trends. Process fundamentals, mechanical, physico-chemical, biological and natural methods. Mass balances and process rates. Removal of organics, nitrogen and phosphorus compounds. Pollutants of industrial origin. Systematic description of treatment equipment, their operation and design. Fundamentals of sludge treatment. Treatment cost estimation and process selection. (2 credits)

Environmental Analysis

BMETKVEGM11

Dr. Jeno Fekete Dr. László Bezúr

General basis of environmental analysis: elements of the analytical process, errors, reliability and performance characteristics of analytical methods, method validation, GLP. Sampling and sample treatment in the analysis of air, water, soil and other samples. Techniques of environmental analysis involving separation of components: GC, LC, CZE, SFC, GC-MS, LC-MS, GC-FTIR, LC-GC, TLC). Techniques without component separation (atomic and molecular spectroscopy, electrochemical analysis, etc.). Typical applications. (6 credits)

Waste Management and Hazardous Wastes I-II

BMETKVECM12 (2 credits) BMETKVECM20 (3 credits)

Dr. Pál Miháltz

Hazardous materials, their environmental impacts, risks. The methodology of waste qualification. Waste collection, storage, transport and disposal. Wastes of sludge consistence and their treatment. Waste valorisation by microbial processes. Solvent recovery and treatment. Hazardous wastes from sulphonation, nitration and oxido- reduction technologies, special features of the pharmaceutical industry. Pesticide residuals. Wastes from plastics processing and use, petrol production and of its derivatives. Wastes from agriculture and food processing. Used batteries and the wastes of galvanic treatment, metal processing and other inorganic chemical processes. Radioactive wastes and their disposal.

Environmental Process Engineering

BMETKVECM21

Dr. Zsolt Fonyó

Unit operations of the Environmental Process Engineering. Principles of mass transfer, equilibria, material balances for stage-contact plants and differential-contact plants, theory of diffusion. Continuos and batch processes. Theoretical stage concept, transfer unit concept. Column and stage efficiencies. Gas absorption. Design of packed towers. Distillation methods: flash distillation, differential and steam distillation, rectification. Design and operating of plate columns. Azeotropic, extractive and reactive distillation. Fractionating devices. Extraction and leaching. Crystallisation. Air-water-contact operations. Drying. Hybrid separation methods. Basic theory of process design: synthesis and analysis. Economical, environmental, operational and energy considerations. (4 credits)

Soil Protection

BMETKVEAM20

Dr. Katalin Gruiz

Formation of soils and soil constituents. Soil classification methods. Fundamentals of soil physics. Water permeability. Soil protection problems at waste disposal. Dispersion and transport of pollutants. Evaluation methods for choosing appropriate sites, types of landfill depones, insulation techniques, collection of leachet. A posterior protection techniques against landfill emissions. Soil degradation. Physical, biological and chemical technologies for soil protection. (3 credits)

Environmental Economics and Law I-II

BMETKKVM204 (3 credits) BMETKKVM301 (3 credits)

Dr. Gyula Bándy

Ecological economics and the global environmental prob-

lems. New macro indicators versus GDP (ISEW; GPI) externalities, theoretical aspect of the environmental regulation, Coase theorema; Environmental policy(OECD; EU; Hungary) Basic ideas of environmental law; environmental acts in Hungary; Hungary and EU harmonisation process.

Modelling and Analysis of Environmental Systems I-II

BMETKEOVM20 (3 credits) BMETKEOVM30 (3 credits)

Dr. László Kormos

Ecological modelling with the help of system analysis and operation research. Goals: understanding, planning and decision support. Demonstration of up-to-date methods: simulation, optimisation, multi-objective decision making. Steps toward developing ecological models. Basic types of environmental models. Calibration and validation, methods in the system analysis. Uncertainty in the models and data. Statistical methods, Kalman-filter, Hornberger-Spear-Young methods. Applied methods and techniques in the optimisation: objective functions, constrains, decision variables. Linear programming, dynamical programming, multi criteria analysis. Examples and case studies.

Environmental Analysis Laboratory Practice

BMETKKVM206

Dr. László Bezúr Dr. Jeno Fekete

Each student has to solve an environmental analytical problem, i.e., read and evaluate the relevant literature (EPA, ISO and national regulations, available analytical methods), choose and design a method for the analysis of given environmental samples, carry out the analysis, evaluate the results and write a report about the problem, the results and the conclusions. Experimental work can be started when the literature survey and the plan for the experiments have been accepted. (5 credits)

Quality Assurance

BMETKKVM303

Dr. János Kövesi

Basics of quality management; quality schools, philosophies quality systems, TQM and quality management; Basics of Western European ISO 9000 quality system; realization model and conditions of the system in Hungary. Data and information basics of quality management. Basics and methods of complex error analysis; Control card systems and basics of SQC and SPC Relationship between quality and reliability, reliability basics. (2 credits)

Environmental Health

BMETKKVM304

Dr. Gyula Dura

Introduction to environmental health (EH). Basic physiological processes in the human body. Identification of EH risks. Environmental factors (air, water, soil, radiation). Health aspects of the built environment. The physosocial environment and its health aspects. Nutrition and its EH aspects. EH impacts of the global environmental processes. EH impact assessment. (2 credits)

Nuclear Environmental Protection

BMETKKVM305

Dr. Péter Zagyvai

Basic standards of dosimetric regulations. Limitations and constraints on immission and emission of radioactivity to the environment. Formulation and modelling of radioactive dispersion in the environment. Natural and artificial radionuclides - their occurrence in the environment and in waste streams. Radioactive waste management. Procedures of waste qualification. Nuclear environmental monitoring: techniques, problems of sensitivity and response interpretation. (3 credits)

Environmental Remediation

BMETKEOVM31

Dr. Kálmán Buzás

Economic, ecological and public health interpretation of environmental damages in the fields of soil and ground and surface water pollution: detection, sampling and re-mediation techniques. Re-mediation of degraded areas. Environmental disasters in the Central- European region: case studies. Action plans against environmental damages in urban areas. Risk assessment. (2 credits)

Transport Processes I

BMETKVECM31

Dr. Zsolt Fonyó

Transport processes and unit operations of the Environmental Process Engineering. Continuity equations, mass balance, component balance, energy equation, momentum balance, equations of motions, transport equations, equations of state, equilibrium, chemical kinetics. Fluid mechanics, concepts of fluid behaviour, steady flow, rheology, viscosity, boundary-layer formation, friction factor. Navier-Stokes, Euler and Bernoulli equations. Transportation of fluids. Hydrodynamic models, flow in pipes and channels, pressure flow through equipment, pressure drop across packed towers. Dimensional analysis. Principles of mass transfer, equilibria. Similarity of momentum transfer, similarity of mass transfer, similarity of heat transfer. Analogies amount mass, heat and momentum transfer. (3 credits)

Transport Processes II

BMETKKEOVM40

Dr. László Somlyódy

Transport equation (3D). Advection and diffusion. Einstein equation of the molecular diffusion. The Fick's laws. Governing equations of turbulent flow motion. Solution techniques: initial and boundary conditions. Deterministic and stochastic approach: Eulerian and Lagrangian description of processes. Dispersion vs. diffusion. Some simple examples. 1D Gauss model. Numerical methods, simplifications. The role of velocity distributions. Regional air pollution problems. Transport processes in rivers, lakes and reservoirs. Integration of governing equations: 2D, 1D models. Analytical and numerical methods. Biochemical models: problems, parameters, data. Transport processes in groundwater. Case studies. (3 credits)

Environmental Impact Assesment and Auditing

BMETKKVM402

Dr. István Zobory

Environmental impact assessment (EIA) as a tool of preventive environmental protection. Review of the implementation of EIA in investments and technological development projects. Legal framework and requirements. Main elements of EIA. The status quo report. Identification of direct and indirect impacts. Determination of the impact area. Methodology. Environmental auditing, requirements. Evaluation of environmental damages. Elaboration of remediation plans with respect to financial aspects. (3 credits)

Description of Branch of Environmental Technology

Compulsory Subjects

Equipment of Environmental Protection

BMETKGEVMX0

Dr. Károly Molnár

Construction and operating principles of the most important machines. Mixing in agitated vessel. Equipment for separation of solid pollutants from gases and liquids (cyclones, filters, centrifuges). Mist removal, spray elimination Heat-exchangers for energy-saving. Evaporators and crystallizers. Adsorption and absorption for gas cleaning. (3 credits)

Environmentally Sound Design

BMETKGEIMX0

Dr. István Elinger

Requirements against products to preserve Environment. Laws and standards concerning Environment. Selection of engineering material, operation in accordance with Environment. Utilization of side-products, recycling waste and worn-out products. Machineries and Technologies of economic recycling. Designing of recycling at agricultural wastes, household equipments. Possible ways of further development in organizing processes for recycling of waste (juridical-, social- and other types of controlling). Designing electric power stations and high voltage circuits in harmony with Environment. Electric power supplying system for public buildings to preserve Environment. Taking into consideration requirements of preserving environment in designing lighting and heating systems. Advantages of electric corrosion protection methods, processes of surface preserving coatings by electrostatic methods. (3 credits)

Energy Production and Environment

BMETKGEKMX0

Dr. Imre László

Sustainable development and energy. Energy sources, reserves. Fundamentals of energy conversion. General model of energy conversion systems. Energy production systems. Fossil-fueled thermal power stations. Environmental effects. Coupled and combined-cycle systems. Nuclear power stations. Renewable energy technologies. Solar, wind, biomass, geothermal systems. Hydrogen technology. Economy. (3 credits)

Environmental Effects of Electrical Systems

BMETKKVMX04

Dr. Norbert Szedenik

Students study the most important processes, equipment, technologies of the energy production and distribution and their effects on the environment, the population. Possible protecting methods, strategies and equipment. Two technical visits and lectures (one in a power station and the other in a substation) are included. (3 credits)

Environmental Biotechnology

BMETKVEAMX5

Dr. Andrea Jobbágy

Basic parameters of biodegradation, biological elimination of pollutants. Environmental importance and measurement of biodegradability. Influence of the quality and concentration of the substrate to be removed, of the biomass and of the type of the electronacceptor available. Application of biodegradation processes in the development of environmental biotechnologies. Spontaneous and controlled biodegradation in the sewer and storage systems. Applied biodegra- dation in wastewater treatment. Basics of modelling biodegradation processes. (3 credits)

Water Chemistry and Technology

BMETKVETMX5

Dr. György Pátzay

The basic chapters of this lecture are: (1) properties of water, water and environment, distribution and resources (2) physical, chemical and biological processes in water (3) water treatment and purification processes (filtration, ion exchange, coagulation and flocculation,disinfection, membrane separation, biological treatment (4) fundamentals of petroleum and inorganic industrial technologies and their water management. (3 credits)

Compulsory Optional Subjects

Environmental Benign Process Design

BMETKVECMX5

Dr. Zsolt Fonyó

Environmental benign process design: synthesis and analysis. Design of heat and mass exchange networks. Hydrodynamic unit operations and processes: mixing, sedimentation, thickeners, filtration, centrifugal separation, fluidisation, pneumatic transport, gas cleaning: cyclones. Flow of heat, conduction, convection, radiation. Heat transfer of condensation, steady and unsteady- state heat transfer. Heat transfer in shell and tube heat exchangers. Evaporation, boiling point rise. Standard and multiple-effect evaporators, vapour compression. Mass transfer operatioins: gas absorption, distillation methods: flash distillation, differential and steam distillation, rectification. Extraction and leaching. Crystallisation. Air-water-contact operations. Drying. Economical, environmental, operational and energy considerations. (3 credits)

Industrial Air Pollution Control

BMETKGEVMX1

Dr. Károly Molnár

Combustion processes and their modification for decreasing the emission of dangerous components. Characterization of the dust, methods of dust removal (filters, cyclones, wet scrubbers). Absorption and adsorption, their application in removal of gaseous components. Design and operation of the equipment. Removal of nitrogen oxides and organic components. Biological methods for waste gas treatment, application of bio-filters. Pollutants transport in the atmosphere. Modelling of the transport. Design of stacks. (3 credits)

Mechanical Vibrations

BMETKGESMX0

Dr. Péterné Szolgay

The primary goal of the course is to show the theoretical basis of mechanical vibrations and to give some interesting examples. Analysis of free, damped and excited mechanical vibrating systems with single degree of freedom. Isolation methods of vibrations. A classification of the mechanical systems. Lagrange's equations of second kind. Mechanical vibrating systems with finite degrees of freedom. (3 credits)

Environmentally Sound Combustion

BMETKGEKMX0

Dr. Antal Penninger

Mechanism of basic combustion reactions. Stoichometry. Physical and chemical properties of fossil fuels. Formation and control of pollution in flames. Primary reduction methods of emission of NOx and Sulfur oxides. Combustion in practical systems. (Reciprocating internal combustion engines, gas turbines, utility boilers). Emission measures and standards. Measurements of combustion generated pollutants from engines and from furnaces. Measurements of exhaust emissions. (3 credits)

Equipment in Waste Water Treatment

BMETKGEAMX0

Dr. Mihály Parti

Physical waste water treatment devices: sand filters, sand separation and sedimentation devices; calculation of their dimensions. Operation and dimensioning of desinfection equipment, thickeners, sludge dewatering equipment and sludge dryers. Basics of membrane techniques. The application of membrane technology in municipal and industrial waste water treatment. Water recycling and recovery of different components. Treatment of brackish water and surface water. Economical comparison of the different waste water treatment methods. (3 credits)

Protection of the Built Environment, our Architectural Heritage

BMETKKVMX14

Dr. Tamás Mezos

Rank and role of the protection of the built environment within the complex of environment protection. Peculiar problems of the protection of the most valuable part of the built environment: the architectural heritage. Environmental harms and their effects. Up-to-date methods of protection. Diagnostics and therapy, with special consideration to the most serious harms. Protection of buildings against groundwater absorption, up-to-date methods of surfaces protection, in conformity with the building surface materials: invisible protective layer, special plasterings and paints. The possibility to dimension the protection as a function of kind and grade of destructive factors. (3 credits)

Architectural Environmental Planning

BMETKKVMX15

Dr. Tamás Csoknyai

Relationship between the environment and the architecture. Influence of the environmental science on the European architecture. Analysis of the Japanese architecture, fully environmental counscioces. Development and international influence of the Finnish architectutal results. Aesthetical description of environmental expanseform. (3 credits)

Electric Vehicle Systems

BMETKKVMX16

Dr. Károly Kurutz Dr. Gyuláné Vincze

Introduction, historical background. Environmental aspects in transportation. Emissions. Possible solutions of energy storing. Batteries. Review of driving gears. Up-to-date process control methods. Hybrid systems. Review of feasible solutions. (3 credits)

Environment Oriented Optimization of Transport Processes

BMETKKVMX17

Dr. Éva Gilicze

Elements of the transport system. Characterization of transport processes in space and time. Related transport, vehicle energetical and environmental load processes. Micro and macro approach investigation of the transport processes. Environmental aspects. Simulation of transport and environmental load processes. Simulation algorithm and its presentation in different transportation modalities. Real-time simulation algorithm. Programmes. Statistical evaluation. (3 credits)

Fuels for Internal Combustion Engines

BMETKKVMX18

Dr. István Emod

Vehicle driving systems. Physical and chemical characteristics of fuels. Production of different types of fuels (petrol, gas oil, alcohols, vegetable oils, propane-butane gas, natural gas, biogas, hydrogen etc.) and their feasibility as fuels for ICE. Power and fuel consumption characteristics, economics, short- medium- and long-term environmental impacts. Application of different types of fuels. Future prospects. Lubricating oils. Viscosity, engine power and fuel consumption. Environmental impacts of lubricating oils. (3 credits)

Environmental Protection in Air Transport

BMETKKVMX19

Dr. József Rohács

Air transportation systems. Rudiments of aeronautic sciences. Aircrafts. National and international requirements, aeronautic regulations. Aircraft generated noise, its propagation, simulation methods. Noise control measures. Reduction of pollutant emission. Environmental impacts related to air transportation (waste water discharges groundwater protection, waste management). Protection of the population from air transportation generated environmental load. (3 credits)

Antipollution Electrotechnologies

BMETKKVMX20

Dr. Norbert Szedenik

Modern heat generating processes. Heating by induction, arc, electron beam, laser, dielectric heating. Antipollution electrostatic technologies (electrostatic paint and powder spraying, pesticide spraying, separation). Generation of the high voltage, the high electric field. Cathodic corrosion protection. (3 credits)

Technical Acoustics

BMETKGEAMX1

Dr. Gábor Koscsó

The subject of acoustic, the dual nature of sound. Linear acoustic approximation, sound speed, the wave equation, and its solution. Harmonic waves, sound spectra. Energetic relations in acoustic sound levels. The source of sound. Outdoor sound propagation. Sound in enclosed area. Basic acoustic measurements. (3 credits)

Noise Control

BMETKGEAMX2

Dr. Gábor Koscsó

The subject of noise control, physics of noise. The effects of noise. Noise level criteria. General review of design methods for noise control. Noise sources and control. Methods for noise control in free and in bounded space. Personal protection. Measurement of noise. (3 credits)