National University of Science and Technology
Politehnica Bucharest

Faculty of Engineering in Foreign Languages

**Undergraduate program: CHEMICAL ENGINEERING in ENGLISH LANGUAGE, 2024-2028**
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# CONTENT OF THE LECTURES FROM THE STUDY PLAN

# I$^{st}$ YEAR

## I Year, 1$^{st}$ Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E / V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.F.01.I.401 | F | 1 | 1 | **Calculus I** | E | 2 | 1 | 0 | 0 | **4** |
| UPB.12.F.01.I.402 | F | 1 | 1 | **Linear Algebra, Analytical and Differential Geometry** | E | 2 | 1 | 0 | 0 | **4** |
| UPB.12.F.01.I.403 | F | 1 | 1 | **Chemistry I** | E | 2 | 0 | 3 | 0 | **5** |
| UPB.12.F.01.I.404 | F | 1 | 1 | **Chemistry II** | E | 3 | 2 | 0 | 0 | **4** |
| UPB.12.F.01.I.405 | F | 1 | 1 | **Applied Informatics** | E | 2 | 0 | 1 | 0 | **3** |
| UPB.12.F.01.I.406 | F | 1 | 1 | **Computer Aided Graphics** | V | 1 | 0 | 1 | 0 | **3** |
| UPB.12.C.01.I.407 | C | 1 | 1 | **Essential Professional Skills for Engineers- Intermediate** | V | 0 | 2 | 0 | 0 | **2** |
| UPB.12.C.01.I.408 | C | 1 | 1 | **European Culture and Civilization I** | V | 1 | 1 | 0 | 0 | **2** |
| UPB.12.C.01.I.409 | C | 1 | 1 | **Physical education** | V | 0 | 2 | 0 | 0 | **3** |

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**Calculus I - Teacher: Carmina Camelia GEORGESCU**

This course, integral to the Chemical Engineering curriculum, aims to equip students with foundational mathematical and engineering principles through an introduction to differential calculus. Calculus 1 extends the study of single-variable functions initiated at the collegiate level. The syllabus encompasses topics such as real and complex number systems, numerical sequences and series, functional sequences and series, partial differentiation, differentials, extrema and constrained extrema, and implicit functions.

**Linear Algebra, analytical and differential geometry - Teacher: Ariana PITEA**

This course delves into the fundamental introductory chapters of Linear Algebra and Analytic and Differential Geometry, aiming to acquaint students with essential approaches, models, and results within these fields. It emphasizes the application of these principles in practical problem-solving and enhances the students' learning experience. The course elucidates key notions, specific concepts, and principles, including linear spaces and subspaces, linear and bilinear mappings, straight lines and planes, conics and quadrics, and curves and surfaces. These topics collectively provide students with a comprehensive understanding of the methodological and procedural principles pertinent to applied engineering models.

**Chemistry I - Teachers: Daniela BERGER; Eugenia TOTU**

The Chemistry I course, part of the Chemical Engineering undergraduate program with a specialization in Chemical Engineering in English, aims to impart, accumulate, and apply fundamental knowledge in chemical equilibria within homogeneous systems. The course focuses on the separation, concentration, and quantification of various chemical entities in solutions. It covers calculating concentrations of dilute and concentrated solutions, correlating concentration and activity of species in specific environments, and defining and identifying proton, electron, and ion or molecule exchange processes. Additionally, it provides guidelines for using operational parameters such as pH, redox potential, and ligand or common ion concentration to design methods for the separation, identification, and quantification of analytes of interest. Theoretical models and practical examples will help students achieve a realistic understanding of the environment, fill knowledge gaps essential for comprehending contemporary technological principles, and develop novel analytical identification methods.

**Chemistry II - Teacher: Ana Maria JOSCEANU**

The Chemistry II course aims to provide students with essential notions, concepts, and theories in inorganic chemistry crucial for chemical engineers. The course focuses on understanding the relationship between atomic structure and the trends in elemental properties as depicted in the Periodic Table, as well as the impact of chemical bonding on the physical and chemical properties of compounds. It emphasizes fundamental concepts and theories to elucidate the properties of elements and their compounds, particularly halogens, noble gases, and hydrogen. The course applies these foundational principles and models to establish the relationship between the structure and chemical reactivity of inorganic compounds, fostering a deep comprehension of chemical processes and phenomena.

**Applied Informatics - Teacher: Constantin Viorel MARIAN**

Applied Informatics aims to equip students with foundational knowledge and skills in computer systems, networks, and security. The course introduces key concepts and mechanisms of modern operating systems and virtualization, providing both theoretical understanding and practical applications.

Students will gain a basic understanding of computers, computer networks, and operating systems, and develop an awareness of computer security principles. Emphasis is placed on the principles and organization of operating systems, with practical projects illustrating key concepts in real-world contexts.

By the end of the course, students will be able to configure a computer operating system, interconnect multiple computers, and implement IT protection and security strategies at the operating system level. The course also highlights the importance of self-learning and teamwork through collaborative project assignments, preparing students to tackle practical IT challenges.

**Computer Aided Graphics - Teachers: Ionuț-Cristian PEREDERIC; Florin-Felix RADUICA**

Computer-Aided Graphics encompasses both fundamental and advanced concepts in descriptive geometry and technical drawing, supplemented by an introduction to relevant software applications. Methods will be adapted to the students, but the process will roughly follow the dissemination of knowledge at the course, followed by homework in preparation for the laboratory, while further emphasizing the important aspects through the exercises from the laboratory.

**Essential Professional Skills for Engineers-intermediate - Teacher: Doina COMANETCHI**

The course focuses on developing the four fundamental communication skills—listening, writing, reading, and speaking—within professional engineering contexts. It aims to enhance communication competence in professional, scientific, and technical settings. Teaching methods will be tailored to students' learning needs and styles, promoting both linguistic competence and learning autonomy. The course will utilize a variety of work formats, including individual, pair, group, and direct teaching. Traditional methods, such as lectures, group discussions, and course book exercises, will be integrated with communicative approaches, incorporating audio/video support, brainstorming, and problem-solving activities. Additionally, direct exploration methods like observation and case studies will alternate with creative activities and role-playing exercises.

**European Culture and Civilization - Teacher: Adelin Costin DUMITRU**

The primary objective of this course is to familiarize students with foundational issues in European philosophy and culture, providing a comprehensive understanding of the concept of Europe. Additionally, the course aims to cultivate independent thinking through analogies, debates, and analytical comparisons focused on key theoretical themes in European history and culture. Designed for undergraduate students, the course addresses significant topics in European history and philosophy to elucidate the meaning of being European. Texts will be examined both as contributions to the understanding of specific historical and cultural events and as means to analyze the relationships between different cultural assumptions. The course will explore the possibility of creating a "theoretical bridge" between conflicting values and cultural identities. Teaching will be interactive, involving discussions of key topics, theoretical problem-solving, and encouraging student debates and teamwork.

**Physical Education - Teacher: Daniela-Carmen GRIGOROIU-NOROCEL**

Physical education serves to augment both physical and intellectual capacities, fostering harmonious bodily development, optimizing overall health, and mitigating the onset of general and localized physical deficiencies, while also instilling and maintaining proper body posture. Moreover, physical education aims to cultivate teamwork skills, facilitating prompt, accurate, and efficient responses to requests, and nurturing rapid, judicious decision-making with presence of mind. It further seeks to nurture interactive communication competencies requisite for evaluating complex problems in teamwork and creativity-innovation endeavors, effectively communicating and demonstrating proposed solutions for team adoption. Additionally, it strives for adept performance in organizing and conducting sports activities, proficiency in diverse motor activities employing basic motor skills and qualities, and the development of self-control and continuous self-improvement.

## I Year, 2nd Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E / V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.F.02.I.401 | F | 1 | 2 | **Calculus II** | E | 2 | 1 | 0 | 0 | **5** |
| UPB.12.F.02.I.402 | F | 1 | 2 | **Physics I** | E | 2 | 0 | 1 | 0 | **4** |
| UPB.12.D.02.I.403 | D | 1 | 2 | **Inorganic Chemistry** | E | 2 | 2 | 2 | 0 | **4** |
| UPB.12.F.02.I.404 | F | 1 | 2 | **Programming Languages** | V | 1 | 0 | 1 | 0 | **3** |
| UPB.12.D.02.I.405 | D | 1 | 2 | **Analytical Chemistry and Instrumental Analysis** | E | 2 | 0 | 2 | 0 | **4** |
| UPB.12.F.02.I.406 | F | 1 | 2 | **Chemistry III** | E | 2 | 1 | 0 | 0 | **4** |
| UPB.12.D.02.I.407 | D | 1 | 2 | **Mechanics** | V | 1 | 1 | 0 | 0 | **2** |
| UPB.12.C.02.I.408 | C | 1 | 2 | **Essential Professional Skills for Engineers – upper intermediate** | V | 0 | 2 | 0 | 0 | **2** |
| UPB.12.C.02.I.409 | C | 1 | 2 | **European Culture and Civilization II** | V | 1 | 1 | 0 | 0 | **2** |

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**Calculus II - Teacher: Carmina Camelia GEORGESCU**

This course in Calculus 2 for Chemical Engineering expands upon the prior knowledge of differential calculus to introduce students to the concept of integration within the realm of multivariable calculus. Students will explore various techniques for integration, including the Riemann integral, improper integrals, and the definition of functions through integration. The course progresses to higher-dimensional integration, encompassing double and triple integrals, alongside line and surface integrals. Furthermore, it introduces fundamental theorems of vector calculus, such as the Green-Riemann, Gauss-Ostrogradski, and Stokes' theorems, which provide powerful tools for manipulating integrals. To complement the theoretical framework, the course delves into applications of these concepts in field theory. Finally, students are exposed to the foundational concepts of metric spaces and the fixed point theorem, further solidifying their mathematical background.

**Physics I - Teacher: Ana Maria POPOVICI**

This introductory physics course, Physics I, focuses on the fundamental principles of electromagnetism and wave optics. Chemical engineering students will have the opportunity to develop a strong foundation in these key areas, gaining exposure to the associated concepts, principles, and technical vocabulary.

Electromagnetism and wave optics have numerous practical applications within the field of chemical engineering, and this course aims to equip students with the knowledge to leverage these connections.

The curriculum provides a concise introduction to the theory of electromagnetic waves, exploring their propagation characteristics. Students will delve into the nature and properties of light as an electromagnetic wave, examining how light interacts with matter. Furthermore, the course will explore a variety of prominent optical phenomena and their real-world applications. To bridge the gap between theory and practice, the curriculum incorporates practical knowledge of modern equipment and techniques that utilize optical phenomena. Examples include optical fibers, lasers, and various spectroscopic techniques such as Raman spectroscopy.

**Inorganic Chemistry - Teacher: Maria Gabriela ALEXANDRU**

This course delves into the foundational principles of inorganic chemistry, specifically as they pertain to the field of chemical engineering. Students will gain a comprehensive understanding of the key concepts, theories, and models employed within the discipline, fostering effective communication in a professional setting.

The curriculum centers on the electronic structure and reactivity of the main group elements, providing a framework for comprehending their chemical behavior. Students will explore the periodic trends observed in both physical and chemical properties, enabling them to predict the behavior of elements across the periodic table. Furthermore, the course emphasizes the structure and properties of the main group elements and their diverse range of compounds.

A critical aspect of the course involves assessing the reactivity of elements and compounds within aqueous solutions. Students will gain insights into the factors governing the stability of oxidation states for the main group elements. The course culminates with a focus on fundamental knowledge regarding the main group elements and their essential classes of compounds, encompassing hydrides, oxides, halides, and acids.

Finally, the curriculum explores the extensive applications of the main group elements and their compounds across various fields, including materials science, biochemistry, and electronics. This comprehensive approach equips students with the necessary knowledge base to leverage inorganic chemistry in diverse chemical engineering contexts.

**Programming Languages - Teacher: Paul A. GAGNIUC**

This course equips chemical engineering students with the computational tools and problem-solving methodologies necessary for success in both general and discipline-specific contexts. Students will gain proficiency in applying computer science and engineering principles to tackle problems encountered in chemical engineering and mechanics.

The curriculum emphasizes the design and implementation of software solutions, utilizing various technologies and programming environments. Students will develop a sophisticated understanding of data structures and their application across diverse scenarios. Furthermore, the course fosters the ability to design and integrate software components, optimizing their performance within deployed systems.

A cornerstone of the course is the exploration of fundamental principles drawn from mathematics, engineering, and computer science. Students will hone their skills in software component design and delve into methods for optimizing software performance. The curriculum culminates in a comprehensive understanding of the software development lifecycle, encompassing design, management, integration, and maintenance of software implementations.

The course employs a multifaceted teaching approach, incorporating both expository (lectures) and interactive methods to foster active learning. Discovery learning models, including experimentation, demonstration, and modeling, are utilized alongside action-based learning through practical activities and problem-solving exercises. Lectures leverage PowerPoint presentations, which are made available to students and incorporate original information through visuals, diagrams, and key phrases. To enhance comprehension, each course session begins with a review of previous material, emphasizing key concepts covered in the preceding unit. The course also fosters collaborative learning through teamwork exercises within laboratory tasks, encouraging optimal communication and collaboration skills.

**Analytical Chemistry and Instrumental Analysis - Teacher: Eugenia TOTU**

This course serves as an introduction to instrumental analytical chemistry within the chemical engineering curriculum. By equipping students with a foundational understanding of these instrumental techniques, the course empowers them to leverage this knowledge in subsequent coursework and practical laboratory experiences. The curriculum delves into key analytical methods, including redox couple analysis, potentiometric and conductometric methods, extraction techniques, gravimetric analysis, and thermal analysis. These techniques provide a critical foundation for further studies within the chemical engineering discipline.

**Chemistry III - Teachers: Maria Gabriela ALEXANDRU; Florina DUMITRU**

The Chemistry III course provides a solid background in coordination chemistry, solid state chemistry, including the structure types of simple solids, Band Theory (with the aim of understanding electrical properties of transition metals and their compounds).

This course focuses on the unique properties of transition metals, a specific group of elements within the periodic table. Students will gain a comprehensive understanding of the electronic structures of transition metals, which directly influence their reactivity. The curriculum delves into the structure and properties of transition metal compounds, equipping students with the ability to analyze these relationships.

A cornerstone of the course is the exploration of theoretical frameworks that explain bonding mechanisms within transition metal compounds. Students will explore various bonding models, including ionic, covalent, and metallic bonding, and how these models relate to the observed electrical, magnetic, and optical properties of the compounds. Furthermore, the course emphasizes the application of these theoretical concepts to explain and propose synthetic procedures for obtaining transition metals and their compounds. By the course's conclusion, students will possess a robust understanding of the interplay between electronic structure, bonding, and properties in transition metal chemistry, fostering their ability to predict and manipulate these materials for various applications.

**Mechanics - Teacher: Mihai BUGARU**

This course integrates the study of mechanics into the chemical engineering curriculum. The curriculum aims to equip students with a comprehensive understanding of the fundamental models, theories, and concepts that underpin this domain. Furthermore, the course emphasizes the development of problem-solving methodologies applicable to various technical challenges encountered within the field of chemical engineering. These problem-solving techniques serve as a cornerstone for fostering the students' learning process. The course curriculum prioritizes the acquisition of knowledge in two key areas of mechanics: the mechanics of material systems (specifically rigid bodies) and core principles of analytical mechanics. By mastering these foundational concepts, students cultivate their logical thinking abilities. This enhanced logical reasoning empowers graduates to effectively solve practical engineering problems by leveraging the theoretical knowledge acquired throughout the course.

**Essential Professional Skills for Engineers-upper intermediate - Teacher: Doina COMANETCHI**

Essential Professional Skills for Engineers, designed for upper-intermediate learners, emphasizes the development of four fundamental communication skills crucial for engineers in the workplace. The course focuses on honing students' ability to effectively receive and understand both spoken and written technical information within an engineering context. This includes active listening during technical presentations, critical analysis of engineering documents, and extracting key information from various sources. Furthermore, the course equips students with the skills necessary to produce clear, concise, and accurate written and oral communication tailored to professional engineering audiences. Students will develop the ability to draft well-structured technical reports, deliver persuasive presentations, and effectively explain complex engineering concepts to both technical and non-technical stakeholders. By cultivating these core communication skills, the course fosters enhanced competence in professional, scientific, and technical contexts.

**European Culture and Civilization II - Teacher: Adelin Costin DUMITRU**

European Culture and Civilization II aims to equip students with a comprehensive understanding of the concept of "Europe" by exploring its philosophical and cultural foundations. The course fosters the development of critical thinking skills through the use of analogies, debates, and analytical comparisons applied to key themes in European history and culture. By examining major historical and philosophical issues, students will grapple with the question of what constitutes European identity. The course structure emphasizes engagement with primary source texts, analyzing them both as reflections of specific historical and cultural events and as tools for revealing the relationships and tensions between different cultural assumptions. A critical aspect of the course is the exploration of the possibility of constructing bridges across these divides, fostering understanding and reconciliation between seemingly conflicting values and cultural identities within Europe. Ultimately, this course provides undergraduate students with a solid foundation in European history, philosophy, and culture, encouraging them to critically analyze the concept of European identity and its evolution.

# IInd YEAR

## IInd Year, 1st Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E / V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.F.03.I.401 | F | 2 | 1 | **Probabilities Theory & Mathematical Statistics** | V | 1 | 1 | 0 | 0 | **2** |
| UPB.12.F.03.I.402 | F | 2 | 1 | **Physics II** | E | 2 | 0 | 1 | 0 | **4** |
| UPB.12.D.03.I.403 | D | 2 | 1 | **Physical Chemistry I** | E | 3 | 2 | 2 | 0 | **7** |
| UPB.12.D.03.I.404 | D | 2 | 1 | **Organic Chemistry I** | E | 3 | 2 | 0 | 0 | **6** |
| UPB.12.D.03.I.405 | D | 2 | 1 | **Strength of Materials I** | E | 2 | 1 | 0 | 0 | **4** |
| UPB.12.D.03.I.406 | D | 2 | 1 | **Electrotechnics and Electronics** | V | 2 | 0 | 1 | 0 | **3** |
| UPB.12.D.03.I.407 | D | 2 | 1 | **Management and Marketing I** | V | 1 | 1 | 0 | 0 | **2** |
| UPB.12.C.03.I.408 | C | 2 | 1 | **Advanced Writing Skills for Engineers** | V | 0 | 2 | 0 | 0 | **2** |

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**Probabilities Theory & Mathematical Statistics - Teacher: Andreea BEJENARU**

Offered within the Chemical Engineering program, specifically for students specializing in English language studies, Probability Theory and Mathematical Statistics introduces students to the fundamental concepts of these fields. The course emphasizes the practical application of these concepts, demonstrating their connection to other engineering and scientific disciplines.

Students will gain a comprehensive understanding of core probability and statistical principles, including probability, conditional probability, random variables, distribution functions, random vectors, correlation, regression analysis, and characteristic functions. Furthermore, the course explores the application of classical statistical laws through characteristic functions.

A critical aspect of the program is the development of data analysis skills. Students will learn to effectively represent and analyze data, construct confidence intervals, and leverage approximation theory in statistical contexts. Additionally, the course delves into the concepts of best approximation and the least squares method, equipping students with valuable tools for optimization problems.

This proficiency empowers graduates to understand and utilize applied models from various fields, such as reliability theory, physics, and game theory. They will also be equipped to conduct prediction studies

based on historical data analysis and estimate parameters within optimization scenarios, allowing them to make informed decisions.

Overall, this course fosters a strong foundation in probability and statistics, specifically tailored to the needs of chemical engineering professionals. The emphasis on practical applications ensures that students are well-equipped to leverage these powerful tools in their future careers.

**Physics II - Teacher: Valerică NINULESCU**

Physics II builds upon foundational physics principles to introduce students to the exciting realm of modern physics, also known as quantum physics. This course delves into the theoretical underpinnings of advanced technologies utilized within various engineering disciplines. Students will explore the fundamental principles governing phenomena at the atomic and subatomic level. The curriculum goes beyond pure theory, incorporating practical applications by showcasing relevant investigation methods and associated equipment employed in modern physics research.

**Physical Chemistry I - Teacher: Catinca SECUIANU**

This introductory course in Physical Chemistry I equips chemical engineering students with a foundational understanding of the physicochemical principles governing physical and chemical processes. The curriculum emphasizes the application of these principles within the domain of chemical thermodynamics. Students will develop the skills necessary to calculate various properties, including heat capacities, thermodynamic functions associated with phase transitions, and the thermodynamics of chemical reactions. These skills are instrumental in performing mass and energy balance calculations, establishing optimal conditions for achieving equilibrium in chemical systems, and ultimately designing reactors and industrial plants within the chemical industry.

**Organic Chemistry I - Teachers: Anca Liana MARTON; Matei RAICOPOL; Nicoleta CHIRA**

This course, Organic Chemistry I, is specifically designed for chemical engineering students specializing in English language studies. The curriculum aims to equip students with a comprehensive understanding of the fundamental concepts, theories, and methodologies employed within organic chemistry.

The course serves as a foundation for further studies by solidifying students' knowledge of key organic chemistry principles. This includes in-depth exploration of various classes of organic compounds, their

synthesis methods, and their physicochemical properties.The curriculum emphasizes the interrelationships between these properties and the chemical transformations undergone by organic compounds.
Organic Chemistry I fosters the development of valuable critical thinking skills. Students will hone their ability to assess problems, formulate hypotheses, design experiments to test those hypotheses, and draw sound conclusions based on the resulting data. Furthermore, the course emphasizes the importance of organic chemistry knowledge in professional communication, ensuring students can effectively utilize this knowledge within their chosen field.

**Strength of Materials I - Teacher: Dan Mihai CONSTANTINESCU**

This course, Strength of Materials, is offered within the Chemical Engineering program, specifically for students enrolled in the Foreign Languages (FILS) specialization. The curriculum aims to introduce students to the core principles, models, and theoretical frameworks underpinning the field of inorganic process and product engineering. These foundational concepts provide a critical toolkit for solving practical engineering problems encountered within the chemical engineering discipline. The course is designed to stimulate the learning process by fostering a deeper understanding of these fundamental principles. Students will gain a comprehensive understanding of material failure mechanisms and the damage that can occur in structural components. The curriculum emphasizes the importance of accurately analyzing stress and deformation phenomena within mechanical structures. Furthermore, the course delves into the core methodologies specific to the mechanics of deformable bodies, focusing on the calculation of stresses and deformations arising from various loading scenarios in two-dimensional bar structures. By acquiring proficiency in these areas, graduates will be well-equipped to analyze the behavior of materials under various stresses and strains, ultimately contributing to the design of safe and reliable structures within the chemical engineering industry.

**Electrotechnics and Electronics - Teacher: Marilena STANCULESCU**

Electrotechnics and Electronics equips students with the ability to apply their knowledge of electromagnetic field theory and circuit theory to solve practical engineering problems. The course emphasizes modeling and analyzing real-world problems in both electromagnetic fields and electrical circuits, while fostering a critical understanding of the limitations inherent to these models. Students will gain a solid grasp of the fundamental principles governing electromagnetic phenomena.

The curriculum is designed to achieve several specific learning objectives. Students will develop the ability to accurately identify and formulate the macroscopic laws of electromagnetism, along with understanding the key consequences that arise from this established theory. They will learn to correctly identify the electrical circuit state associated with a specific engineering application and write Kirchhoff's equations to analyze electrical circuits. A cornerstone of the course is the development of an "engineering approach" to problem-solving, where students will strategically select appropriate methodologies to address various challenges encountered in electrical engineering.

By achieving these objectives, graduates will possess a strong foundation in electrotechnics and electronics, enabling them to effectively analyze and solve complex problems within the electrical engineering domain.

**Management and Marketing I - Teacher: Ana Maria NEAGU**

Management and Marketing I, offered within the Chemical Engineering program, aims to equip students with the fundamental principles of economic thinking. This course fosters the development of an "economic mindset," enabling students to identify and implement entrepreneurial decision-making strategies at the microeconomic level. Additionally, the curriculum emphasizes effective resource management, including materials, human capital, and time.

The course delves into specific economic concepts to provide a strong foundation for analysis. These concepts include foundational economic principles, various market models, the concept of equilibrium price and its role within the market system, the impact of government intervention on market dynamics, different types of costs associated with business operations, and the various market structures that exist within the economic landscape.

By applying these concepts and engaging in discussions surrounding relevant examples, students develop a solid foundation in economic reasoning and decision-making. These skills are transferable and can be applied to both professional and personal challenges, empowering graduates to make informed decisions in diverse contexts.

**Advanced Writing Skills for Engineers - Teacher: Doina COMANETCHI**

This course is designed to refine the essential communication skills needed by engineers to thrive in a professional setting. It focuses on four key areas that are crucial for successful communication within the technical domain. Firstly, the course emphasizes **effective reception** of technical information. Students

will hone their ability to actively listen and comprehend complex engineering concepts presented both orally (e.g., during presentations) and in written form (e.g., engineering reports). By developing critical analysis skills, students will learn to extract key data and insights from various technical sources.

Secondly, the course equips students with the tools to produce **clear and concise communication**. This encompasses the ability to draft well-structured technical reports, deliver persuasive and informative presentations, and effectively explain complex engineering concepts to both technical and non-technical stakeholders. Students will learn to tailor their writing and speaking to ensure clarity, accuracy, and conciseness when disseminating technical information.

Thirdly, the course emphasizes the importance of cultivating a **professional communication style**. This involves using precise language, maintaining objectivity, and adhering to established technical writing conventions. By mastering these aspects, students will ensure clear and unambiguous communication within the scientific and technical context.

## II$^{nd}$ Year, II$^{nd}$ Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E / V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.D.04.I.401 | D | 2 | 1 | **Physical Chemistry II** | E | 3 | 2 | 2 | 0 | **10** |
| UPB.12.D.04.I.402 | D | 2 | 1 | **Organic Chemistry II** | E | 3 | 2 | 2 | 0 | **7** |
| UPB.12.D.04.I.403 | D | 2 | 1 | **Organic Chemistry III** | E | 2 | 0 | 2 | 0 | **6** |
| UPB.12.F.04.I.404 | F | 2 | 1 | **Numerical Methods** | V | 2 | 0 | 2 | 0 | **3** |
| UPB.12.C.04.I.405 | C | 2 | 1 | **Advanced Oral Skills for Engineers** | V | 0 | 2 | 0 | 0 | **2** |
| UPB.12.D.04.I.406 | D | 2 | 1 | **Management and Marketing II** | E | 1 | 1 | 0 | 0 | **2** |

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**Physical Chemistry II - Teachers: Catinca SECUIANU; Luisa PILAN**

Physical Chemistry II builds upon the groundwork established in Physical Chemistry I to introduce students to advanced physico-chemical laws governing physical and chemical processes. The course emphasizes three key areas crucial for industrial applications: Chemical Thermodynamics, Chemical Kinetics, and Statistical Thermodynamics.

Chemical Thermodynamics delves deeper into advanced concepts, equipping students with the tools to predict the feasibility and spontaneity of chemical reactions, a critical factor in industrial process design.

Chemical Kinetics explores the study of reaction rates, allowing students to understand the factors that influence the speed of these reactions, another key aspect of optimizing industrial processes. Finally, Statistical Thermodynamics bridges the gap between microscopic and macroscopic properties of matter, providing valuable insights into the behavior of complex chemical systems encountered in industrial settings.

By mastering these areas, students will gain a comprehensive understanding of the physico-chemical principles that underpin various industrial processes. This knowledge is instrumental for the design and optimization of reactors and industrial plants within the chemical and materials industries.

**Organic Chemistry II - Teachers: Anca Liana MARTON; Matei RAICOPOL; Nicoleta CHIRA**

Organic Chemistry II, offered within the Chemical Engineering program specifically for students in the English specialization, builds upon the foundation established in Organic Chemistry I. The course aims to deepen students' knowledge and understanding of core organic chemistry concepts, theories, and methodologies.

Organic Chemistry II emphasizes the importance of this subject as a foundational discipline for further studies in chemical engineering. Students will gain a comprehensive understanding of various classes of organic compounds, along with the associated synthesis methods, physicochemical properties, and the interrelationships between these properties and the chemical transformations undergone by these compounds.

The course fosters the development of valuable critical thinking and problem-solving skills. Students will learn to critically analyze and define problems, develop well-founded hypotheses to guide their approach, design effective experiments to test those hypotheses, and finally, analyze the data obtained from experiments and draw sound conclusions based on their analysis.

Organic Chemistry II also highlights the importance of organic chemistry knowledge in professional communication within the engineering field. By understanding the fundamental concepts and terminology, students will be well-equipped to effectively utilize this knowledge when communicating with colleagues and other professionals.

**Organic Chemistry III - Teacher: Maria-Cristina TODASCA**

Organic Chemistry III ventures into the realm of instrumental methods used to analyze the structure of organic compounds. This course equips students with the knowledge and skills necessary to employ

spectrometric and chromatographic techniques for qualitative and quantitative characterization of organic molecules.

The course contains different issues, such as: Chromatography, Mass spectrometry, IR and FTIR Spectroscopy, UV Spectroscopy, NMR spectroscopy and combined techniques for inducing the students to corroborate data in order to solve complex problems of structure determination.

A cornerstone of the curriculum is the practical application of spectral and chromatographic data. Students will gain proficiency in interpreting this data to elucidate the structure of organic compounds. Particular emphasis is placed on understanding the properties and quantitative relationships that govern the interaction of electromagnetic waves with organic compounds of varying concentrations and purities (both raw materials and final products).

**Applications (Laboratory)**: Generally, follows the same items as the course. Problems are discussed and solved and experimental skills in manipulating equipment are targeted.

Laboratory experiments are an integral part of the course, providing students with hands-on experience in operating analytical instruments specific to organic compound analysis.

**Numerical Methods - Teacher: Claudia IONITA**

The Numerical Methods course bridges the divide between theoretical mathematics and practical engineering applications. Its core objective is to translate complex mathematical equations, often used to model engineering processes, into a form suitable for computer analysis. This allows engineers to obtain practical solutions to these problems using computational tools.

The course and laboratory components work in tandem to achieve this objective. The course equips students with a foundational understanding of key numerical techniques employed in modern engineering practice. This includes in-depth exploration of common engineering problems, along with a comparative analysis of various solution techniques. Additionally, the course emphasizes the importance of error analysis and mitigation strategies to ensure the accuracy of solutions.

The hands-on laboratory component builds upon the theoretical foundation established in the course. Here, students develop the skills necessary to utilize computational tools effectively. Through practical exercises, they gain proficiency in using software specifically designed to solve engineering problems numerically. This fosters the application of these methods to address real-world engineering challenges.

**Advanced Oral Skills for Engineers - Teacher: Doina COMANEȚCHI**

Advanced Oral Skills for Engineers isn't just about communication; it's about refining communication specifically for success in the engineering field. This course targets four key areas that are crucial for engineers to excel in a professional setting:

Firstly, it emphasizes **active reception**, honing students' ability to absorb and comprehend complex technical information, whether presented orally (e.g., during presentations) or in written form (e.g., engineering reports). Developing critical analysis skills allows them to extract key data and insights from various technical sources.

Secondly, the course equips students with the tools to produce **clear and concise communication**, tailored for professional engineering audiences. This encompasses the ability to draft well-structured technical reports, deliver persuasive and informative presentations, and effectively explain complex engineering concepts to both technical and non-technical stakeholders.

Thirdly, the course emphasizes the importance of cultivating a **professional communication style**. This involves using precise language, maintaining objectivity, and adhering to established technical writing conventions. By mastering these aspects, students will ensure clear and unambiguous communication within the scientific and technical context.

Finally, the course acknowledges the importance of **audience awareness and adaptability**. Students will learn to strategically adjust their communication strategies to suit different audiences and contexts. This includes tailoring their communication style to effectively engage with technical specialists, non-technical stakeholders, or a general audience.

By mastering these advanced oral skills, engineers will be well-equipped to collaborate effectively with colleagues, disseminate technical information with clarity and precision, and navigate the complexities of the engineering profession. In essence, this course empowers engineers to become effective communicators within the specialized context of their field.

**Management and Marketing II - Teacher: Ana Maria NEAGU**

Management and Marketing II, offered within the Chemical Engineering program, aims to equip students with an "economic mindset." This course fosters the development of critical and strategic thinking from an economic perspective. The curriculum cultivates two key skills: **Entrepreneurial Decision-Making:** Students will learn to identify and implement entrepreneurial decisions, not only at the microeconomic level (specific to individual businesses) but also with an understanding of the broader macroeconomic landscape; **Effective Resource Management:** The course emphasizes the importance of managing

resources effectively, including materials, human capital, and time. Students will develop the ability to optimize resource allocation to achieve desired outcomes.

By applying these concepts and engaging in discussions surrounding relevant examples, students will develop a solid foundation of economic reasoning and decision-making. These transferable skills can be applied to both professional and personal challenges, empowering graduates to make informed decisions in diverse contexts.

# III$^{rd}$ YEAR

## III$^{rd}$ Year, 1$^{st}$ Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E /V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.D.05.I.401 | D | 3 | 1 | **Organic Chemistry IV** | E | 2 | 0 | 2 | 0 | **4** |
| UPB.12.D.05.I.402 | D | 3 | 1 | **Transfer Processes** | E | 3 | 1 | 2 | 0 | **6** |
| UPB.12.D.05.I.403 | D | 3 | 1 | **Materials Science I** | E | 3 | 0 | 2 | 0 | **5** |
| UPB.12.D.05.I.404 | D | 3 | 1 | **Electrochemistry and corrosion** | V | 2 | 0 | 2 | 0 | **4** |
| UPB.12.S.05.I.405 | S | 3 | 1 | **Reaction mechanisms** | E | 2 | 1 | 0 | 0 | **4** |
| UPB.12.S.05.I.406 | S | 3 | 1 | **Organic Chemistry Technology I** | E | 2 | 0 | 2 | 0 | **5** |
| UPB.12.D.05.I.407 | D | 3 | 1 | **Management and Marketing III** | V | 1 | 1 | 0 | 0 | **2** |

*"E/V" = evaluation form (E=exam in exam session, C or V = semester evaluation) "C" = Lectures (hours/week); "S" = Tutorial; "L" = Labwork; "P" = Project*

**Organic Chemistry IV - Teacher: Matei RAICOPOL**

Organic Chemistry IV, offered within the Chemical Engineering program specifically for students in the English specialization, builds upon the foundation established in previous organic chemistry courses. The course aims to deepen students' knowledge and understanding of core organic chemistry concepts, theories, and methodologies.

Organic Chemistry IV underscores the critical importance of organic chemistry as a foundational discipline for further studies in chemical engineering. Students will gain a comprehensive understanding

of various classes of organic compounds, along with the associated synthesis methods, physicochemical properties, and the interrelationships between these properties and the chemical transformations undergone by these compounds.

The course goes beyond knowledge acquisition by fostering the development of valuable critical thinking and problem-solving skills. Through engaging activities, students will develop their ability to:

- **Critically Analyze and Define Problems:** Students will learn to approach problems in organic chemistry with a discerning eye, clearly defining the issue at hand.
- **Construct Well-Founded Hypotheses:** The course equips students with the skills necessary to formulate sound hypotheses to guide their approach to solving organic chemistry problems.
- **Design Effective Experiments:** Students will gain proficiency in designing experiments that effectively test the hypotheses they have developed.
- **Analyze Data and Draw Sound Conclusions:** The course hones the skills necessary to analyze data obtained from experiments and draw well-supported conclusions based on their analysis.

Furthermore, Organic Chemistry IV highlights the importance of organic chemistry knowledge in professional communication within the engineering field. By understanding the fundamental concepts and terminology, students will be well-equipped to effectively utilize this knowledge when collaborating with colleagues and other professionals.

By achieving these objectives, graduates will possess a robust understanding of organic chemistry, empowering them to excel in further studies and professional careers within the chemical engineering domain.

**Transfer Processes - Teachers: Raluca Daniela ISOPESCU; Paula POSTELNICESCU**

The Transfer Processes course serves as a cornerstone for chemical engineering students. Its primary objective is to introduce students to the fundamental concepts, theories, and models that govern the transport of momentum, heat, and mass within the field of chemical engineering.

This foundational knowledge equips students with the ability to:

- **Identify Transport Mechanisms:** The course emphasizes the key mechanisms that drive the transport of momentum (fluid flow), heat, and mass within chemical processes.
- **Apply Calculation Methods:** Students will gain proficiency in applying appropriate calculation methods to determine critical parameters that characterize fluid flow in chemical plants.

- **Evaluate Heat and Mass Transfer Problems:** By the course's conclusion, students will be able to accurately assess and solve problems related to heat and mass transfer encountered in various industrial processes.

  By mastering these core principles, students will develop a strong foundation for understanding and analyzing various unit operations employed within the chemical process industry. This knowledge is essential for the design, optimization, and troubleshooting of these processes.

**Materials Science I - Teacher: Horia IOVU**

Materials Science I embarks on a captivating exploration of organic and composite materials, substances that are intricately woven into the fabric of our daily lives.

The curriculum delves into a broad spectrum of materials, encompassing naturally occurring organic materials like wood, leather, and rubber, alongside a vast array of synthetic materials. These synthetic materials, including polymers and composites, find applications in diverse fields like space exploration, medicine, transportation, and electronics.

A core focus of the course is understanding composite materials, which are comprised of at least two distinct components: a binder that acts as a matrix holding the composite together, and a reinforcing or filling agent that enhances its properties.

Students will gain a thorough understanding of polymers, the building blocks of many composite materials. The course explores the entire spectrum of polymer matrices used in creating composites, including thermoplastics that soften upon heating for easy processing, thermoset materials that become rigid upon curing, and elastomers prized for their exceptional elasticity.

Furthermore, the course explores the various types of reinforcing materials used in composites, including both organic and inorganic fibers. Students will learn about the synthesis methods for these fibers and the specific advantages of using different fiber types in various applications, from sports equipment like skis to electronic data storage systems.

Finally, the course dedicates a section to the exciting field of polymer composites in controlled drug release systems and other medical and biomedical applications. This highlights the potential of these materials to revolutionize healthcare.

By delving into the world of organic and composite materials, Materials Science I equips students with a foundational understanding of these ubiquitous materials and their applications across diverse fields.

**Electrochemistry and corrosion - Teachers: Danut-Ionel VĂIREANU; Anca COJOCARU**

Aligned with the recommendations of the European Federation of Chemical Societies (FECS) and the International Society of Electrochemistry (ISE) as outlined in the "Eurocurriculum for Electrochemistry," the Electrochemistry and Corrosion course offers a comprehensive exploration of this field, serving as a mandatory component for students pursuing chemical engineering, materials engineering, or materials science.

The course delves into the fundamentals of electrochemistry and its applications, with the core objective of equipping students with a well-rounded skillset. This encompasses a thorough understanding of how to properly utilize electrochemical systems, including their interfaces with both chemical and electrical systems. Students will gain insights into the principles of converting chemical energy into electrical energy and the methods for storing this electrical energy through electrochemical systems.

Beyond theoretical knowledge, the curriculum emphasizes the translation of these concepts into practical applications. Through various exercises and activities, students will develop the skills necessary to implement electrochemistry concepts in real-world scenarios. Furthermore, research activities are integrated within the course to stimulate students' creative thinking and foster a deeper interest in the field of electrochemistry. This encourages them to explore and investigate beyond the core curriculum.

**Reaction mechanisms - Teacher: Daniela ISTRATI**

The Reaction Mechanisms course, offered within the Chemical Engineering program specifically for students in the English specialization, delves into the fascinating world of chemical reaction pathways. This course equips students with the knowledge and tools to understand the "how" and "why" behind chemical reactions, fostering a critical foundation for various chemical engineering disciplines.

The curriculum focuses on familiarizing students with the main approaches, models, and explanatory theories utilized in the field of reaction mechanisms. By mastering these concepts, students will be empowered to not only solve practical problems encountered in chemical engineering but also to stimulate their own learning and further exploration of this captivating field.

This deeper understanding of reaction mechanisms translates into practical benefits for chemical engineers. They will be able to design and optimize chemical processes more effectively, predict reaction outcomes with greater accuracy, and even develop new technologies and catalysts for various applications within the field.

In essence, the Reaction Mechanisms course empowers chemical engineering students to not only understand how chemical reactions occur but also to leverage this understanding for practical applications and future advancements in the field.

**Organic Chemistry Technology I - Teacher: Adrian TRIFAN**

Offered within the Chemical Engineering program specifically for students in the English specialization, Organic Chemistry Technology I delves into the captivating world of organic chemical production. The course aims to familiarize students with the core principles and practical applications involved in transforming raw materials into valuable organic products.

The curriculum focuses on two key areas: understanding the various sources, both renewable and fossil-based, used to obtain raw materials for the organic chemical industry, and exploring the specific concepts and principles applied in the core processes of separation, conversion, and purification. By mastering these concepts, students will gain a comprehensive understanding of how these processes are used to obtain a wide range of hydrocarbons and other essential intermediates used in the organic chemical industry.

This knowledge empowers students to develop a holistic understanding of intermediate production, the various routes and possibilities for obtaining intermediate products within the organic chemical industry, and finished product development, how these intermediates are ultimately transformed into finished organic chemical products. This comprehensive overview fosters the development of critical thinking skills and problem-solving abilities relevant to the organic chemical industry, while also stimulating students' interest in further exploration of this dynamic field.

In essence, Organic Chemistry Technology I equips students with the foundational knowledge necessary to navigate the world of organic chemical production, empowering them to contribute to the development of new sustainable practices and innovative products within this ever-evolving field.

**Management and Marketing III - Teacher: Ana Maria NEAGU**

Management and Marketing III, offered within the Chemical Engineering program, goes beyond traditional engineering curricula by equipping students with financial literacy. This course bridges the gap between engineering and finance, emphasizing the importance of understanding the financial system for informed decision-making.

The core objective is to cultivate a solid understanding of the key elements that make up the financial system. This knowledge empowers students to not only manage financial resources effectively but also to identify and implement sound entrepreneurial decisions. By fostering this financial literacy, the course equips engineers to excel in both professional and personal endeavors.

The curriculum delves into foundational monetary concepts that are crucial for engineers. Students will gain a clear understanding of the functions and importance of money within the economic system. The course explores the dynamic relationship between the supply and demand for money, a key factor influencing economic activity. Furthermore, students will learn about the impact of changes in money supply on inflation and the potential risks associated with inflation.

## III$^{rd}$ Year, II$^{nd}$ Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E / V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.S.06.I.401 | S | 3 | 2 | **Inorganic products** | V | 2 | 1 | 0 | 0 | **2** |
| UPB.12.S.06.I.402 | S | 3 | 2 | **Biochemistry** | E | 2 | 0 | 2 | 0 | **3** |
| UPB.12.S.06.I.403 | S | 3 | 2 | **Organic Chemistry Technology II** | E | 2 | 0 | 2 | 0 | **3** |
| UPB.12.S.06.I.404 | S | 3 | 2 | **Organic Chemistry Technology II-Project** | V | 0 | 0 | 0 | 1 | **1** |
| UPB.12.D.06.I.405 | D | 3 | 2 | **Materials Science II** | E | 3 | 0 | 2 | 0 | **4** |
| UPB.12.S.06.I.406 | S | 3 | 2 | **Macromolecular Compounds I** | E | 3 | 0 | 2 | 0 | **4** |
| UPB.12.S.06.I.407 | S | 3 | 2 | **Hydrodynamic and Thermal Operations** | E | 2 | 1 | 1 | 0 | **3** |
| UPB.12.D.06.I.408 | D | 3 | 2 | **Management and Marketing IV** | V | 1 | 1 | 0 | 0 | **2** |

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**Inorganic products - Teacher: Daniela Simina Stefan**

Offered within the Chemical Engineering program specifically for students in the Foreign Languages program (FILS), Inorganic Products embarks on a captivating exploration of the world of inorganic process and product engineering. This course equips students with the knowledge and tools to excel in this field, fostering a stimulating learning environment that emphasizes practical applications.

The curriculum delves into core concepts and their applications, providing students with a comprehensive understanding of the principles and methods employed for utilizing processes, technologies, and equipment within the inorganic chemical industry. Furthermore, the course explores the established methodological and procedural benchmarks that guide this field, offering students a solid foundation for navigating the complexities of inorganic process and product engineering.

Foundational terminology forms a crucial aspect of the course. Students will gain clear definitions and explorations of concepts such as technology, process, manufacturing stages, unit operations, and various classifications of raw materials, products, and byproducts.

Chemical reactions and catalysis are addressed within the course. Students will explore the concepts of equilibrium and kinetics as they pertain to gas-phase reactions within the inorganic industry. Additionally, they will delve into the fundamentals of catalysis, including the properties of solid catalysts and the mechanisms behind catalytic processes.

**Biochemistry - Teachers: Paul Catalin BALAURE; Nicoleta CHIRA**

Biochemistry, offered within the Chemical Engineering program, delves into the captivating world of biomolecules, the essential building blocks of life. This course equips students with a foundational understanding of biomolecules, fostering a deeper appreciation for their critical roles within living systems.

The curriculum focuses on two key areas: biomolecule diversity and biomolecular properties. Students will gain insights into the various classes of biomolecules, including carbohydrates, proteins, lipids, and nucleic acids. By exploring the unique properties of each class, the course allows students to understand how these molecules function within biological systems.

Furthermore, the course incorporates practical demonstrations to bridge the gap between theory and practice. These hands-on experiences provide students with the opportunity to develop essential laboratory techniques commonly used in biochemistry research. This practical component reinforces the theoretical concepts learned in the classroom, solidifying students' understanding of biomolecular principles.

The knowledge gained in Biochemistry for Chemical Engineers serves as a springboard for comprehending other subjects within the curriculum. A strong understanding of the biochemical processes that underpin living systems is crucial for many areas of chemical engineering.

In essence, this course equips students not only with the knowledge of the fundamental principles of life but also with the practical skills necessary to leverage this knowledge in their future endeavors within the vast field of chemical engineering.

**Organic Chemistry Technology II - Teachers: Adina GAVRILA; Adrian TRIFAN**

Offered within the Chemical Engineering program specifically for students in English, Organic Chemistry Technology II dives deep into the heart of organic chemical production. This course equips students with the knowledge and skills to transform raw materials into valuable organic intermediates, the essential building blocks for a vast array of applications.

The curriculum hinges on two key areas: understanding the main processes used to convert raw materials into desired organic intermediates, such as alkylation, oxidation, and halogenation, and process optimization. By exploring the theoretical foundations of each process, encompassing chemistry, thermodynamics, reaction mechanisms, kinetics, and catalysis, students will gain the ability to establish optimal synthesis conditions.

This combined knowledge empowers students to not only select the most appropriate reactor type for efficient production based on the chosen process and desired outcome, but also to develop basic technological schemes. These schemes integrate their understanding of processes, reaction conditions, and reactor selection to ensure high productivity and selectivity. Recognizing the ever-evolving nature of the organic chemical industry, the course acknowledges the continuous advancements in transforming natural resources like oil, natural gas, and coal into valuable intermediates. This equips students to navigate these evolving technologies and contribute to future innovations.

Organic Chemistry Technology II offers a comprehensive exploration of the field, encompassing both foundational and advanced concepts. This holistic understanding equips students with the methodological and procedural benchmarks necessary to excel in various sectors of the organic synthesis industry, including the production of polymers, dyes, pesticides, and other essential products.

In essence, the course empowers students to become skilled practitioners in the transformation of raw materials, laying the groundwork for their future contributions to the ever-changing world of organic chemical production.

**Organic Chemistry Technology II-Project - Teacher: Adrian TRIFAN**

The Organic Chemistry Technology II Project course, offered within the Chemical Engineering program for English-speaking students, takes a practical approach to reinforce the knowledge gained in Organic Chemistry Technology II. It delves into the essential sources of raw materials for the organic chemical industry, fostering a deeper understanding of the entire production process.

The project focuses on real-world applications, familiarizing students with:

- **Raw Material Sources:** Students will explore both renewable and fossil-based sources used to obtain raw materials for organic chemical production. This understanding is crucial for promoting sustainable practices within the industry.
- **Separation, Conversion, and Purification Processes:** The project delves into the specific concepts and principles applied in these core processes. Students will gain insights into how these processes are used to isolate and purify valuable hydrocarbons and other essential intermediates.

By engaging with these real-world scenarios, students will gain a holistic overview of:

- **Intermediate Production:** The project explores the various routes and possibilities for obtaining intermediate products, the building blocks for various organic chemicals.
- **Finished Product Development:** Students will gain insights into how these intermediates are ultimately transformed into final organic chemical products.

This project-based approach not only stimulates the learning process but also equips students with the knowledge and skills necessary to navigate the complexities of the organic chemical industry. They will be able to critically evaluate potential solutions and propose innovative approaches to real-world problems within this dynamic field.

In essence, the Organic Chemistry Technology II Project Course empowers students to bridge the gap between theoretical knowledge and practical applications, preparing them to become well-rounded chemical engineers who can contribute meaningfully to the sustainable development of the organic chemical industry.

**Materials Science II - Teachers: Adrian VOLCEANOV; Mihai-Alexandru EFTIMIE**

Offered within the Chemical Engineering program for English-speaking students, Materials Science II embarks on a captivating exploration of non-metallic materials. This course equips students with the knowledge and tools to understand the properties and applications of a vast array of materials that play a crucial role in various engineering fields. The curriculum emphasizes a practical approach, fostering a

stimulating learning environment that encourages students to not only grasp the theory but also see its application in solving real-world problems.

A core focus of the course is familiarizing students with the properties of the major non-metallic material families: ceramics, glass, and polymeric materials (plastics) and derived composites. Students will gain insights into the unique characteristics of each material, such as the high refractoriness and electrical insulation capabilities of ceramics, the transparency and thermal conductivity of glass, and the flexibility and lightweight design advantages offered by plastics and their composites.

The course delves deeper by establishing correlations between the microscopic structure of these materials and their macroscopic properties. This fosters a deeper understanding of material behavior as students learn how the arrangement of atoms and molecules within a material influences its overall characteristics.

This course presents the basic principles for understanding structure-property relations in engineering materials. The course assumes a basic knowledge of general physics, general chemistry, and mathematics. With these tools and the subject matter outlined in this course, students will understand modern challenges to applying modern materials. When appropriate, state-of-the-art problems will be discussed to illustrate the structure-property relationship in materials. The student will grasp structure concepts from bonding to microstructure and then learn to consider the interrelationships between structure and property. Properties ranging from mechanical, thermal, electrical, optical, magnetic, and chemical in nature will all be considered. Further, examples will discuss manipulating these structure-property relationships in engineering materials such as ceramics, glasses, composite materials, and nanomaterials.

Several key factors influencing material behavior are explored. Students will examine the concept of molecular order and disorder within materials and how it impacts their properties. Additionally, the course emphasizes the crucial role of a material's structure and inherent defects in influencing its behavior, using classical examples to illustrate these concepts. Particular attention is paid to the mechanical properties of these non-metallic materials. By gaining a strong foundation in this area, students will be well-equipped to make informed decisions in engineering design applications where material selection is critical. Recognizing the rapid advancements in materials science, the course also introduces students to contemporary materials like ceramic nanomaterials and nanocomposites. This exposure to the cutting edge of the field broadens their knowledge base and prepares them for future innovations in material development. By mastering the concepts explored in Materials Science II, students will gain a comprehensive understanding of the vast world of non-metallic materials. This

knowledge empowers them to make informed decisions in various engineering disciplines, fostering the development of new materials with improved performance, durability, and reliability.

**Macromolecular Compounds I - Teachers: Livia Maria BUTAC; Andrada SERAFIM**

Macromolecular Compounds I delves into the fascinating realm of polymerization reactions, a cornerstone of polymer science. This course equips students with a comprehensive understanding of the unique characteristics of these reactions and the resulting macromolecular products, which differ significantly from traditional low-molecular-weight organic compounds.

A core focus lies on the quantitative evaluation methods employed for both additive and condensative polymerization processes. Students will gain the ability to critically analyze and interpret data related to these reactions.

Furthermore, the course explores various polymerization techniques, providing a comparative evaluation of the processes and the resulting polymeric products. This in-depth analysis equips students to select the most appropriate technique for a given desired polymer structure and application.

To solidify this knowledge, the course delves into the key industrial polymeric materials synthesized by two prominent polymerization methods: condensation polymerization and free-radical polymerization. By studying these essential materials, students gain valuable insights into the practical applications of polymer science.

In essence, Macromolecular Compounds I lays a strong foundation for further exploration of the vast and ever-evolving field of polymer science.

**Hydrodynamic and Thermal Operations - Teachers: Tiberiu Dinu DANCIU; Petrica IANCU**

Offered within the Chemical Engineering program, Hydrodynamic and Thermal Operations delves into the core principles that govern the world of chemical processing. This course equips students with the foundational knowledge and tools necessary to navigate fluid flow (hydrodynamics) and heat transfer, both crucial aspects of various unit operations within the chemical engineering industry.

The curriculum emphasizes a practical approach, fostering a stimulating learning environment. Students will gain a comprehensive understanding of the key unit operations employed in chemical processing, particularly those related to fluid flow and heat transfer. These operations form the building blocks of complex chemical processes. Furthermore, the course explores the fundamental theories and models that

underpin both hydrodynamics and heat transfer. By mastering these concepts, students will be able to predict and analyze the behavior of fluids and heat in various scenarios.

To solidify this knowledge and bridge theory to practice, students will gain insights into the design principles applied to specific equipment utilized in chemical processing. This equips them to understand the selection and application of appropriate equipment for different processes.

In essence, Hydrodynamic and Thermal Operations fosters a holistic understanding of the methodological and procedural milestones that are essential for success in chemical engineering. By mastering the concepts explored in this course, students will be well-prepared to analyze, design, and optimize various chemical processes in the future.

**Management and Marketing IV - Teacher: Ana Maria NEAGU**

Management and Marketing IV, offered within the Chemical Engineering program, takes a unique approach by venturing beyond traditional engineering curricula. This course equips students with the knowledge and skills necessary to thrive in the dynamic world of entrepreneurship. It fosters an entrepreneurial mindset, guiding them through the entire process of transforming an initial business idea into a complete and implemented project.

The curriculum emphasizes the importance of economic thinking, allowing students to develop a holistic understanding of how to identify and capitalize on entrepreneurial opportunities. They will learn how to effectively manage financial resources and make sound business decisions, fostering success not only at the macro but also at the microeconomic level.

Students will delve into the core concepts of entrepreneurship, gaining a comprehensive understanding of the journey from identifying a promising business idea to its successful implementation. Marketing essentials form a crucial component of the course. Students will explore consumer behavior, target market selection, distribution strategies, promotion techniques, and pricing considerations. By mastering these concepts, they will be well-equipped to develop effective marketing plans for their ventures.

# IV$^{th}$ YEAR

## IV$^{th}$ Year, 1$^{st}$ Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E / V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.S.07.I.401 | S | 4 | 1 | **Mass Transfer Operations** | E | 3 | 1 | 1 | 0 | **5** |
| UPB.12.S.07.I.402 | S | 4 | 1 | **Mass Transfer Operations-Project** | V | 0 | 0 | 0 | 1 | **1** |
| UPB.12.S.07.I.403 | S | 4 | 1 | **Macromolecular Compounds II** | E | 3 | 0 | 0 | 1 | **5** |
| UPB.12.D.07.I.404 | D | 4 | 1 | **Management and Marketing V** | V | 1 | 1 | 0 | 0 | **2** |
| PACHET OPTIONALE I (2024-2025; 2026-2027 academic years): | | | | | | | | | | |
| UPB.12.S.07.O.401 | S | 4 | 1 | **Polymer Physics** | E | 3 | 0 | 3 | 0 | **6** |
| UPB.12.S.07.O.402 | S | 4 | 1 | **Technologies of Polymer Synthesis** | E | 3 | 0 | 3 | 0 | **6** |
| UPB.12.S.07.O.403 | S | 4 | 1 | **Biopolymers and Biocomposites** | E | 2 | 0 | 2 | 0 | **5** |
| PACHET OPTIONALE II (2025-2026; 2027-2028 academic years): | | | | | | | | | | |
| UPB.12.S.07.O.401 | S | 4 | 1 | **Chemistry and Technologies of Pesticides** | E | 2 | 0 | 2 | 0 | **5** |
| UPB.12.S.07.O.402 | S | 4 | 1 | **Chemistry and Technologies of Cosmetic Products** | E | 2 | 0 | 1 | 0 | **3** |
| UPB.12.S.07.O.403 | S | 4 | 1 | **Synthetic Drugs** | E | 2 | 0 | 3 | 0 | **5** |
| UPB.12.S.07.O.404 | S | 4 | 1 | **Dyes and Pigments** | V | 2 | 0 | 2 | 0 | **4** |

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**Mass Transfer Operations - Teachers: Petrica IANCU; Tiberiu Dinu DANCIU**

Offered within the Chemical Engineering program specifically for English-speaking students, Mass Transfer Operations delves into the heart of a fundamental concept: the movement of matter within a system. This course equips students with a comprehensive understanding of the key concepts, models, and theories that govern mass transfer phenomena. By mastering these principles, students will be able to solve practical problems and design efficient processes encountered in various engineering applications.

The curriculum emphasizes a strong foundation in the core fundamentals of mass transfer. Students will gain a solid understanding of the basic theories, concepts, and principles that underpin this crucial field. This foundational knowledge paves the way for deeper exploration of the subject matter.

A core focus lies on property calculations for pure compounds and mixtures. The course emphasizes the importance of these calculations as they are directly applied to mass and heat balances, a critical skill for various mass transfer operations. By mastering these calculations, students will be well-equipped to tackle complex problems encountered in the field.

Mathematical modeling forms another cornerstone of the curriculum. Students will delve into the mathematical models used to describe mass transfer processes. By understanding these models, they will be equipped to design specific equipment tailored for optimal performance within chemical process plants. This empowers them to not only analyze existing processes but also to contribute to the development of innovative solutions in the future.

The course also provides an overview of the different types of equipment found in chemical process plants. Students will gain insights into the operation modes of this equipment, fostering a holistic understanding of chemical engineering processes. This exposure to real-world applications bridges the gap between theory and practice, solidifying their grasp of the subject matter.

This comprehensive approach to mass transfer operations not only equips students with the necessary problem-solving skills but also stimulates their learning process. By the end of the course, they will have a strong foundation for success in various chemical engineering endeavors, including process design, plant operation, and further academic pursuits.

**Mass Transfer Operations-Project - Teacher: Petrica IANCU**

The Mass Transfer Operations Project, offered within the Chemical Engineering program specifically for English-speaking students, takes a practical approach to solidify student understanding of mass transfer phenomena. This project delves into the design of equipment and plants where these principles play a crucial role. By engaging in this project, students will:

- **Apply Design Methods:** Move beyond theoretical knowledge and gain hands-on experience with design methods for equipment and plants utilized in mass transfer processes. This equips them with the practical skills necessary for future engineering endeavors.

- **Distillation Column Design:** The project focuses specifically on applying learned mass transfer principles to the design of rectification columns. These columns are essential for separating homogeneous mixtures of substances, a fundamental process in the chemical industry.
- **Chemical Process Plant Insights:** Through the design process, students will gain valuable insights into the dimensions and operation modes of equipment commonly found in chemical process plants. This fosters a holistic understanding of how mass transfer principles translate into real-world applications.

This project-based approach not only stimulates the learning process but also empowers students to bridge the gap between theoretical knowledge and practical applications. By successfully completing the project, they will graduate with a deeper understanding of mass transfer operations and the confidence to tackle design challenges within the chemical engineering industry.

**Macromolecular Compounds II - Teacher: Livia Maria BUTAC**

Macromolecular Compounds II builds upon the foundation established in the first course, propelling students deeper into the captivating realm of advanced polymer science. This course equips them with a comprehensive understanding of various cutting-edge polymerization techniques and their diverse applications.

The curriculum delves into the mechanisms and applications of ionic polymerization, a powerful technique for synthesizing a broad spectrum of polymers with precisely controlled structures. Students will explore the concept of copolymerization, where two or more unique monomers are combined to create polymers with properties tailored for specific functionalities. Additionally, the course sheds light on various strategies for chemically modifying existing polymers to enhance their performance and broaden their applicability.

Understanding the mechanisms of polymer degradation is crucial, and the course equips students with this knowledge to optimize polymer stability and ensure material longevity in various applications. To fully characterize these complex materials, the course emphasizes the importance of analytical techniques such as spectroscopy methods (e.g., Infrared (IR) spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy). By mastering these techniques, students gain the ability to determine the structure and properties of polymers with precision.

Macromolecular Compounds II culminates in a project-based learning experience that bridges the gap between theory and practice. Students are tasked with designing a functional technological flow for a pilot or industrial plant. This project encompasses:

- **Process Design:** Students will demonstrate their ability to design a technological flow, essentially a roadmap outlining the key steps involved in the polymer production process.
- **Capacity Calculations:** They will learn to calculate the production capacity of the designed plant, ensuring it meets desired output levels.
- **Material and Thermal Balances:** Performing material and thermal balance calculations is crucial for optimizing resource utilization and maintaining process stability. Students will gain hands-on experience with these essential calculations.

By successfully completing Macromolecular Compounds II, students will graduate with a comprehensive understanding of advanced polymerization techniques, polymer characterization methods, and process design principles. This equips them not only to analyze existing polymer materials but also to contribute to the development of novel and innovative polymers for various applications in the future.

**Management and Marketing V - Teacher: Dumitru Radu STANCIU**

Management and Marketing V, offered within the Chemical Engineering program, takes a strategic approach to empower future engineers by equipping them with the knowledge and tools necessary to thrive in their careers.

This course delves into the critical role of management in engineering endeavors, fostering a comprehensive understanding of why management skills are essential for success. Students will learn how effective management practices contribute to project completion, resource optimization, and team performance. Recognizing the importance of clear communication within the business world, the course emphasizes mastering the scientific vocabulary specific to the domain of management. By expanding their terminology, students will be well-equipped to communicate effectively with colleagues and stakeholders.

This equips them to navigate the technical and economic landscape with confidence. The course provides a solid foundation in basic technical and economic notions, allowing students to understand the financial and technical aspects of engineering projects, empowering them to make informed decisions. Furthermore, Management and Marketing V equips students with a practical toolkit. They will gain

familiarity with a variety of essential management tools, fostering their ability to effectively plan, organize, and execute projects, ensuring optimal outcomes.

By successfully completing this course, students will bridge the gap between engineering expertise and business acumen. They will graduate with a well-rounded skillset that prepares them not only to solve complex engineering problems but also to navigate the complexities of the professional world and contribute meaningfully to the success of their organizations.

**PACHET OPTIONALE I (valid for 2024-2025; 2026-2027 academic years):**

**Polymer Physics - Teacher: Livia Maria BUTAC**

Polymer processing courses embark on a captivating exploration of these versatile materials, equipping students with the knowledge and skills to transform them into a vast array of products. The journey begins with establishing a strong foundation in polymers themselves. Students will delve into the unique mechanical, thermal, and dielectric properties that set polymers apart from other materials. Understanding these distinctive characteristics is crucial for selecting the most suitable polymer for a specific application. The course also examines the factors that have propelled polymers to become such dominant materials in the marketplace, highlighting their versatility and unique advantages.

The focus then shifts to characterizing polymers, a crucial aspect of both processing and product development. Students will explore various techniques for analyzing the behavior of polymers in solution. These techniques provide valuable insights into the molecular properties of the polymers, with direct applications not only for practical use in processing but also for understanding the fundamental properties at the molecular level. This holistic approach bridges the gap between theory and practice.

Some examples of polymer characterization techniques include gel permeation chromatography (GPC), which separates and analyzes polymer chains based on their size, providing information about molecular weight distribution. Light scattering is another method used to determine the size and shape of polymer molecules in solution. Additionally, viscometry, by measuring the viscosity of a polymer solution, can provide information about the molecular weight and size of the polymer.

By successfully completing a polymer processing course, students will gain a comprehensive understanding of polymers as materials, their unique properties, and the techniques used to characterize them. This knowledge empowers them not only to select and process polymers effectively but also to contribute to the development of innovative polymeric materials for the future.

**Technologies of Polymer Synthesis - Teacher: Celina Maria DAMIAN**

The Technologies of Polymer Synthesis course ventures into the heart of polymer engineering, equipping students to design, synthesize, and characterize novel polymeric materials for specialized applications. This course bridges the gap between theory and practice, fostering a comprehensive understanding of how to tailor polymer structure and properties to meet specific needs.

The curriculum delves into the fundamental principles of designing polymeric materials. Students will explore the correlation between synthesis technology, polymer structure, and desired properties. Key considerations include aspects like synthesis reactions, structure formation, mechanical behavior, wear resistance, and recyclability.

Furthermore, the course delves into the various mechanisms governing polymerization reactions, placing them in the context of different synthesis technologies. This knowledge empowers students to select the most appropriate technique for a given desired polymer structure. Students will gain a comprehensive understanding of the particularities associated with different polymerization technologies, including exploring the advantages, disadvantages, costs, and types of applications associated with each technique. Through this exploration, they will develop a critical lens for selecting the most suitable technology for a specific purpose.

Complementing the theoretical foundation, the laboratory component provides hands-on experience in synthesizing and characterizing polymers and copolymers relevant to industrial applications. This practical experience solidifies student understanding of the concepts explored in the course and hones their technical skills.

Beyond technical expertise, both the course and laboratory activities aim to cultivate the ability to work effectively in multidisciplinary fields. This prepares students to become well-rounded specialists who can thrive in collaborative environments, contributing to advancements in polymer engineering and the development of innovative materials for the future.

By successfully completing this course, students will graduate with a deep understanding of polymer synthesis technologies, along with the practical skills necessary to design and create novel polymeric materials for a wide range of applications.

**Biopolymers and Biocomposites - Teacher: Adriana LUNGU**

The Biopolymers and Biocomposites course, offered within the Chemical Engineering program specifically for English-speaking students, explores the captivating world of bio-based materials. This

course equips students with a comprehensive understanding of both natural and synthetic biopolymers and biocomposites, emphasizing their utilization in developing products for diverse applications.

A significant focus lies on natural polymers, highlighting their origin from renewable resources. Students will delve into the fascinating interplay between a polymer's source and its function. For instance, the course explores how proteins act not only as structural components within cells but also as catalysts and signaling molecules. Polysaccharides, another class of natural polymers, will be investigated in the context of their role in intracellular communication, cell surface recognition, and their contribution to cell wall structure.

The course underscores the numerous advantages associated with bio-based polymers. These advantages include:

- **Sustainable Synthesis and Processing:** Biopolymers offer a more environmentally friendly alternative to traditional materials, often requiring less energy-intensive processing methods.
- **Enhanced Recoverability and Recyclability:** The course explores the potential for recovering and recycling bio-based materials, further contributing to their sustainable nature.
- **Biodegradability:** A critical advantage of biopolymers is their inherent biodegradability, which minimizes their environmental impact at the end of their useful life.

By successfully completing this course, students will graduate with a thorough understanding of biopolymers and biocomposites, along with their potential for sustainable material development. This knowledge equips them to contribute to advancements in this exciting field and the creation of innovative materials with a reduced environmental footprint.

**PACHET OPTIONALE II (valid for 2025-2026; 2027-2028 academic years):**

**Chemistry and Technologies of Pesticides - Teacher: Paul Catalin BALAURE**

The Chemistry and Technologies of Pesticides course underscores the crucial role of organic chemistry within the Chemical Engineering field. This specialized course, focusing on organic chemistry, emphasizes its practical applications and socio-economic importance in tackling the complex challenges facing humanity in the 21st century. These challenges encompass ensuring food safety, environmental protection, public health, and overall quality of life.

The course highlights the necessity for collaboration between organic chemists and specialists from diverse fields like biochemistry, toxicology, medicine, and genetic engineering. This collaborative

approach is paramount for developing effective solutions to combat pests. The course emphasizes the design and synthesis of novel pest control compounds that meet the following critical criteria:

- **Environmental Stability:** The pesticides must resist degradation by environmental factors long enough to penetrate the target organism.
- **Targeted Action:** Once within the target organism, the compound must be transported and interact optimally with the specific molecular structures responsible for the pest's survival. This targeted interaction triggers the organism's response and the desired toxic effect.
- **Selective Toxicity:** An ideal pesticide exhibits selective toxicity, effectively eliminating the target pest without harming beneficial organisms within the ecosystem.
- **Environmental Sustainability:** Minimizing harm to the environment is paramount. The course emphasizes the development of pesticides that degrade readily and do not pose long-term environmental risks.
- **Resistance Management:** The emergence and development of resistance in pest populations is a significant challenge. The course explores strategies for designing pesticides that minimize the likelihood of resistance development.
- **Economic Feasibility:** Cost-effective production and formulation are essential for ensuring the affordability and accessibility of these pest control solutions.

The course goes beyond its overarching goal of addressing contemporary challenges by establishing specific learning objectives:

- **Pesticide Fundamentals:** Students will gain a comprehensive understanding of pesticides, including their definition, classification based on various criteria, mode and mechanism of action, commercial product formulations, economic significance, and safe use practices.
- **Modern Pesticide Classes:** The course provides an up-to-date exploration of the major pesticide classes. This exploration encompasses the mechanism of action, chemical structure, modern synthesis methods with industrial applicability, and key physicochemical and toxicological characteristics of each class.

By successfully completing this course, students will gain a thorough understanding of the critical role organic chemistry plays in developing sustainable solutions for pest control. This knowledge equips them to contribute to advancements in this vital field and the creation of novel pesticides that address contemporary challenges while safeguarding human health and the environment.

**Chemistry and Technologies of Cosmetic products - Teacher: Brindusa BALANUCA**

The Chemistry and Technologies of Cosmetic Products course delves into the fascinating world of cosmetics, exploring the scientific principles that underpin their development and function. This course equips students with a comprehensive understanding of the various ingredients used in cosmetics and the technologies employed in their formulation and production.

**Demystifying the Ingredients:**

The course begins by delving into the building blocks of cosmetics. Students will explore a range of chemical compounds, including:

- **Water:** The foundation of most cosmetic products, water plays a crucial role in their texture and application.
- **Emulsifiers:** These essential ingredients facilitate the blending of oil and water-based components, ensuring a smooth and stable product.
- **Preservatives:** To prevent spoilage and ensure product safety, preservatives are carefully selected and incorporated.
- **Thickeners and Gelling Agents:** These ingredients control the viscosity and consistency of cosmetics, creating a desirable user experience.
- **Moisturizers:** Essential for maintaining skin hydration, moisturizers come in various forms and functions.
- **Colors and Fragrances:** From pigments to dyes and essential oils to synthetic fragrances, these components add aesthetic appeal to cosmetic products.

By successfully completing this Chemistry and Technologies of Cosmetic Products course, students will gain a well-rounded understanding of the scientific foundation of cosmetics. This knowledge equips them to pursue careers in the cosmetic industry, from product development and formulation to quality control and regulatory affairs. They will graduate with the ability to appreciate the science behind the beauty and functionality of cosmetic products.

**Synthetic Drugs - Teachers: Daniela ISTRATI**; **Anca Liana MARTON**

The Synthetic Drugs course, offered within the Chemical Engineering program specifically for English-speaking students, delves into the captivating realm of fine synthesis - the intricate science behind creating life-saving medications. This course underscores the critical role of Chemical Engineering in this vital field, a field that has profoundly shaped the modern world.

Synthetic Drugs serves as a cornerstone, bridging the gap between theory and practice. By showcasing the practical applications of the fundamental and domain-specific chemical processes explored throughout the curriculum, the course ignites student interest in the transformative power of chemical engineering.

Furthermore, by delving into the world of synthetic drugs, the course empowers students to make informed decisions about their future careers. They gain a deeper understanding of the exciting opportunities within this top field, a field that is constantly seeking talented individuals who possess the following intellectual capacities:

- **Problem-solving:** The ability to assess complex problems and develop creative solutions is essential.
- **Hypothesis Building:** Formulating strong hypotheses to guide research and development is a crucial skill.
- **Experimental Design:** Designing effective experiments to test hypotheses and gather meaningful data is a cornerstone of scientific exploration.
- **Data Analysis:** Drawing accurate and insightful conclusions from experimental data is essential for progress.

Beyond traditional textbook learning, the course provides students with a glimpse into the real-world challenges and triumphs of synthetic drug development. This exposure fosters a profound appreciation for the impact of this field on human health and well-being.

By successfully completing Synthetic Drugs, students will graduate with a deeper understanding of the fascinating world of fine synthesis. This knowledge, coupled with the problem-solving skills honed throughout the course, equips them to become valuable contributors to the ongoing development of life-saving medications. They will be prepared to embark on fulfilling careers within the ever-evolving field of Chemical Engineering.

**Dyes and Pigments - Teacher: Stefan Theodor TOMAS**

The "Dyes and Pigments" course offers a comprehensive exploration of these fascinating materials, equipping students with a deep understanding of both organic dyes and pigments.

The course delves into the complexities of color and color vision, providing a strong foundation for appreciating the world of dyes and pigments. Students will explore the fundamental principles of how we perceive color and the mechanisms behind color creation. The curriculum delves into the vast array of organic dyes, focusing on the major classes that hold significant scientific and practical interest. Students

will explore the diverse applications of these dyes across various substrates, gaining valuable insights into their practical uses.

The course recognizes the importance of responsible dye use. Students will explore the potential toxicity associated with certain dyes and gain knowledge of best practices for minimizing pollution and ensuring safe use. They will also learn about non-conventional applications of dyes, including their use in food, cosmetics, biology, data recording, and electronics.

The course is complemented by a series of laboratory syntheses, providing students with hands-on experience in creating dyes. Through these experiments, students will gain a practical understanding of the reaction sequences involved in dye production. The focus of the laboratory component is to cultivate meticulous technique in each reaction step, ensuring optimal yield and high product purity.

The course progresses beyond dye synthesis, exploring the optimization of reactions to maximize yields for specific target dye molecules. Students will gain insights into selecting the most efficient technologies and reaction pathways for specific dye production processes. The course emphasizes the crucial role of aromatic chemistry in dye production. Students will explore the various methods for introducing different substituent groups onto aromatic compounds, as well as the interconversion of these groups and the transformation of different functional groups. Understanding the reaction mechanisms behind these transformations provides a deeper understanding of the underlying chemistry.

By the end of the course, students will have gained a comprehensive picture of the modern aromatic intermediates, dyes, and pigments industry. This knowledge equips them to navigate this dynamic field and potentially pursue careers in related sectors.

## IV$^{th}$ Year, 2$^{nd}$ Semester

| Cod disciplina | F/D/ S/C | An | Sem | Denumire disciplina | E / V | C | S | L | P | Credite |
|---|---|---|---|---|---|---|---|---|---|---|
| UPB.12.S.08.I.401 | S | 4 | 2 | **Modelling and Design of Chemical Reactors** | V | 3 | 2 | 0 | 1 | **6** |
| UPB.12.D.08.I.402 | D | 4 | 2 | **Management and Marketing VI** | V | 1 | 1 | 0 | 0 | **2** |
| PACHET OPTIONALE I (2024-2025; 2026-2027 academic years): | | | | | | | | | | |
| UPB.12.S.08.O.401 | S | 4 | 2 | **Polymer Processing** | V | 3 | 0 | 2 | 0 | **5** |
| UPB.12.S.08.O.402 | S | 4 | 2 | **Industrial Polymeric Materials** | V | 3 | 0 | 2 | 0 | **5** |
| UPB.12.S.08.O.403 | S | 4 | 2 | **Adhesives and Surface Coatings** | V | 2 | 0 | 1 | 0 | **3** |
| UPB.12.S.08.O.404 | S | 4 | 2 | **Polymer Recycling** | V | 2 | 0 | 1 | 0 | **3** |
| PACHET OPTIONALE II (2025-2026; 2027-2028 academic years): | | | | | | | | | | |
| UPB.12.S.08.O.401 | S | 4 | 2 | **Petrochemical and Carbochemical Technologies** | V | 2 | 0 | 1 | 0 | **3** |
| UPB.12.S.08.O.402 | S | 4 | 2 | **Tensioactive Compounds** | V | 2 | 0 | 2 | 0 | **4** |
| UPB.12.S.08.O.403 | S | 4 | 2 | **Catalysis in Organic and Petrochemical Industry** | V | 2 | 0 | 2 | 0 | **4** |
| UPB.12.S.08.O.404 | S | 4 | 2 | **Natural Products** | V | 2 | 0 | 1 | 0 | **3** |
| UPB.12.S.08.O.405 | S | 4 | 2 | **Depollution in Organic and Petrochemical Industries** | V | 2 | 0 | 0 | 0 | **2** |

*"E/V" = evaluation form (E=exam in exam session, C or V = semester evaluation) "C" = Lectures (hours/week); "S" = Tutorial; "L" = Labwork; "P" = Project*

**Modelling and design of chemical reactors - Teachers: Vasile LAVRIC; Romuald GYORGY**

The Modeling and Design of Chemical Reactors course equips students with the fundamental knowledge and skills necessary to understand, design, and optimize these critical industrial workhorses. The course delves into the core concepts, theories, and models that govern the behavior of chemical reactors.

**Building a Strong Foundation:** The course begins by emphasizing the fundamental interplay between the flow characteristics of reactants within a reactor and its overall performance. Students will strengthen their knowledge of key concepts and basic theories, fostering a solid understanding of this crucial relationship. This foundation empowers students to tackle a wide range of chemical reaction problems.

**Problem-Solving Tools:** The curriculum equips students with the essential tools and methods needed to solve problems related to chemical processes across various scales. These problems range from simple, single reactors to complex networks of reactors employed in industrial, pilot, or laboratory settings. Students will gain valuable insights into the role and function of chemical reactors within larger industrial plants and installations.

**Dynamic Control and Optimization:** The course progresses to explore how various operating parameters can influence a reactor's performance over time and space. Students will gain an understanding of how these parameters can be controlled and manipulated to optimize the performance of a single reactor or an entire network of reactors. This optimization is achieved through the use of appropriate performance metrics, allowing students to evaluate the effectiveness of different strategies.

**Navigating Complexity:**The course acknowledges the inherent complexity of heterogeneous chemical processes. Students will learn how to quantify this complexity based on the time and space scales involved, and how these factors influence reactor performance. By applying the principles of chemical engineering, students will develop the ability to analyze and address this complexity effectively.

**Beyond the Classroom:** By successfully completing the Modeling and Design of Chemical Reactors course, students will graduate with a comprehensive understanding of these essential industrial components. They will possess the knowledge and skills necessary to design reactors, optimize their performance, and contribute to advancements in the chemical engineering field. This knowledge equips them to play a vital role in developing and implementing efficient and optimized chemical processes across various industries.

**Management and Marketing VI - Teacher: Olga BUCOVEȚCHI**

Management and Marketing VI delves into the intricate world of industrial management, equipping students with a comprehensive understanding of how businesses operate and compete within the global marketplace.

The course establishes a strong foundation by exploring various industrial management concepts, principles, and methods. This in-depth exploration encompasses research and development, a crucial driver of innovation and competitive advantage. Students will also gain insights into operations management, the efficient planning, scheduling, and control of production processes to ensure smooth operation. Techniques for predicting future demand and market trends, known as forecasting, are explored, equipping students to make informed business decisions. Scheduling, the optimization of

production schedules for efficiency and on-time delivery, is also a key focus area. Maintaining consistently high product quality is paramount, and the course explores methods for achieving this through quality assurance practices.

Understanding how to effectively recruit, train, and manage a skilled workforce is crucial for success. The course delves into human resources management, providing students with the knowledge to navigate this critical aspect of any organization. Furthermore, effective financial management, including budgeting and risk assessment, is foundational for any business. Management and Marketing VI equips students with the knowledge of finance and accounting management practices. Finally, students will gain valuable knowledge of marketing, sales, and distribution strategies through an exploration of commercial management.

The course emphasizes the practical application of these concepts. Students will analyze real-world business situations, using their newfound knowledge to make informed decisions regarding decision making and risk assessment. The course equips students with the tools necessary to analyze complex situations and choose the optimal path forward, while also learning to identify, evaluate, and mitigate potential risks within the business environment.

**PACHET OPTIONALE I (valid for 2024-2025; 2026-2027 academic years):**

**Polymer Processing - Teacher: Cătălin ZAHARIA**

Polymer Processing offers a captivating exploration of transforming raw materials into the vast array of polymer products we encounter in daily life. This course bridges the gap between the science of polymer chemistry and its practical applications within the macromolecular compounds industry.

The course emphasizes that polymer processing represents the final step in a polymer's life cycle, transforming it from a raw material into the finished goods used across various sectors. Students will gain a comprehensive understanding of the design and manufacturing processes involved in creating these polymer products.

A core focus of the course is the crucial interplay between material selection and processing techniques. Students will explore how to choose the most appropriate polymer materials for specific applications. This selection considers factors such as the desired engineering properties of the finished product. The course explores the engineering properties of various polymer types, including elastomers, thermoplastics, blends, composites, and specialty polymers. Students will learn how these properties influence processing characteristics and ultimately the performance of the final product.

To transform polymers, the course provides a detailed exploration of various industrial processing operations. These methods include milling (reducing polymer materials into smaller particles), calendaring (flattening and shaping polymer sheets), extrusion (continuously forcing molten polymers through a shaped die to create specific shapes), fiber spinning (producing long, thin fibers from molten polymers), molding (shaping molten or semi-molten polymers into desired forms using molds), and mixing (combining different polymers or additives to achieve specific properties).

The course incorporates a design component, challenging students to apply their newfound knowledge. Students will be tasked with selecting appropriate materials and processing methods for a specific engineering application. This practical exercise reinforces the importance of tailoring the polymer processing approach to the desired end product.

By successfully completing Polymer Processing, students will graduate with a comprehensive understanding of this critical field. They will possess the knowledge and skills necessary to make informed decisions regarding material selection, processing techniques, and product design. This equips them to pursue rewarding careers within the ever-evolving macromolecular compounds industry.

**Industrial Polymeric Materials - Teachers: Ionut-Cristian RADU; Cătălin ZAHARIA**

The success of polymeric materials in various applications rests heavily on their inherent properties. Industrial Polymeric Materials delves into the critical relationship between a material's potential and its performance in the real world. The course bridges this gap by exploring the crucial role of additives and standardized property characterization. The course delves into the world of additives within the polymer processing industry. These additives act as the bridge between the potential of a polymer and its ability to meet the demands of specific applications. Students will explore various classes of additives, each playing a specific role in enhancing performance:

- Plasticizers enhance flexibility and processability, making the material easier to work with.
- Stabilizers protect polymers from degradation during processing and use, ensuring they maintain their integrity.
- Lubricants minimize friction during processing, improving flow characteristics.
- Fillers and reinforcements modify mechanical properties, such as strength and stiffness, to meet specific engineering requirements.
- Curing agents are essential for thermosetting polymers, initiating the cross-linking process that defines their final properties.

- Compatibilizers, in polymer blends, promote good dispersion and interaction between different polymer types, creating a more uniform material.

Selecting the right additives is a critical decision. The course emphasizes the importance of considering several factors:

- Modern Industry Requirements: Students gain insights into the latest trends and advancements in additive technology, ensuring their knowledge is current and relevant.
- Environmental Considerations: Environmentally friendly additives are increasingly important, and the course explores sustainable options that minimize environmental impact.
- Human Health and Safety: Potential health and safety concerns associated with certain additives are addressed, ensuring responsible selection.
- Global Market Trends: The course explores how global market forces can influence the availability and cost-effectiveness of different additives.

The course also explores the realm of physico-mechanical characterization, a set of standardized tests used in quality control laboratories. These tests act as a window into the true potential of a polymeric material by quantifying its key properties:

- Mechanical Strength: The ability of a material to withstand stress without failure.
- Thermal Properties: Behavior of the material under varying temperatures.
- Electrical Properties: Conductivity and other electrical characteristics.
- Chemical Resistance: The material's ability to withstand exposure to specific chemicals.

By incorporating a design component, the course challenges students to apply their newfound knowledge. Students will be tasked with selecting appropriate additive classes and processing methods for a specific engineering application. This practical exercise reinforces the importance of tailoring the material properties to the desired end product.

By successfully completing Industrial Polymeric Materials, students will graduate with a deep understanding of the intricate relationship between additives, property characterization, and the ultimate success of polymeric materials. They will possess the knowledge and skills to select appropriate additives, interpret characterization data, and design polymeric materials for a wide range of applications within the ever-evolving polymer industry.

**Adhesives and Surface Coatings - Teacher: Livia Maria BUTAC**

Adhesives and Surface Coatings delves into the fascinating world of materials that hold our world together, literally and figuratively. This course offers a comprehensive exploration of the main classes of adhesives and surface coatings, examining their properties, functions, and the science behind their effectiveness.

The course begins by unraveling the diverse landscape of adhesives. Students will gain a thorough understanding of the various classifications, such as high-strength structural adhesives used in critical applications, pressure-sensitive adhesives found in common tapes and labels, hot melt adhesives activated by heat, and environmentally friendly water-based adhesives. Moving beyond classification, the course explores the fundamental principles of adhesion, the invisible force that allows adhesives to form strong bonds with surfaces. Students will delve into the interplay of various factors such as surface chemistry and mechanical interlocking, gaining a deeper appreciation of how these materials function.

To fully understand adhesive performance, the course equips students with knowledge of the chemical composition of different adhesive types. This includes exploring polymers, the backbone of many adhesives, which provide strength and flexibility. Resins, acting as binding agents, hold the adhesive together and ensure it adheres effectively to the target surface. Fillers are incorporated to modify properties like viscosity or add volume at a lower cost, while additives can enhance specific properties such as flexibility, heat resistance, or shelf life.

By successfully completing Adhesives and Surface Coatings, students will graduate with a comprehensive understanding of these essential materials. They will possess the knowledge and skills to select appropriate adhesives and coatings for various applications, ensuring optimal performance and aesthetics. This knowledge equips them for careers in diverse fields, from manufacturing and construction to product design and material science.

**Polymer Recycling - Teacher: Celina Maria DAMIAN**

For chemical engineers, understanding the environmental impact of synthetic polymers is crucial. This course, Polymer Recycling, delves into this critical topic, exploring the far-reaching consequences of these materials as pollutants in water, soil, and air.

**An Interdisciplinary Approach:** The course emphasizes the importance of an interdisciplinary approach. Students will explore the release and exposure pathways of synthetic polymers, considering

factors from various scientific fields. This holistic perspective fosters a deeper understanding of the long-term impact of these materials on our environment.

**From Waste to Resource:** The course equips students with the knowledge and skills necessary to navigate the field of polymer recycling and the circular economy. A core focus is on the concept of sustainability, emphasizing the development and utilization of materials and techniques that minimize environmental impact.

**Reintegration and Applications:** A critical component of the course is understanding the degree of integration of recycled polymers back into the process industry. Students will explore various sectors, including construction, aeronautics, and the varnishes and paints industry, gaining insights into how recycled polymers are finding new life in diverse applications.

**Knowledge for Action:** Recent advancements in our understanding of polymer behavior and environmental impact inform this course. By studying these characteristics and effects, students are empowered to identify areas where recycling techniques can be rapidly developed and improved. This knowledge equips them to mitigate the risks associated with polymer pollution.

**Regulatory Landscape:** The course recognizes the importance of regulatory frameworks within the process industry where polymers are utilized. Students will gain knowledge of relevant regulations, ensuring they possess a comprehensive understanding of the legal landscape surrounding polymer use and recycling.

By successfully completing Polymer Recycling, students will graduate with a well-rounded understanding of the challenges and opportunities associated with synthetic polymers. They will possess the knowledge and skills to contribute to a more sustainable future, promoting responsible waste management and the development of innovative recycling technologies within the chemical engineering field.

**PACHET OPTIONALE II (valid for 2025-2026; 2027-2028 academic years):**

**Petrochemical and Carbochemical Technologies - Teacher: Adina GAVRILA; Adrian TRIFAN**

The ever-evolving world of petrochemical and coal-chemical processing forms the heart of this course. Students will embark on a captivating exploration of the technological processes that transform natural resources like oil, natural gas, and coal into the essential building blocks for various industries.

The course delves into the most crucial technologies employed in processing these natural resources. Students will gain a comprehensive understanding of how these processes yield valuable hydrocarbons and other raw materials used in organic synthesis.

Providing a strong foundation, the course explores both the chemistry and technology involved in synthesizing a wide range of products derived from coal and petrochemicals. Students will discover how these raw materials are transformed into essential components used in diverse fields such as the polymer industry, the production of dyes for various applications, and the responsible creation of pesticides.

Designed specifically for students pursuing a specialization in Chemical Engineering, this course equips them with the fundamental knowledge and skills necessary for success in this field. The course emphasizes the importance of theoretical frameworks in understanding and applying practical knowledge. Students will explore the main approaches, models, and explanatory theories that underpin the field of petrochemical and coal-chemical processing. By mastering these theoretical concepts, students gain the ability to solve real-world problems and applications effectively.

The course is designed to foster a stimulating learning environment. By integrating theoretical concepts with practical applications, students are encouraged to engage actively with the material. This approach ignites curiosity and a deeper understanding of the subject matter.

By successfully completing this course, students will graduate with a strong foundation in the fascinating world of petrochemical and coal-chemical processing. They will possess the knowledge and skills to solve practical problems, design efficient processes, and contribute to the development of innovative technologies within the ever-evolving field of Chemical Engineering.

**Tensioactive Compounds - Teacher: Adina Ionuta GAVRILA**

Surfactants, a cornerstone of the organic synthesis and conditioning industry, hold immense economic significance due to their widespread use across various sectors. This course delves into the fascinating world of these versatile materials, exploring the science behind them and their diverse applications.

The course establishes a strong foundation in the physico-chemical principles governing surfactant synthesis and application. Students will explore the intricate relationship between a surfactant's structure, its properties, and its effectiveness. This includes understanding how raw materials are sourced and selected for surfactant production, the various techniques employed for manufacturing them, and the importance of characterization to ensure consistent quality and performance. The course also emphasizes the processes involved in formulating surfactants for specific commercial applications.

A core focus of the course is the critical relationship between a surfactant's chemical structure and its impact. Students will explore the potential risks associated with surfactants and gain knowledge of selecting safer alternatives. They will delve into the interplay between a surfactant's structure and its

properties, such as detergency, wetting, and foaming. This knowledge empowers students to select the most appropriate surfactant for a given application.

The course goes beyond theory, equipping students with the necessary skills and knowledge for success. Students will gain the ability to select and utilize surfactants appropriately in various applications. The course provides a foundation for those interested in surfactant synthesis, introducing them to the essential principles involved. The course content and approach are designed to foster creativity and a deeper interest in the field, potentially igniting a passion for research in surfactant science.

By successfully completing this course, students will graduate with a strong foundation in the science and applications of surfactants. They will possess the knowledge and skills to select appropriate surfactants, understand their impact, and potentially contribute to the development of novel and sustainable surfactant technologies within the field of Chemical Engineering.

**Catalysis in Organic and Petrochemical Industry - Teacher: Adrian TRIFAN**

The organic and petrochemical industries weave a silent magic into the fabric of our daily lives, transforming raw materials into countless products. But behind this modern-day alchemy lies an even more fascinating force: catalysis. This course delves into the world of catalysts, exploring their power to accelerate and control chemical reactions, the invisible engine driving the creation of these essential materials.

The course begins with a deep dive into the fundamental principles of catalysis. Students will unlock the secrets behind how catalysts work, specifically how they increase reaction rates without being consumed themselves. This includes understanding the intricate pathways by which chemical reactions occur, and how catalysts can influence these pathways to favor the production of desired products. The course also explores the diverse landscape of catalysts, ranging from homogeneous (dissolved in the reaction mixture) to heterogeneous (a separate phase from the reactants). Students will learn how to evaluate a catalyst's effectiveness in terms of both speed (activity) and its ability to produce the desired product (selectivity).

Understanding catalyst behavior is crucial for optimizing industrial processes. The course explores various techniques used to design catalysts with tailored properties for specific reactions. Students will gain insights into methods used to analyze a catalyst's structure and properties, providing valuable information for improving performance. No catalyst lasts forever, and the course explores the factors that lead to catalyst deactivation. Students will learn about methods for regeneration or replacement, ensuring the continued effectiveness of these essential industrial workhorses.

By successfully completing this course, students will graduate with a comprehensive understanding of catalysis and its transformative power in the organic and petrochemical industries.

**Natural Products - Teacher: Daniela ISTRATI**

The Natural Compounds course delves into the fascinating world of naturally occurring molecules with immense significance in various fields, from food science to medicine. Designed specifically for students pursuing a specialization in Organic Chemistry within Chemical Engineering, this course builds upon the foundation of organic chemistry acquired in previous years.

By exploring natural products through the lens of organic chemistry, the course deepens understanding and expands its practical applications. A core focus is equipping students with the main methods for identification and isolation of natural compounds. These methods form the foundation for unlocking the potential of natural resources and harnessing their valuable properties. Students will explore techniques such as extraction, which involves separating the desired compounds from their natural source materials, and purification, which isolates specific natural compounds in a pure form. Spectroscopic techniques like NMR and mass spectrometry are also explored, providing valuable tools for identifying the structure of these natural compounds.

By studying natural compounds, students gain a broader overview of the possibilities for applying their knowledge of organic chemistry in the real world. The course fosters an appreciation for the potential of natural resources and the power of chemistry in harnessing their benefits for various applications. Successfully completing this course equips students with a strong understanding of the methods used to identify and isolate natural compounds, knowledge of their diverse applications across various industries, and the ability to see the broader relevance of organic chemistry principles in the field of natural products. This foundation prepares them for potential careers in food science, pharmaceuticals, cosmetics, or other fields that leverage the power of natural compounds.

**Depollution in Organic and Petrochemical Industries - Teacher: Adrian TRIFAN**

The organic and petrochemical industries, while powering our modern world, face a critical challenge: pollution. This course, Depollution in Organic and Petrochemical Industries, tackles this challenge head-on, exploring strategies and technologies to minimize the environmental footprint of these vital sectors.

The course opens by examining the types of pollutants generated by organic and petrochemical processes. Students will delve into air, water, and land pollutants, understanding their sources and potential

environmental consequences. This includes volatile organic compounds (VOCs), greenhouse gases, and particulate matter polluting the air; hazardous chemicals, heavy metals, and organic wastewaters threatening water sources; and improper waste disposal and spills contaminating soil and groundwater.

Moving from the problem to the solution, the course delves into the various depollution technologies employed to minimize the environmental impact. A core focus is on waste minimization, promoting cleaner production processes at the source to reduce waste generation in the first place. Students will then explore wastewater treatment, learning about biological treatment, chemical precipitation, and advanced filtration methods used to clean industrial wastewater. Air pollution control techniques like scrubbers, catalytic converters, and biofilters will be examined, showcasing how these technologies capture and remove pollutants from exhaust streams. The course also explores land remediation techniques, including bioremediation and soil washing, for cleaning up contaminated soil and groundwater.

The course emphasizes the importance of adhering to environmental regulations. Students will gain insights into relevant regulations governing air and water emissions, as well as waste disposal practices.

Looking towards the future, the course explores ongoing research and development efforts aimed at advancing depollution technologies. Students will gain insights into emerging trends such as the use of nanotechnology and bio-based technologies for more efficient and sustainable depollution solutions.

By successfully completing this course, students will graduate with a comprehensive understanding of depollution challenges and solutions in the organic and petrochemical industries. They will possess the knowledge and skills to identify and assess the environmental impact of these industries, evaluate and select appropriate depollution technologies, design and implement sustainable practices, and contribute to the development of innovative depollution solutions for a cleaner future.