COURSE DESCRIPTION OF DOCTORL SUBJECTS GEORGE A. OLAH DOCTORAL SCHOOL

DEPARTMENT OF APPLIED BIOTECHNOLOGY AND FOOD SCIENCE

Engineering aspects of biorections I-II
(Subject code: BMEVEMBDF1A- BMEVEMBDF1B)
Responsible lecturer: Németh Áron / Tardy Gábor

I. To familiarize students with the operations and processes used in bioengineering practice, to explore their quantitative relationships at a deeper level, and to further develop their ability to apply this knowledge.

II. The aim of the course is to provide a more thorough understanding of environmental biotechnology operations and processes, with a focus on pollution control and bioenergy production. The course includes a detailed overview of wastewater treatment biotechnologies for the removal of organic matter, nitrogen, and phosphorus. Furthermore, the course provides students with an introduction to the topics of biomass utilization, anaerobic technologies, and biogas production.

DNA repair (Subject code: BMEVEMBDM03)
Responsible lecturer: Vértessy Beáta

The primary objective of this course is to introduce the system responsible for one of the most complex functions of living organisms: the transmission of genetic material. The topic is of great interest in many respects. From a drug development perspective, it is worth noting that the mechanism of action for a significant portion of cancer therapies, as well as many antibiotics, is based on disrupting this system. From a biotechnology perspective, perhaps the most exciting aspect of this topic is CRISPR, which in just a few years has emerged as the genome editing method with the greatest potential today. Its relevance is well illustrated by the fact that the developers of this technology were awarded the Nobel Prize in Chemistry in 2020.

Keeping in mind the relevance of this topic, we will review the structure and properties of the proteins and protein complexes involved in DNA replication and repair, based on material compiled using recent literature sources. In addition, we will discuss the structural features and mechanisms that enable these processes, with a special focus on the pathways operating in prokaryotes and eukaryotes. Throughout the discussion, we will explain the more complex processes and their regulation through a deeper understanding of biomolecular structure and molecular interactions. With this unique approach, our goal is to bridge the interests of bioengineers, chemical engineers, and pharmaceutical engineers. In addition, the course places great emphasis on experimental techniques for testing hypotheses. These range from tests based on fundamental knowledge to the most modern measurement methods.

Upon completion of the course, students in chemical engineering, pharmaceutical engineering, and bioengineering will have gained valuable interdisciplinary knowledge, the acquisition of which also helps foster a research mindset that extends beyond the scope of the subject matter.

Food biochemistry I-II (Subject code: BMEVEMBDF2A- BMEVEMBDF2B)
Responsible lecturer: Gergely Szilveszter

A systematic study of the natural and non-natural components found in food, and an introduction to the chemical, biochemical, microbiological, and colloid-chemical processes related to nutrition that occur in living organisms, as well as their interrelationships.

Novel methods in food analysis II (Subject code: BMEVEMBDM04)
Responsible lecturer: Tömösközi Sándor

The aim of the course is to familiarize students with the necessary background knowledge (biochemistry, analytical chemistry, food chemistry, and nutrition) with the objectives and principles of food testing, as well as with classical and modern instrumental testing techniques. A further objective is to explore and discuss methodological and method-selection issues related to the determination of macro- and micro-components and food contaminants, as well as the complex evaluation tasks associated with the processing of test results, with particular regard to food quality, health, and safety regulations and requirements. We address the analysis of biologically active substances (e.g., enzymes, biogenic amines, antioxidants), antinutritional factors (e.g., inhibitors), and toxic substances (e.g., toxins) that positively or negatively influence food quality, The course presents the theoretical background and application possibilities of modern testing techniques based on biochemical and molecular biological principles. We review the fundamentals and areas of application of automated and rapid testing methods.

We summarize the typical analytical tasks of various industries and the specialized testing techniques associated with each field. We also discuss the most important elements of analytical method validation, quality assurance of results, and the establishment of laboratory management systems. Within the scope of the course, we also cover the domestic and international food control systems, their significance, and the responsibilities of food analysts. The course can be supplemented with the completion of a project assignment on a specific topic, which may also cover specialized methodological areas.

Kinetics of Microbial and Ezyme Systems (Subject code: BMEVEMBDM01)
Responsible lecturer: Németh Áron

The course focuses on presenting, documenting, and summarizing the implementation, mathematical modeling, measurement, and monitoring of bioreactions carried out by microorganisms and enzymes, with an eye toward opportunities and solutions relevant to students' own research topics.

Soil as an environmental element (Subject code: BMEVEMBDM07)

Responsible lecturer: Molnár Mónika

Soil, as a partially renewable environmental element, is the top solid layer of the Earth. Soil is all that is between the surface and the bedrock. Basic characteristic of it is fertility, so it provides living area primarily for plants, but also provides living area for animals and humans. The soil science has strong relationship with other disciplines however, it can be divided itself.

The aim of the subject is to provide knowledge on living and non-living subsystem of soil and their processes, including their agronomic and environmental importance. The part of this subject is presenting of the soil degradation process and melioration technics with new methods as well. The subject also provides a comprehensive overview of main soil types in Hungary for the students.

DEPARTMENT OF PHYSICAL CHEMISTRY AND MATERIALS SCIENCE

Physical Chemistry I-II (Subject code: BMEVEFADF1A- BMEVEFADF1B)
Responsible lecturer: Kállay Mihály / Szilágyi András

The course Physical Chemistry I provides theoretical and practical knowledge on those topics in physical chemistry best characterized by the term “equilibrium.” We define thermodynamic state functions and teach their application in chemical engineering and bioengineering practice. We interpret multicomponent phase equilibria and chemical equilibria using chemical potentials. The Physical Chemistry II course provides theoretical and practical knowledge on those topics in physical chemistry best characterized by the word “change.” Thus, we primarily focus on reaction rates and the factors influencing them. In addition, we cover equilibrium electrochemistry. The three main chapters of Physical Chemistry II are reaction kinetics, transport processes, and electrochemistry.

Optical Spectroscopy (Subject code: BMEVEFADM02)
Responsible lecturer: Kubinyi Miklós

Optical spectroscopic methods are of fundamental importance in materials science, analytical chemistry, and biological and medical imaging. The aim of this course is to introduce both classical methods and newer techniques, most of which utilize laser light sources. The former methods include UV-visible absorption, fluorescence, infrared, and Raman spectroscopy; the latter include, among others, multiphoton absorption, flash photolysis, single-photon counting, and time-resolved techniques based on the pump-probe principle. In discussing each method, we cover the theoretical (quantum mechanical) foundations, instrument design, and applications. A further objective of the course is to familiarize students with several technologies developed in recent years that have optical spectroscopic implications. These topics will be covered in separate lectures. Such topics include photodynamic diagnosis and therapy, confocal, two-photon, and super-resolution fluorescence microscopes, as well as the development and applications of luminescent nanoparticles.

The course is also taken by international doctoral students, so lectures are held in English.

Colloid Chemistry and nanotechnology I-II
(Subject code: BMEVEFADF4A- BMEVEFADF4B)
Responsible lecturer: László Krisztina / Hórvölgyi Zoltán

The aim of the course is to provide a foundation in colloid chemistry as it relates to nanotechnologies, to develop a colloid chemistry perspective, and to present interfacial phenomena in detail. During the course, students will learn about the chemical and physical background of colloid chemical processes related to nanotechnologies and traditional industrial technologies. They will gain knowledge of measurement and testing methods used in colloid chemistry and interfacial processes, as well as the new challenges and achievements of nanotechnological developments. The course covers topics related to functional and responsive material systems—particularly colloidal dispersions and solutions, and nanoporous materials—as well as interfacial phenomena. The course provides a detailed overview of the properties and applications of key nanostructured materials.

Degradation and stabilization of polymers (Subject code: BMEVEFADM12)
Responsible lecturer: Pukánszky Béla

During the processing and use of polymers, numerous physical and chemical processes take place that alter the polymer's structure and, consequently, its properties. These processes generally reduce the service life of plastic products. Understanding these processes makes it possible to slow them down and mitigate their effects, as well as to develop effective stabilization methods. In everyday life, polyolefins are used in the largest quantities, so understanding degradation processes is particularly important for these materials. The course primarily aims to discuss the chemical processes occurring during the processing and application of polyolefins and to present appropriate stabilization strategies and methods according to the following topics: Changes, chemical processes, degradation, and aging occurring during the processing and application of plastics. Major external influences. The relationship between the chemical structure of polymers and the changes that occur, and their consequences. Protection against these changes, and additives that facilitate and ensure processing and application.

Degradation mechanisms. Degradation of polyolefins, fundamental processes. Factors determining the course of these processes: temperature, shear, light, oxygen, molecular structure. Chemical changes and degradation occurring during processing. Oxidation chain and individual reactions. Changes in polymer structure during processing and the effect of structural changes on product properties. Key factors influencing degradation: weak points, catalyst residues, oxygen, shear, and temperature. Antioxidants: mechanism of phenolic antioxidants, reactions, discoloration, and other changes. Secondary antioxidants, with particular emphasis on phosphorus-containing antioxidants. Molecular structure, mechanism of action, and efficacy. The role of stabilizer solubility and diffusion in determining efficacy. Stabilizer systems, mixtures, synergy, and antagonism.

Polymer Physics I-II (Subject code: BMEVEFADF2A- BMEVEFADF2B)
Responsible lecturer: Pukánszky Béla

Thermoplastics account for nearly 70% of all plastics used. They are mostly processed in the molten state. Understanding the melt rheological properties of polymers and the relationships between measured rheological characteristics and processability is essential for the production of suitable products. Rheological properties are determined by the molecular and supramolecular (melt, physical network) structure of polymers; however, the relationships between structure and properties are still not fully understood. The course deals with the measurement and interpretation of rheological quantities, and in particular with structure-property relationships, according to the following topics: Fundamental and derived rheological quantities, measurement methods, and areas of application. Flow in simple geometric spaces, capillary viscometry, rotational viscometers, measurement under constant shear, dynamic-mechanical spectroscopy. Newtonian and apparent viscosity, factors determining viscosity. Linear viscoelasticity, calculation and conversion of measured quantities, their physical meaning, interpretation. Elastic effects during flow, the Weisenberg effect, normal stresses, rheological swelling, yield failure. Molecular structure, molecular weight and molecular weight distribution, branching, the relationship between molecular characteristics and the physical network.

The relationship between rheological properties and molecular structure in homogeneous polymer melts. Multiphase systems, the influence of rheological properties on phase structure formation, and the relationship between structure and product properties. The effect of thermal and deformation history on material behavior and measured rheological properties.

Polymers with a regular structure that are prone to crystallization. Morphological models describing the semi-crystalline structure. The concept of the degree of crystallinity and methods for its determination (X-ray diffraction, dilatometry, calorimetry, spectroscopy). The levels of structural hierarchy: X-ray, electron microscopic, and optical microscopic levels. The structure of unit cells and various crystal systems. The phenomena of isomorphism and polymorphism in polymers. Monotropy and enantiotropy. Polymers with polymorphic modifications. Folded and extended-chain primary crystallites. Characteristics of aggregates composed of primary crystallites. Supermolecular structures: single crystals, spherulites, cylindrites, hedrites, dendrites. Transcrystalline and shish-kebab structures. Methods suitable for investigating the characteristics of supramolecular structures: light microscopy, transmission and scanning electron microscopy (TEM, SEM), atomic force microscopy (AFM).

Types of spherulites and their structural composition. Positive and negative birefringent spherulites. The so-called cross-hatched structure. Ring-shaped and radial spherulites. Methods suitable for the deliberate control of the characteristics of supramolecular structures. Kinetic theory of polymer crystallization. Recent theories describing polymer crystallization. Recrystallization of crystalline polymers under stretching and the structural models describing it (Peterlin and Kobayashi models). The oriented state of crystalline polymers and methods for determining orientation. Models describing the structure of oriented polymers. The effect of orientation on properties. Methods for producing high-modulus and high-strength polymers and models describing their structure. Structure-property relationships in semi-crystalline polymers. Macromorphology of multicomponent polymer systems. Phase morphology of polymer blends. Simple dispersions, fibrillar and lamellar phase morphology, microemulsions, cocontinuous “matrix-in-matrix” phase structures. Phase inversion.

Theory of polyreactions (Subject code: BMEVEFADM13)
Responsible lecturer: Csiszár Emília

The objective of the course is to familiarize students with the chemical reactions of polymers, the latest polymer synthesis methods, the mechanisms and kinetic characteristics of these reactions, as well as special polymer structures and their specific applications. It covers various types of polymer reactions (polymerization, polycondensation, polyaddition) and the different types of chain polymerization reactions (free-radical, anionic, cationic, stereospecific). It discusses stereospecific polymerization in detail, introduces metallocene catalysts and their mechanisms of action, as well as post-metallocene technologies. It provides new insights into the principle and fundamental characteristics of living radical polymerization. It discusses in detail new methods based on reversible chain termination (ATRP, SFRP) and reversible chain transfer (RAFT). It introduces the principle and significance of metathesis polymerization: ring-opening metathesis polymerization (ROMP) and metathesis polymerization of non-cyclic dienes (ADMET), as well as the catalysts used. It covers the role of new polymerization processes in the formation of special polymer molecular structures (e.g., star, comb, etc.) (polymer architecture).

Textile chemistry I: Fibres (Subject code: BMEVEFADF3A)
Responsible lecturer: Csiszár Emília

The objective of this course is to provide students with a deeper understanding of recent developments and applications in the field of natural and synthetic fiber-forming polymers, new fiber surface treatment processes, and certain fiber testing methods.

In the field of natural fiber-forming polymers, it covers: (1) the manufacturing technology of Lyocell regenerated cellulose, the main steps of fiber production, and the issue of solvent recovery; it also discusses the topics of the fiber’s supramolecular structure, sorption properties, fibrillation, and potential applications; (2) the modification of cellulose by grafting and discusses the effect of supramolecular structure and morphology on grafting; (3) reactions suitable for formaldehyde-free cross-linking of cellulose; (4) potential new applications of chitosan fiber, silk, and wool.

In the field of synthetic fibers, it discusses the following developments: (1) high-strength fibers based on liquid-crystal polymers; (2) polyester fibers, their surface characteristics, and changes in surface properties during fiber formation and subsequent modifications (stretching and heat treatment, as well as hydrolysis, plasma treatment, spinning, and laser treatment); (3) so-called Shin-gosen fibers (silk- or wool-type fibers, shrinkable fibers). In addition, it covers (4) the modification of fiber surfaces via plasma treatment, as well as the topic of "nature-mimicking" synthetic fibers (silk, leather, fur, lotus leaf).

Approximately one-quarter of the course may be devoted to a review of the literature on natural and synthetic fibers, tailored to the doctoral student's interests.

Textile chemistry II: Processes in Textile Chemical Technology
(Subject code: BMEVEFADF3B)
Responsible lecturer: Csiszár Emília

The objective of this course is to provide students with in-depth knowledge of the three main areas of finishing fabrics made from the fiber materials most commonly processed in the textile industry, their fundamental principles of chemical technology, and the theoretical background of these processes. The course focuses on the preparation, dyeing, and printing of natural and synthetic fiber materials, as well as finishing processes aimed at achieving both traditional and specialized functions. In discussing the physical-chemical foundations of textile chemical processes, the course presents in detail the role of diffusion in textile chemical operations, as well as during washing, dry cleaning, and drying. It covers the sorption properties of dyes and synthetic resin monomers with different mechanisms of action. It covers the topics of wetting and penetration, addressing, for example, the mechanism of action of wetting agents and the requirements placed on wetting agents. It also presents complex processes such as soiling and stain removal, as well as effective finishing treatments for applications such as stain removal or the design of protective clothing. It also discusses the mechanisms of action of these treatments.

DEPARTMENT OF CHEMICAL AND ENVIRONMENTAL PROCESS ENGINEERING

Process Control I-II (Subject code: BMEVEKFDF1A- BMEVEKFDF1B)
Responsible lecturer: Szilágyi Botond

The process control gives funded knowledge about the control theory and practice. Currently, everywhere the computer is used, also for control. The compter helps, however, not only for the control but also for the design of the control sturctur. It enables the engineer to calculate controllability features and also modelling both steady state and dynamic. Single input single output (SISO) processes, control of SISO systems, Multiple Input Multiple Output processes (MIMO), control of MIMO systems. State-space modelling, state-space models, Determination of gain array, Desing of control structure for MIMO systems. Controlability indexes, Niederlinski index, Interconnection of control loops, measurement of the interconnection among control loops, relative gain array, condition number, singular value. Morari resiliency index, Complex steps of control sturcture design for MIMO systems. Uncertanity in the controler tuning, Skogestad-Morari method, Doyle-Stein criterium, Alternatives of the computer application for control and operation. On-line data collection, supervisory control, direct digital control, Hardware tools, Sampling theory, mathematical modeling, Time function, Laplace transormation, Frequency function. „Z"-transformation, characters of the Z-transformation, Application of the Z – transformation, Sampling theory, Dead time in the Z domain. Stability in the Z-domain, Internal Model Control, Model Based Control, Smith predictor.

Design of Experiments (Subject code: BMEVEKFDM02)
Responsible lecturer: Komka Kinga

To teach the basics and methods of mathematical statistical treatment of measurement data. To teach the design and analysis of the most basic full factorial experimental designs.

Topics: Random variable, density and distribution function, expected value, variance. Continuous distributions: normal distribution, standard normal distribution, khi2, t and F distribution. Central limit theorem. Population and sample. Parameter estimation. Confidence interval. Hypothesis testing. Error of first and second kind. Parametric tests: z-test, t-test, khi2-test, F-test, two sample t-test, paired t-test. Mutual distribution of several random variables, correlation. Principles of linear regression. Checking the assumptions, estimation of the parameter (slope and intercept), confidence and prediction band. Design of experiments. 2p full factorial design, orthogonality, estimation of the effects and the parameters, significance tests, center point. 2p-r fractional factorials.

DEPARTMENT OF INORGANIC AND ANALYTICAL CHEMISTRY

Modern Methods of Analysis and Structural Determination I-II
(Subject code: BMEVESADF1A- BMEVESADF1B)
Responsible lecturer: Höfler Lajos

"Modern Analytical and Structural Analysis Methods I/II" is a two-semester doctoral core course consisting of several modules. The aim of the course is for students to acquire a high-level understanding of the most important modern and classical analytical techniques from recognized experts in the field, in accordance with the requirements of the PhD program. The detailed curriculum covers the theoretical and practical applications of classical analytical chemistry, chemical and biosensors, chromatographic methods (GC, HPLC), elemental analysis, and NMR spectroscopy. Successful completion of the course ensures that PhD students involved in teaching courses in the Department of Inorganic and Analytical Chemistry possess up-to-date and in-depth knowledge necessary for delivering the curriculum.

Methods of Analytical Separation (Subject code: BMEVESADM02)
Responsible lecturer: Tóth Blanka

The aim of the course is to familiarize students with modern analytical separation methods, with a particular focus on liquid and gas chromatography and electrophoretic methods, supplemented by supercritical and liquid-liquid chromatography techniques. The goal is not only to provide a theoretical foundation but also to review currently used methods through real-world examples. Sample preparation procedures closely related to separation techniques (liquid-liquid extraction, solid-phase extraction, solid-phase microextraction) are also included in the curriculum.

Upon completion of the course, students will have up-to-date knowledge of analytical separation methods.

Chemical and Biosensors (Subject code: BMEVESADM04)
Responsible lecturer: Gyurcsányi Róbert

Chemical and biological sensors constitute an important subfield of analytical chemistry. The analytical significance of chemical sensors lies in the fact that they can be used not only in laboratories but also within living organisms and directly at the site of analysis for sample analysis and for monitoring and controlling chemical and biochemical processes. The aim of the course is to introduce the major types of sensors and the fundamentals of their operation, as well as to develop the interdisciplinary, integrative approach necessary for their development. Another objective is to demonstrate the applicability of sensor technology in various fields of importance to society, such as medical diagnostics, environmental science, and materials science.

Spectroscopy for Structural Determination (Subject code: BMEVESADM10)
Responsible lecturer: Simon András

The objective of this course is for students to acquire the knowledge of UV, IR, MS, and NMR spectroscopy necessary for the structural elucidation and identification of compounds, and to be able to apply this knowledge independently in everyday practice. The knowledge provided in the field of chemical structural research makes a fundamental contribution to meeting the requirements of the pharmaceutical, analytical, and structural analysis specializations. The course is recommended for doctoral students who did not acquire the above basic spectroscopic knowledge during their BSc/MSc studies (Organic Structure Determination (BMEVESAA512) is required only for students in the Pharmaceutical Engineering track and the Analytical and Structural Analysis track, as well as for doctoral students coming from other higher education institutions).

Chemistry of D and F Elements, Complexes (Subject code: BMEVESADM01)
Responsible lecturer: Benkő Zoltán

The primary objective of this course is to provide a comprehensive understanding of the transition metals and their major compounds, as well as their physical and chemical properties. The course also covers the properties of lanthanide and actinide metals. The course will also address the potential applications of these metals, with a particular focus on catalysis and organometallic chemistry.

Chemistry of Main Group Elements (Subject code: BMEVESADM03)
Responsible lecturer: Kelemen Zsolt

The aim of this course is to describe the properties of the elements and major compounds in this group. The course covers the most important trends, with a particular focus on changes in chemical properties. The diagonal rule and the inert s-orbit effect are discussed in detail.

Calculation of chemical and enzyme reactions (Subject code: BMEVESADM05)
Responsible lecturer: Oláh Julianna

The aim of the course is to provide an insight into the techniques used to model small molecules and protein enzymes. The methods examined include quantum chemical calculations, including those based on density functional theory, molecular mechanical force fields, and molecular dynamics simulations. The course covers the application areas of each method, but also discusses the complicating and limiting factors and limitations. The course pays particular attention to how we can apply physicochemical principles in the planning of computational chemistry research and the interpretation of results. The course relies heavily on practical examples and targeted discussion of scientific research results. In addition to examining scientific relationships, the course also develops students' scientific communication, presentation, and debate skills.

Organometallic Chemistry (Subject code: BMEVESADM07)
Responsible lecturer: Benkő Zoltán

The aim of the course is to develop a comprehensive understanding and perspective in the field of complex and organometallic chemistry (structure, stability, and reactivity of complex and organometallic compounds), as well as to illustrate the practical significance of organometallic compounds through examples. The course emphasizes the special properties of organometallic compounds (which differ from those of classical organic and inorganic compounds) and their role in their use as chemical reagents or catalysts. Among the main-group elements, the chemistry of the organic compounds of alkali metals, magnesium, aluminum, tin, lead, and silicon is discussed in detail. The organometallic chemistry of transition metals is discussed in accordance with the literature, classified by ligands. At the end of the course, the significance of organometallic catalysis in syntheses and its industrial applications are discussed.

Modern inorganic materials (Subject code: BMEVESADM08)
Responsible lecturer: Kelemen Zsolt

The aim of this course is to introduce inorganic compounds that play a prominent role in modern materials science and medicine. The course covers modern ceramics, self-cleaning surface coatings, and inorganic pharmaceuticals, along with their potential applications. The fundamentals of boron neutron capture therapy and various thermal therapies will also be covered.

Inorganic Chemistry I-II (Subject code: BMEVESADF3A- BMEVESADF3B)
Responsible lecturer: Kelemen Zsolt / Benkő Zoltán

The primary objective of this course is to provide an in-depth examination of inorganic chemistry and to foster a comprehensive understanding of the subject. The course explores the relationships and patterns that determine the properties of inorganic compounds (physical properties, chemical behavior). Another key objective is to familiarize students with the physical and chemical properties of elements and their inorganic compounds. In addition, the course covers the chemistry of inorganic chemical processes that are important from an industrial perspective. It also introduces the chemical properties of inorganic substances that are significant from an environmental perspective.

DEPARTMENT OF ORGANIC CHEMISTRY AND TECHNOLOGY

Organic chemical technology I-II (Subject code: BMEVESZDF2A- BMEVESZDF2B)
Responsible lecturer: Hegedűs László

Building on the knowledge gained in the undergraduate and master's-level courses in Organic Chemical Engineering, Environmentally Friendly Chemistry and Technology, and Pharmaceutical Technology, students are introduced to state-of-the-art organic chemical processes, illustrated through several representative examples. One of the key topics is homogeneous and heterogeneous catalytic conversions (e.g., hydroformylation and liquid-phase heterogeneous catalytic hydrogenation), with a focus on the recovery, recycling, or regeneration of the respective catalysts. Another important area is the presentation of modern environmentally friendly processes, with particular regard to sustainability considerations and the reduction of environmental impact. The third topic is the introduction of technologies for the production of new pharmaceutical active ingredients. In each case, the research and development methods in the given field are emphasized. As part of a project assignment, students prepare a 10–15-page report on a given topic using data from the international literature, and then present the most important new developments orally.

Organic chemistry I-II (Subject code: BMEVESZDF1A- BMEVESZDF1B)
Responsible lecturer: Huszthy Péter

Advanced training in the natural sciences for chemical engineering students. In addition to the fundamentals of organic chemistry, the course covers the latest research trends in this field, with a particular focus on applications and practical uses. The course material serves as a supplement to the knowledge acquired in the Organic Chemistry I and II introductory courses.

Unit Processes and Technologies in Pharmaceutical Industry
(Subject code: BMEVESZDM10)
Responsible lecturer: Faigl Ferenc

As a supplement to the "Fundamentals of Medicinal Chemistry" course offered in the regular curriculum, students gain insight into how to address and resolve issues related to new technologies and technological changes. One of the key topics of the course is the presentation of modern resolution and enantiomer enrichment methods for the production of chiral drug substances, illustrated through concrete examples implemented on an industrial scale. Through the analysis of known processes, we also discuss organometallic reactions, which are now of decisive importance in modern drug synthesis. We will analyze in detail the properties of organometallic superbases, as well as the conditions and possibilities for their practical application. The course will cover the fundamentals of flow chemistry and demonstrate its integration into drug research and pharmaceutical manufacturing processes through practical examples.

Organophosphorus (Subject code: BMEVESZDM12)
Responsible lecturer: Keglevich György

It provides an overview of the synthetic and practical significance of organophosphorus chemistry. The course covers the importance of phosphorus compounds in everyday life (medicines, pesticides, the food industry, the plastics industry, etc.) and in biochemistry. It provides an overview of trivalent and pentavalent forms—the latter being tetracoordinated or pentacoordinated—in terms of reactivity and synthesis. Methods for the interconversion of trivalent and pentavalent forms are covered. Special emphasis is placed on the applicability of P-ligands in catalysts and bioactivity, reactive P-intermediates, and P-heterocyclic chemistry. The eponymous P-reactions, such as the Arbuzov, Pudovik, Kabachnik-Fields, Wittig, Wittig-Horne, and Hirao reactions, are indispensable.

Synthesis and Molecular Recognition of Macrocycles (Subject code: BMEVESZDM02)
Responsible lecturer: Huszthy Péter

The course will cover the synthesis of crown ethers, cryptanes, spheranes, hemispheranes, calixarenes, cyclophanes, catenanes, rotaxanes, cyclodextrins, and other macrocycles, as well as their recognition capabilities toward cations, anions, and neutral molecules. Within the context of molecular recognition, the course will also cover enantiomer recognition enabled by chiral macrocycles and the most actively researched areas of supramolecular chemistry, with particular emphasis on their application as sensor and selector molecules.

Technologies of pharmaceutical materials and Biopolymer systems (Subject code: BMEVESZBM11)

Responsible lecturer: Marosi György

To provide theoretical and practical knowledge of pharmaceutical technology, including the characteristics of pharmaceutical excipients and carriers, the related structural and pharmacodynamic relationships, and the manufacturing technologies, testing methods, and applications of major types of pharmaceutical preparations. Upon successful completion of the course, students should be familiar with the theoretical foundations necessary for formulation, have at least a basic understanding of all tasks involved in the production of finished pharmaceuticals, and be able to discuss the subject with specialists in the field. The knowledge gained here serves as a foundation for deepening their expertise in this field and prepares them for specialized practical training and the completion of thesis projects related to the subject.

Synthetic biotransformations (Subject code: BMEVESZDM04)

Responsible lecturer: Poppe László

General features of biotransformations and biocatalysis - Enzyme and cell immobilization - Development of novel biocatalysts by traditional and molecular genetics methods - Stereochemical questions related to biotransformations - Selectivity types in biotransformations - Biotransformations with isolated enzymes (hydrolases, oxido-reductases, liases, transferases) - Biotransformations with multienzyme systems - Synthetic whole-cell biotransformations with traditional and recombinant microbes - Industrial biotransformations: examples of biotransformations on industrial scale.