Faculty of Chemical Technology and Biotechnology

IMPORTANT NOTES

If for one subject you can find several different types (lecture, practice, laboratory) of courses then please choose one and only one course from each type in order to be able to perform the subject's requirements successfully.Civil Engineering courses are on the website seperately. Courses chosen from the offer of Faculty of Civil Engineering will be checked and arranged individually by the departmental coordinator.

Subject code	Subject name	Requirement	ECTS credit
BMEVEFAA409	Colloid Chemical Approach to Nanotechnology	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	A0-ER	English	TUE:14:15-17:00(F1MFK)

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. Colloid stability. Rheology. Colloids in Nanotechnology

Subject code	Subject name	Requirement	ECTS credit
BMEVEFAM110	Materials science: traditional structural materials and polymers	Exam	4

Course type	Course code	Course language	Timetable information
Laboratory	16A_lab	English	MON:14:15-18:00(HF4)
Lecture	16A	English	TUE:12:15-14:00(HF2)

Subject code	Subject name	Requirement	ECTS credit
BMEVEFKA304	Physical Chemistry I	Exam	5

Course type	Course code	Course language	Timetable information
Lecture	A0-ER	English	MON:10:15-12:00(CH307); WED:10:15-12:00(CH302)
Practice	A1-ER	English	MON:10:15-12:00(CH307); WED:10:15-12:00(CH302)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEVEFKA603	Physical Chemistry of Surfaces	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	A06-ER	English	WED:08:15-10:00(F1MFK)

Fundamentals of solid/fluid interfaces. The qualitative description of the surface layer, the concept of surface excess. Thermodynamics of the interfaces, surface tension and interaction potential. Interactions at solid/gas and solid/liquid interfaces. Adsorption isotherms, their interpretation (Langmuir, BET, Dubinin-Radushkevich and DFT models). Experimental methods, including calorimetry. Particle size analysis. Applied surface science: the role of interfaces in material science, environmental and industrial processes. Heterogenous catalysis, Pressure/Temperature Swing Adsorption

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFA203	Chemical Technology	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	ENGLISH-ER	English	MON:12:15-14:00(CH307)

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. Laboratory practice 28 hours, 7 lessons, 4 hours each: water treatment, ion exchange, membrane filtering, measurement of boiler efficiency, analysis of exhaust gases, hydrocarbon tests, flammability, viscosity, engine exhaust gas analysis, corrosion test, catalytic reformation.

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFA403	Environmental Chemistry and Technology	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	english-ER	English	THU:14:15-17:00(F211)

Elements of the environment, dangerous factors. The process of pollution: emission, transmission, imission. The aim and the instruments of environmental protection. Technical solutions. Economical instruments, fees, fines, supports. Air polluting materials (carbonmonoxide, nitrogen oxides, sulfur oxides, ozone, hydrocarbons, photochemical oxidants, particulates, dioxins, water polluting materials (materials with high oxygen demand, detergents, mineral oils, organic compounds, inorganic compounds, chemistry of their formation, parameters influencing their rate of formation, their chemical and physical interaction with the atmosphere, hydrosphere, litosphere and biosphere. Biologycal degradation of polymers. Heat pollution. Techniques of air and water pollution control. Classification of wastes, dangerous wastes, treatment and disposal technologies.

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFM104	Modern Separation Technologies	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	theory+prac_ ER	English	THU:14:15-17:00(F211)

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFM105	Chemical Process Design and Control	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	eng_ER	English	TUE:10:15-12:00(F211)

Chemical process synthesis and analysis, levels of chemical process design, batch vs. continous systems, input-output structure, reactor system, recycling system, separation systems, heat exhanger network, pinch technology, flowsheeting and flowsheeting softwares, advanced process control system, control structure design, selective control, examples for design and controls, individual computer aided process design.

Subject code	Subject name	Requirement	ECTS credit
BMEVEKFM501	Environmentally Benign Chemical Processes	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	eng_ER	English	WED:11:15-14:00(CH307)

Subject code	Subject name	Requirement	ECTS credit
BMEVEMBM301	Biology, biotechnology	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	A7	English	WED:14:15-16:00(CH305)

1. Introduction, special features of biotech: de novo fermentations and biotransformations. 2. Cell biology summary: cell structure and function 3. Microbiology and physiology survey: kinds of industrial microorganisms, their biochemistry: aerobes eacute;s anaerobes, basic microbial metabolic paths. 4. Introduction to enzyme engineering. 5. Techniques and unit operations applied in bioindustries: cultivation methods of microorganisms, culture media, sterilization, bioreactors: mass transfer. 6. Special methods of product isolation and purification: cell homogenization, affin (biocpecific) methods. 7. Some examples in white and green biotechnology: ethanol, citric acid, lactic acid fermentations, etc., biotransformations (semisynthetic antibiotics, enzymatic resolution methods) 8. Biotechnological waste water treatments:removal of organic materials, removal of phosphorus and nitrogen.

Subject code	Subject name	Requirement	ECTS credit
BMEVESAA208	Inorganic Chemistry	Mid-semester mark	3

Course type	Course code	Course language	Timetable information
Lecture	A10-ER	English	WED:13:15-16:00(CHFSEKÖ)

Reactions and properties of elements and their major compounds; Qualitative inorganic analysis: detecting the most important cations and anions: alkaline metals (Li+, Na+, K+); alkaline earth metals (Mg2+, Ca2+, Sr2+, Ba2+); boron group (BO33ndash;, Al3+); carbon group (CO32-, HCO3ndash;, SiO32ndash;, Sn2+, Sn4+, Pb2+); nitrogen group (NH4+, NO2ndash;, NO3ndash;, PO43ndash;, As3+, As5+); oxygen group (OHndash;, S2ndash;, SO32ndash;, SO42ndash;); halogens (Fndash;, Clndash;, Brndash;, Indash;); some transition metal ions (Cr3+, Mn2+, Fe2+, Fe3+, Ni2+, Cu2+, Zn2+, Ag+, Cd2+, Hg2+, Hg22+); Analytical system of Fresenius and Bunsen, analysis of mixed cations, mixed anions, mixed compounds, and polluted compound

Subject code	Subject name	Requirement	ECTS credit
BMEVESAA403	Analytical Chemistry Laboratory Practice	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	A11L-ER	English	WED:14:15-18:00(CHFLAB)
Lecture	A11E-ER	English	WED:14:15-18:00(CHFLAB)

Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of different inorganic ions and organic compounds. 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,) methods.Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of difinorganic ions and organic compounds. 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,) methods. Literature: Skog D.A., West D. M., Holler F. J.: Fundamentals of Analytical Chemistry.5th Edition, Sounders College Publishing, New York, USA, 1988. Willard H. H., Merritt L. L., Dean J. A., Settle F. A.: Instrumental Methods of Analysis. 7th. Edition, Wadsworth Publ. Comp., Belmont, California, USA, 1988. Lecture material in electronic form ravand titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of different inorganic ions and organic compounds. 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,) methods. Gravimetric and titrimetric (acid-base, argentometry, complexometry, redoxi) determinations of difinorganic ions and organic compounds. 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,) methods.

Subject code	Subject name	Requirement	ECTS credit
BMEVESAM101	Complex and Inorganic Chemistry	Mid-semester mark	2

Course type	Course code	Course language	Timetable information
Lecture	A10-ER	English	TUE:14:15-16:00(CH306)

The subject provides an overview about organometallic chemistry and application of organometallic compounds. It discusses the special properties of orgamometallic compounds (different from those of classical inorganic and organic compounds) and their role in applications as chemical reagents and catalysts. It discusses the basics of homogen catalysis and the mechanism of industrial homogen catalytic processes.The organometallic chemistry of the following elements is discussed in detail: Li, Mg, Al, Sn, Ti, Cr, Fe, Co, Ni, Cu, Zn, Rh, and Pd. Discussion involves stability, structure, synthesis, physical and chemical properties, characteristic reactions, and application (industrial and laboratory). Short syllabus of the subject: History of organometallic chemistry. Definitions. Grouping of organometallic compounds. General properties of organometallic compounds. Synthesis of organometallic compounds. Characteristic reactions. Homogen catalysis. Synthesis, structure and characteristic reactions of Li- and Mg-organic compounds (substitution and addition reactions, metalation and transmetalation, catalytic reactions). Synthesis, structure and characteristic reactions of Al-organic compounds (polymer catalyst, Ziegler-Natta catalyst, synthesis of alpha;-olefins and alpha;-alcohols, olefin dimerization, preparation of organometallic compounds, preparation of high purity inorganic materials). Sn-organic compounds: synthesis, structure, and characteristic reactions (hydrostannation, hydrostannolysis, radical reactions, organostannylenes, redistribution reactions). Application as polymer catalyst, stabilizer, curing agent, and pharmaceutical. Ti-organic compounds: synthesis and characteristic reactions (substitution and insertion reactions of alkines, reactions of aldehydes and ketones, reductiv coupling and elimination with Ti-organic compounds, polymer catalysts). Cr-organic compounds: synthesis, characteristic reactions, substitution reactions, reactions on the organic ligand, rections of carben complexes. Fe-organic compounds: synthesis, characteristic reactions, Friedel-Crafts acylation, Mannich reaction, metalation, cyclization, polymerization. Co-organic compounds: synthesis, characteristic reactions, cyclization of acetylenes and olefins, Pauson-Khand reaction, carbonylations. Rh-organic compounds: synthesis, characteristic reactions, hydrogenations, hydrometalations, decarbonylations, carbonylations, hydroformylations, cyclizations. Ni-organic compounds: sysnthesis, characteristic reactions, substitution reactions, carbonylation, oligomerization of unsaturated hydrocarbons, catalytic reactions, coupling reactions with organic halides. Pd-organic compounds: synthesis, characteristic reactions, insertions, cyclic dimerizations, oxidative reactions with Pd(II),catalysts, Wacker process, reactions with Pd(0) catalysts, coupling reactions, Heck arylation, cyclization and carbonylation, cascade reactions. Cu- and Zn-organic compounds: sysnthesis, characteristic reactions (substitution, addition and transmetalation).

Subject code	Subject name	Requirement	ECTS credit
BMEVESAM301	Computational Chemistry	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	A8-ER	English	MON:09:15-12:00(CHFGEP)

Aim of the subject: The subject gives an overview about the principles used to describe the structure of molecules and bulk phases. The modeling of physico-chemical parameters, chemical processes will be presented together with the usual techniques. Solution of practical problems by computer modeling. Short syllabus of the subject: 1./ Basic principles of quantum mechanics: The axioms, the hydrogen atom, the Born-Oppenheimer approximation, the

independent particle model, and the MO theory. Hyerarchy of the theoretical models: Molecular mechanics, semiempirical, Hartree-Fock and post HF methods. Oniom and QM-MM methods. Density functional methods. The concept of the electron density. 2./ Application possibilities. Energy and electronic structure of atoms and molecules. Computation of measures related to physico-chemical or chemical concepts. Molecular geometry, conformation, conformational space. Modeling chemical reactions, thermodynamics and transition structures. Large systems, solutions and crystal structures. Molecular dynamics.

Subject code	Subject name	Requirement	ECTS credit
BMEVESKA504	Organic Chemistry III	Exam	2

Course type	Course code	Course language	Timetable information
Lecture	A6-ER	English	WED:08:15-10:00(CH204)

Based on the knowledge of subjects Organic Chemistry I and II, this subject puts major emphasis on all aspects of chemical problems associated with chiral compounds. By systematic classification of all major stereochemical terms and stereoselective syntheses, this subject adds solid knowledge to the existing understanding of organic chemistry for the future chemical engineers of pharmaceutical and fine chemicals industry. Short syllabus of the subject: Stereochemistry, the stereostructure of organic compounds:Constitution, configuration, conformation and the order of chemical bonds. Chirality and symmetry elements. Configuration of stereocenters and bonds. Chiral and achiral conformations and molecules. Constitutional and stereoisomers. Enantiomerism and diastereomerism. Enantiomeric and diastereomeric conformations and molecules. Symmetry of groups and faces: diastereotopic, enentiotopic and homotopic relations. Physical and chemical requirements of enantiomerism: stereoselective and stereospecific reactions, optical activity. Relative and absolute configuration. Optical inactivity of the achiral molecules. Substitution reactions at centers of asymmetry: inversion, retention, racemization. Racemic and mezo compounds. Atropisomerism. Nitrogen inversion. Center of asymmetry, axis of asymmetry, pseudoasymmetric centers. Dynamic properties. Tutomerism. Effects influencing tautomeric equilibria. Types of tautomers. Mutarotation. Asymmetric synthetic methods Definition and classification of stereoselective transformations. Background and methods of enentiomeric composition determination. Enantiomer selectivity. Principle of resolution. Chiral reagents and catalysts. Kinetic resolutions by biological systems. Dynamic kinetic resolutions by biological systems. Basics of diastereotopic and enentiotopic selectivity. Basic principles of asymmetric reactions by chemical and biological systems. Stoichiometric and heterogeneous catalytic asymmetric reactions. Asymmetric reactions by homogenous catalytic systems and by biological systems. Asymmetric reactions of industrial importance.

Subject code	Subject name	Requirement	ECTS credit
BMEVESTA411	Organic Chemical Technology	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	26a	English	MON:10:15-12:00(F2M012)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEVESZA401	Organic Chemistry II.	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	A9-ER	English	TUE:10:15-13:00(CH204)

Derivatives of carbonic acid; Diazomethane, diazonium salts; Sulfur and phosphor-containing compounds; Unsaturated carboxylic acids, lipids; Substituted acids; alpha;-, beta;-, gamma;-, and delta;-halogen, hydroxy, and oxo acids and derivatives. Stereochemistry; Amino acids and proteins; Carbohydrates; Nucleic acids; Polycyclic aromatic compounds; Heterocycles;

Subject code	Subject name	Requirement	ECTS credit
BMEVESZA402	Organic Synthesis Laboratory Practice	Mid-semester mark	4

Course type	Course code	Course language	Timetable information
Laboratory	A7-ER	English	MON:14:15-18:00(CH207)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEVESZA403	Medicines	Exam	3

Course type	Course code	Course language	Timetable information
Lecture	7a	English	TUE:08:15-10:00(F2M012)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEVESZM101	Organic Chemistry	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	A8-ER	English	THU:10:15-13:00(CH304)

In the frame of this subject the teaching of basic knowledge in modern organic chemistry is carried out at an advanced level. The aim of the subject is to make acquainted the M.Sc students with the theory, the molecular structures, the stereochemistry, the kinetics and the synthetic strategies applicable in organic chemical reactions taking place in idustrial sytheses, in plastic industry, in biochemical processes and in the environment. Short syllabus of the subject: The theory and application of the most important types of reactions: nucleophilic and electrophilic substitutions, addition to multiple carbon-carbon bonds, polymerization, elimination, nucleophilic addition and addition-elimination at carbonyl groups, nucleophilic addition and addition-elimination at conjugated systems, polycondensation, ring closing and ring opening reactions, processes accompanied by rearrangements. Simple reactions and polimerizations taking place by radical mechanism. Static stereochemistry and dynamic stereochemistry. Basics of planning synthesis; kinetical, molecule structural and stereochemical aspects in planning synthesis. Planning of synthesis: retrosynthetic analysis. Synthetic strategies: linear and convergent syntheses, synthons, inverse synthons, synthetic equivalents, stereochemical questions. Using of heterocycles and natural products (sugars, amino acids, alkaloids and their synthetic analogues) in organic syntheses. Bio- and chemo-catalysis: regio- and stereoselectivity. Applying of enantioselective synthetic methods in building up of complex natural products containing more than one stereocenters. Special synthetic technics. Chemical syntheses using solid supports. The basics of combinatorial chemistry. The theory of molecular recognition and its use in analytical and separation technics

Subject code	Subject name	Requirement	ECTS credit
BMEVEVMA504	Chemical Process Control	Mid-semester mark	5

Course type	Course code	Course language	Timetable information
Laboratory	lab.prac_ER	English	THU:12:15-14:00(DFcsarnok)
Lecture	theor_ER	English	TUE:14:15-16:00(F211)
Practice	prac_ER	English	THU:12:15-14:00(DFcsarnok)

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.

Subject code	Subject name	Requirement	ECTS credit
BMEVEVMA607	Environmental Benign Chemical Process	Exam	4

Course type	Course code	Course language	Timetable information
Lecture	english_ER	English	WED:11:15-14:00(CH307)

Green chemistry metrics: The concepts of green chemistry, green engineering and sustainability. The necessity of quantifying a green reaction/process/product/firm. E factor, EQ factor, CI. Atom selectivity, atom efficiency, stoechiometric factor, conversion, reaction mass efficiency, material recovery parameter. Metrics to be applied for a process/production: mass index; energy factors: life cycle, waste treatment, solvent recovery; intensity factors: solvent, waste, energy; Emission control ndash;Example: Gas purification: Regulation aspects, Best available technology concept, Nitric acid production, environmental considerations in process development; Processes under vacuum: Sublimation, Freeze drying, lyophilization, Evaporation under vacuum, Short-path distillation, Molecular distillation; High-pressure processes: High-pressure distillation, Pressure-sensitive distillation (breaking azeotropes), High pressure processing of food; Supercritical fluid extraction and other processes: Supercritical fluids, properties, Solubility in supercritical fluids, Supercritical fluid extraction and fractionation, Chemical and biochemical reactions in supercritical fluids, Particle formation (crystallization) using supercritical fluids, Supercritical fluid chromatography; Biofuels (raw materials, by-products): Bioethanol, Biodiesel: trans-estherification; gasification; Fischer ndash; Tropsch synthesis, Biogas: hydrolysis; fermentation/digestion; purification; Recovery of organics from water:

Separation of ethanol: azeotropic distillation, extractive distillation, liquid-liquid extraction, adsorption, membrane separations; Separations in fine chemical ndash; biochemical industry: Aqueous biphasic extraction, Chromatographic techniques (size exclusion, ion-exchange), Example: IgG purification from a fermentation broth.