Faculty of Chemical Technology and Engineering

WEST POMERANIAN UNIVERSITY OF TECHNOLOGY
IN SZCZECIN, POLAND

THE OFFER FOR INTERNATIONAL STUDENTS FOR THE YEAR 2023/2024 SECOND DEGREE

	Course title	Person responsible for the course	Semester (winter/summer)	ECTS points	Hours
1	ADVANCED CHEMICAL REACTION ENGINEERING	Halina Murasiewicz	winter/summer	4	60
2	ADVANCED PROCESS DESIGN	Halina Murasiewicz	winter/summer	7	75
3	BIO-INSPIRED MATERIALS	Mirosława El Fray	winter/summer	5	45
4	CHEMICAL ENGINEERING PROCESS SIMULATION	Halina Murasiewicz	winter/summer	7	75
5	COSMETIC CHEMISTRY	Edyta Kucharska	winter	4	30
6	COSMETIC FORMULATION (ADVANCES)	Paula Ossowicz-Rupniewska	winter/summer	5	45
7	ENERGY AND EVNIRONMENT	Halina Murasiewicz	winter/summer	4	60
8	NATURAL AND SYNTHETIC FIEBERS TECHNOLOGY	Joanna Rokicka	winter	5	45
9	PHARMACEUTICAL CHEMISTRY (ADVANCES)	Paula Ossowicz-Rupniewska	winter/summer	6	60
10	POLYMERS IN MEDICINE	Mirosława El Fray	winter/summer	2	30
11	PROCESS SAFETY MANAGEMENT	Halina Murasiewicz	winter/summer	5	60
12	RESEARCH PROJECT IN CARBON MATERIALS ADSORPTION PROPERTIES	Iwona Pełech	winter/summer	15	120
13	RESEARCH PROJECT IN TWO PHASE SYSTEM FORMULATION	Halina Murasiewicz	winter/summer	15	120
14	RESEARCH PROJECT ON PHOTOCATALYTIC WATER TREATMENT	Ewelina Kusiak-Nejman	winter/summer	15	120
15	SLUDGE MANAGEMENT	Ewelina Kusiak-Nejman	winter/summer	15	150
16	SURFACTANTS IN CHEMICAL AND PROCESS ENGINEERING	Ewa Janus	winter/summer	6	60

Course title	ADVANCED CHEMICAL REACTION ENGINEERING		
Level of course	second cycle		
Teaching method	auditory class / lecture		
Person responsible for the course	Halina Murasiewicz	**E-mail address to the person**	Halina.Murasiewicz@zut.edu.pl
Course code (if applicable)	WTiICh-2-01	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	The student will be able to: 1.Describe and define the rate of reaction. 2.Derive the mass balance equation. 3.Apply the mass balance equation to the most common types of industrial reactors. 4.Write the rate law in terms of concentrations, and temperature. 5.Use nonlinear regression to determine the rate law parameters. 6.Apply the differential and integral methods for analysis of reactor data. 7.Define a catalyst and describe its properties. 8.Describe the steps in a catalytic reaction. 9.Suggest a mechanism and apply the concept of a rate-limiting step to derive a rate law.		
Entry requirements	Fundamentals of chemical engineering		
Course contents	Derivation of general mass balance equations. Reactor sizing. Analysis of stoichiometry. Analysis of rate data. Analysis of catalytic reactors . Analysis of three-phase reactors. Analysis of isothermal and nonisothermal reactors. Analysis of biochemical reactors. Chemical reactor Design using ASPEN Plus. Introduction. Fundamental concepts. The General Mass Balance Equation. Reactor sizing. Stoichiometry. Conversion. The Reaction Order. The Rate Law. Collection and analysis of rate data. Multiple reactions. Reaction mechanisms. Catalytic reactors. Three-phase reactors. Isothermal and nonisothermal reactor design. Biochemical reactors.		
Assessment methods	Lecture illustrated by Power Point presentation and computer simulation Classis illustrated by computer and manual calculations Periodic assessment of student achievement Lecture: exam at the end of the semester Classis: written test		
Recommended readings	1. Fogler H.S., Elements of chemical reaction engineering, Prentice-Hall, New Jersey, 2009 2. Levenspiel O., Chemical reaction engineering, Wiley, New York, 1999 3. Luyben W.L., Chemical reactor design and control, Wiley, New York, 2007		
Knowledge	The student will be able to: 1.Describe and define the rate of reaction. 2.Derive the mass balance equation. 3.Write the rate law in terms of concentrations, and temperature. 4.Define a catalyst and describe its properties. 5.Describe the steps in a catalytic reaction.		
Skills	The student will be able to: 1.Apply the mass balance equation to the most common types of industrial reactors. 2.Use nonlinear regression to determine the rate law parameters. 3.Apply the differential and integral methods for analysis of reactor data.		
Other social competences	The student will be able to suggest a mechanism and apply the concept of a rate-limiting step to derive a rate law.		

Course title	ADVANCED PROCESS DESIGN		
Level of course	second cycle		
Teaching method	project / lecture		
Person responsible for the course	Halina Murasiewicz	**E-mail address to the person**	Halina.Murasiewicz@zut.edu.pl
Course code (if applicable)	WTiICh-2-02	**ECTS points**	7
Semester	winter/summer	**Language of instruction**	english
Hours per week	5	**Hours per semester**	75
Objectives of the course	The student will be able to: 1.Apply knowledge of chemical engineering fundamentals to identify and solve chemical engineering design problems. 2.Perform step-by-step design of chemical engineering processes. 3.Use of Aspen Plus for chemical engineering design.		
Entry requirements	Fundamentals of chemical engineering		
Course contents	Project of the selected equipment or process instalation in ASPEN Plus software supplemented by appriopate calculaton. Introduction to design. Design information. Physical properties of chemical compounds. Materials of Construction. Costing. Mechanical design of process equipment. Flow-sheeting. Material and energy balances. Energy utilization. Piping and instrumentation. Equipment selection, specification and design: separation columns, heat-transfer equipment. Aspen simulation. Plant location and site selection. Environmental considerations. Safety and loss prevention.		
Assessment methods	Lecture illustrated by Power Point presentation and computer simulation Project Periodic assessment of student achievement Lecture: exam at the end of the semester Project: assessment of project		
Recommended readings	1. Sinnott R.K., Coulson & Richardson's Chemical Engineering, Vol. 6: Chemical Engineering Design, Butterworth-Heinemann, Oxford, 2003 2. Luyben W.L., Distillation design and control using Aspen simulation, Wiley, New York, 2006		
Knowledge	The student will be able to demonstrate basic knowledge of chemical engineering design problems.		
Skills	The student will be able to apply knowledge of chemical engineering fundamentals to identify and solve chemical engineering design problems.		
Other social competences	The student will be able to use of Aspen Plus for chemical engineering design.		

Course title	BIO-INSPIRED MATERIALS		
Level of course	second cycle		
Teaching method	project / lecture		
Person responsible for the course	Mirosława El Fray	**E-mail address to the person**	Miroslawa.ElFray@zut.edu.pl
Course code (if applicable)	WTiICh-2-03	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	This course is aimed at giving introduction to the field of bio-inspired materials where natural processes and phenomena are used by engineers to design functional materials. Student will be able to defined basic terms related to biologically inspired materials and structires, will be able to work in a group and will be able to broaden her/his knowledge in the field.		
Entry requirements	none		
Course contents	Literature review on study subject, including research papers Design, preparation and characterization of bio-inspired materials (functional polymer or composite) with biomimetic functionalities Preparation of written report and presentation of the final work Basic definitions used in bio-inspired design of materials: biomimetic and bionics Molecular design of biological and nanomaterials Multifinctional materials: gradient and hierarchical structures Functional surfaces in biology: self-cleaning, self-adhesion Biological materials in engineering design and mechanisms Artificial muscles using electroactive polymers Artificial replacement of human tissues and bones		
Assessment methods	lecture project examination written report and presentation		
Recommended readings	1. Bar-Cohen Y., Biomimetics Biologically Inspired Technologies, CRC Taylor & Francis, New York, 2006 2. Ratner B.R., Biomaterials Science, Elsevier, New York, 2004		
Knowledge	To provide a theoretical knowledge in the field of bio-inspired materials and structures		
Skills	To provide a practical knowledge in the field of bio-inspired materials and structres, the principle designs and relationships		
Other social competences	To provide competences necessary to understand design principles in engineering materials inspired by nature		

Course title	CHEMICAL ENGINEERING PROCESS SIMULATION		
Level of course	second cycle		
Teaching method	laboratory class / lecture		
Person responsible for the course	Halina Murasiewicz	**E-mail address to the person**	Halina.Murasiewicz@zut.edu.pl
Course code (if applicable)	WTiICh-2-04	**ECTS points**	7
Semester	winter/summer	**Language of instruction**	english
Hours per week	5	**Hours per semester**	75
Objectives of the course	The student will be able to: 1. Develop the process models based on conservation principles. 2. Use Aspen Plus to model chemical engineering processes.		
Entry requirements	Fundamentals of chemical engineering		
Course contents	Selected process simulation in Aspen Plus software. Introduction to chemical engineering process simulation. Introduction to the Aspen Plus interface. Simulation file creation. Basic process options and simulation tools in Aspen Plus. Selecting physical property models. The data regression system. Unit operation models. Reaction and reactors. Separation columns. Processes with recycle. Sensitivity analysis. Optimization.		
Assessment methods	Lecture illustrated by Power Point presentation and computer simulation in ASPEN Laboratory Periodic assessment of student achievement Lecture: exam at the end of the semester Laboratory: assessment of reports		
Recommended readings	1. Hangos K.M., Cameron L.T., Process modelling and model analysis, Academic Press, 2001 2. Dhurjati P., Shiflett M., Modeling and simulation in chemical engineering using Aspen and Matlab, CRC Press, 2014 3. Rice R.G., Do D.D., Applied mathematics and modeling for chemical engineers, Wiley, New York, 2012 4. Finlayson B.A., Introduction to chemical engineering computing, Wiley, New York, 2005 5. Schefflan R., Teach Yourself the Basics of Aspen Plus, Wiley, New York, 2011 6. Luyben W.L., Chemical Reactor Design and Control, Wiley, New York, 2007		
Knowledge	The student will be able to develop the process models based on conservation principles.		
Skills	The student will be able to use Aspen Plus to model chemical engineering processes.		
Other social competences	The student will be able to model chemical engineering processes.		

Course title	COSMETIC CHEMISTRY		
Level of course	second cycle		
Teaching method	laboratory class		
Person responsible for the course	Edyta Kucharska	**E-mail address to the person**	edyta.makuch@zut.edu.pl
Course code (if applicable)	WTiICh-2-05	**ECTS points**	4
Semester	winter	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	Student has knowledge about synthesis of active substances, isolation and identification of active substances from plant materials, synthesis and quality control of cosmetic products containing active substances.		
Entry requirements	Student has knowledge about synthesis of active substances, isolation and identification of active substances from plant materials. Student has knowledge about synthesis of cosmetic products containing active substances. Student has knowledge about quality control of cosmetic products containing active substances.		
Course contents	Synthesis of active substances and isolation and identyfication of active substances from plant materials. Synthesis of cosmetic products containing active substances. Quality control of cosmetic products containing active substances.		
Assessment methods	laboratory written reports, grade		
Recommended readings	1. Salvador A, March JG, Vidal MT, Chisvert A, Balaguer A, Analysis of Cosmetic Products, Elsevier, Amsterdam, 2007, Edited by Amparo Salvador Department of Analytical Chemistry Faculty of Chemistry University of Valencia Valencia, Spain and Alberto Chisvert Department of Analytical Chemistry, Nutrition and Bromatology Faculty of Sciences University of Alicante Alicante, Spain 2. Jan Vacek, Borivoj Klejdus, Lea Lojkova, Vlastimil Kuban, Current trends in isolation, separation, determination and identification of isoflavones: A review, Wiley, 2008, 2008 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 3. Eliseo F. González Abellán, Desirée Martínez Pérez, Chapter 2 - Quality Control of Cosmetic Products: Specific Legislation on Ingredients, Elsevier, Amsterdam, 2018		
Knowledge	Student will have knowledge on synthesis of active substances; the isolation and identification of active substances from plant materials. Student will have knowledge on the methods of synthesis of cosmetic products containing active substances. Student will have knowledge on the evaluation of quality control of cosmetic products containing active substances.		
Skills	The student will be able to obtain active substances based on other substrates. Student will be able to isolation and identification of active substances of other plant materials. Student will be able to synthesis of other cosmetic products containing active substances. Student can determine quality control of other cosmetic products containing active substances.		
Other social competences	Student has knowledge about synthesis of active substances and isolation and identification of active substances of other plant materials. Student has knowledge about synthesis of other cosmetic products containing active substances. Student is able to determine quality control of other cosmetic products containing active substances.		

Course title	COSMETIC FORMULATION (ADVANCES)		
Level of course	second cycle		
Teaching method	laboratory class / lecture		
Person responsible for the course	Paula Ossowicz-Rupniewska	**E-mail address to the person**	Paula.Ossowicz@zut.edu.pl
Course code (if applicable)	WTiICh-2-06	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	Student has knowledge of group of cosmetic raw materials - their chemical structure, properties and functions in cosmetics. Student can recognize relationship between structure and properties and applications of raw materials. Student can name and describe steps in the production of cosmetics. Student can prepare different cosmetic formulations (solutions, emulsions, gels, suspensions), using the knowledge of raw materials and their impact on the physicochemical form of the cosmetic and its application. Student can assess and control the quality of the cosmetic formulation.		
Entry requirements	organic chemistry inorganic chemistry		
Course contents	Preparation selected type of shampoos Preparation selected type colour cosmetics Formulation of emulsions. Choice of the emulsifier. Investigation of the properties of emulsions Gels in cosmetics and personal care products. Toilet and metallic soaps – obtaining and characteristic. Fats and oils in cosmetics - analysis in skin care products. Definition of a cosmetic, nomenclature of cosmetic ingredients and their functions, application limits and requirements, information on the label, graphic symbols, the safety of raw materials and the cosmetic product Cosmetic raw materials and their characteristics (solvents, mineral and silicone oils, emollients, lipid raw materials and waxes, surfactants) Enzymes in cosmetics, low molecular weight peptides, protein hydrolysates, biogenic proteins. Lifting and anti-aging agents. Anti-aging Skin Care Formulations UV filters, antiperspirants. Oral and dental care products. Varnishes and nail polish removers. Herbs in Cosmeceuticals		
Assessment methods	laboratory lectures project work continuous assesment final written test - lectures		
Recommended readings	1. H. Mollet, A. Grubenmann, Formulation Technology. Emulsions, suspensions, solid forms, Wiley-VCH, Weinheim, 2001 2. I. D. Morrison, S. Ross, Colloidal dispersions, Suspensions, Emulsions and Foams, Wiley-Interscience, New York, 2002 3. A. O. Barel, M. Paye, H. I. Maibach (Eds.), Handbook of Cosmetic Science and Technology, Informa Healthcare, 2009, third		
Knowledge	Student will have knowledge of production of different cosmetic formulation, effect of cosmetic ingredients on application and quality of formulation		
Skills	Student prepares various cosmetic formulations (solutions, emulsions, gels, suspensions) using the knowledge about raw materials and their impact on the physicochemical form of the cosmetic; the student is able to assess and control the quality of the cosmetic formulation; the student uses the rules and requirements set out in the cosmetics law		
Other social competences	Student is aware of the importance of legal and health aspects related to the formulation of cosmetic products and the need to expand knowledge in this field		

Course title	ENERGY AND EVNIRONMENT		
Level of course	second cycle		
Teaching method	auditory class / lecture		
Person responsible for the course	Halina Murasiewicz	**E-mail address to the person**	Halina.Murasiewicz@zut.edu.pl
Course code (if applicable)	WTiICh-2-07	**ECTS points**	4
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Student is expected to be able to: • List and generally explain the main sources of energy and their primary applications in the world. • Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, about future supply and the environment. • Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources. • List and describe the primary renewable energy resources and technologies. • Describe/illustrate basic electrical concepts and system components. • Make quantity/quality comparisons among energy uses, resources, and technologies.		
Entry requirements	Fundamentals of mass and energy balances Thermodynamics Heat transfer		
Course contents	Students will analyse/calculate many examples of the application of renewable energy resources to identify the optimal solutions: PV panel, solar panel, wind tower, heat pumps Introduction to renewable energy sources Energy from the physical view Renewable energy - hydropower, wind energy, solar energy, geothermal energy and energy of biomass Fossil fuels and nuclear energy Transmission and energy storage World energy balance Environmental aspects of energy consumption Economic aspects of energy production and consumption Emerging technologies		
Assessment methods	activating methods: lecture and didactic discussion practical methods - tutorials assessment of progress of the work - monthly written final test/report		
Recommended readings	1. B. Godfrey, Renewable Energy: Power for a Sustainable Future, Oxford Univ. Press, 2004 2. J. F. Manwell, J. G. McGowan, A. L. Rogers, Wind energy explained, theory, design and application, Wiley and sons LTD, 2005 3. Taylor, F. W., Elementary climate physics, Oxford University Press, 2005		
Knowledge	Student is expected to be able to list and generally explain the main sources of energy and their primary applications in the world. Student is expected to be able to describe the challenges and problems associated with the use of various energy sources, including fossil fuels, about future supply and the environment. Student is expected to be able to discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources. Student is expected to be able to list and describe the primary renewable energy resources and technologies. Student is expected to be able to describe/illustrate basic electrical concepts and system components. Student is expected to be able to make quantity/quality comparisons among energy uses, resources, and technologies.		
Skills	Student can ensure adequate protection of his/her own workplace and assess the risks during testing, measurements and experiments Student is able to acquire, critically evaluate and creatively process information from the scientific literature databases, and other properly chosen sources		
Other social competences	Student is able to define the social role of the graduate of technical university, particularly in the dissemination of technical culture in society and communicating in a meaningful and attractive way information on the achievements of applied energetics and its effects on development of modern technologies, especially in the renewable energy sector Student is able to work as individual or in group		

Course title	NATURAL AND SYNTHETIC FIEBERS TECHNOLOGY		
Level of course	second cycle		
Teaching method	laboratory class / lecture		
Person responsible for the course	Joanna Rokicka	**E-mail address to the person**	Joanna.Rokicka@zut.edu.pl
Course code (if applicable)	WTiICH-2-08	**ECTS points**	5
Semester	winter	**Language of instruction**	english
Hours per week	3	**Hours per semester**	45
Objectives of the course	To provide a general understanding of fibers technology. Student characterizes mechanical, thermal and surface properties of fibers and filaments. Student explains the methods of production of synthetic fibers and filament and their impact on further textile processing.		
Entry requirements	Basic polymer science		
Course contents	Fibre-forming polymer synthesis. Single-filament alloy spinning. Preparation of the spinning solution. Multi-filament solution spinning. Dyeing of fibers in acidic and alkaline environment. Testing the color fastness of fibres. Introduction to fibres. Classifications of fibres. Properties of textile fibres. Fiber morphology. Fiber structure concepts. Pre-orientation and proper fiber orientation. Manufacture of chemical fibers. Textile processing.		
Assessment methods	Class lectures Laboratory work Report Final written test		
Recommended readings	1. Sinclair, R. & Sinclair, Rose, Textiles and fashion [Elektronisk resurs] : materials, design and technology, Oxford: Woodhead Publishing, 2015 2. Kadolph, Sara J, Textiles, Pearson New International Edition, 2013		
Knowledge	Student is able to differentiate between natural and synthetic fibers and filaments. Student is able to characterize mechanical, thermal and surface properties of fibres and filaments.		
Skills	Student is able to produce mono- and multifilament and characterize them.		
Other social competences	Student is able to demonstrate strategies to acquire knowledge in contemporary fibre technology research.		

Course title	PHARMACEUTICAL CHEMISTRY (ADVANCES)		
Level of course	second cycle		
Teaching method	laboratory class / lecture		
Person responsible for the course	Paula Ossowicz-Rupniewska	**E-mail address to the person**	Paula.Ossowicz@zut.edu.pl
Course code (if applicable)	WTiICh-2-09	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Student has knowledge about drug discover, sources of drugs and lead compounds, classification of drugs and drug action. Student can synthesis different active substances (drugs).		
Entry requirements	Basics of organic compound and biochemistry.		
Course contents	Synthesis of 2-3 products by standard processes in pharmaceutical chemistry. Isolation of products from natural sources Qualitative analysis of pharmaceutical products Nomenclature and classification of drugs The influence of isomerism on the activity of medicinal substances Biotransformation of drugs Drugs of selected groups - synthesis, mechanism of action, medicinal uses, adverse effects		
Assessment methods	lectures laboratory wtritten exam written report, grade		
Recommended readings	1. Gareth Thomas, Medicinal Chemistry An Introduction, John Wiley & Sons Ltd,, Chichester, England, 2007, Second Edition 2. Camille Georges Wermuth, The Practice of Medicinal Chemistry, Elsevier, Oxford, England, 2003, Second Edition 3. Pharmaceutical Chemistry, David G. Watson, Elsevier, 2011 4. Gareth Thomas, Fundamentals of Medicinal Chemistry, John Wiley & Sons Ltd,, Chichester, England, 2003		
Knowledge	Student will have knowledge about drugs, their classification, types of drugs, sources and drug action.		
Skills	The student will be able to obtain simple compounds with pharmaceutical activity.		
Other social competences	Student is able to indicate by-products and waste substances arising in the production process of selected groups of drugs and their impact on the quality of drugsand the ways of their elimination.		

Course title	POLYMERS IN MEDICINE		
Level of course	second cycle		
Teaching method	lecture		
Person responsible for the course	Mirosława El Fray	**E-mail address to the person**	Miroslawa.ElFray@zut.edu.pl
Course code (if applicable)	WTiICh-2-10	**ECTS points**	2
Semester	winter/summer	**Language of instruction**	english
Hours per week	2	**Hours per semester**	30
Objectives of the course	The course is aimed at giving an introduction to polymers used in medicine. Student will be able to define basic terms related to polymer structure and properties, will be able to select materials for particular applications according the applications requirements. Student will be able to work in a group and will be able to broaden her/his knowledge in the field.		
Entry requirements	none		
Course contents	Polymeric in medicine: basic concepts of biocompatibility, in vitro and in vivo testing methods Synthetic polymers and composites in medical applications Biodegradable polymers: structure and properties Polymers for drug delivery Stimuli responsive polymers for medical applications Polymers for cardiac applications Porous polymeric structures for bone: manufacturing and characterization Polymer fibers in medical applications		
Assessment methods	lecture examination/presentation of a topic formulated by the supervisor		
Recommended readings	1. Wise D.L., Biomaterials and Bioengineering Handbook, Marcel Dekker, New York, 2000		
Knowledge	To provide a detailed theoretical knowledge within the field of polymers in medicine		
Skills	To provide a practical knowledge within the framework of polymers in medicine		
Other social competences	To provide basic competences in knowledge on polymer praparation, characterization and applications in medicine		

Course title	PROCESS SAFETY MANAGEMENT		
Level of course	second cycle		
Teaching method	project / lecture		
Person responsible for the course	Halina Murasiewicz	**E-mail address to the person**	Halina.Murasiewicz@zut.edu.pl
Course code (if applicable)	WTiICh-2-11	**ECTS points**	5
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Students in this course will learn how to apply basic chemical engineering fundamentals involving energy and mass balances, fluid mechanics, heat and mass transfer, thermodynamics, etc. to the analysis and design of elements of processes and process equipment associated with loss prevention and safe operations involving hazardous materials and/or conditions. Techniques for process hazard analysis, risk assessment, and accident investigations are also covered. A case study approach will allow demonstrating the potential risks involved in many process operations in chemical or similar plants.		
Entry requirements	Fundamentals of mass and energy balances Thermodynamics		
Course contents	Students will analyse a case study in process safety for the selected chemical process or storage of hazardous chemicals by using ALOHA programme and relevant methods applicable to process safety engineering. Process Safety Management; Responsibility; OSHA and EPA Regulations Properties of Toxic Materials; Industrial Hygiene Vaporization Rates; Dilution; Ventilation; Toxic and Flammable Release and Dispersion Modeling Fires and Explosions; Flammability, MOC; Explosions, Detonations, Blast Damage Fire and Explosion Protection and Prevention; Inerting and Purging; Static Electricity; Ventilation Hazard Identification; DOW F&EI, HAZOP, Safety Reviews Risk Assessment; Probability Theory; Event Tree; Fault Tree Accident Investigations- ALOHA programme		
Assessment methods	activating methods: lecture and didactic discussion practical methods - case study/project assessment of progress of the work - monthly written final test/report		
Recommended readings	1. D.A. Crowl, J.A. Louvar, Chemical Process Safety: Fundamentals with Applications, Prentice Hall PTR, 2002 2. R. E. Sanders, Chemical Process Safety, Elsevier, 2011 3. D.P. Nolan, Safety and Security Review for the Process Industries: Application of HAZOP, PHA, What-IF and SVA Reviews, Elsevier, 2014		
Knowledge	Student knows how to apply basic chemical engineering fundamentals involving energy and mass balances, fluid mechanics, heat and mass transfer, thermodynamics, etc. to the analysis and design of elements of processes and process equipment associated with loss prevention and safe operations involving hazardous materials and/or conditions. Techniques for process hazard analysis, risk assessment, and accident investigations are also covered. A case study approach will allow demonstrating the potential risks involved in many process operations in chemical or similar plants.		
Skills	Student will have the following skills in the field of: - calculating the extent of danger zones in natural and turbulent dispersion. - calculation of the extent of hazard zones in the flow scattering. - determination and design of natural ventilation. - determination of explosion hazard zones for industrial and storage facilities.		
Other social competences	Student will be aware of the responsibility for safety in the workplace and in chemical industry and also will know how to eliminate risk of occurrence of potential major industrial accident		

Course title	RESEARCH PROJECT IN CARBON MATERIALS ADSORPTION PROPERTIES		
Level of course	second cycle		
Teaching method	laboratory class / seminar		
Person responsible for the course	Iwona Pełech	**E-mail address to the person**	Iwona.Pelech@zut.edu.pl
Course code (if applicable)	WTiICh-2-12	**ECTS points**	15
Semester	winter/summer	**Language of instruction**	english
Hours per week	8	**Hours per semester**	120
Objectives of the course	Applying of knowledge and skills learned during studies to solving a practical research problems.		
Entry requirements	Fundamentals of chemical engineering Fundamentals of chemistry Fundamentals of analytical chemistry		
Course contents	The students perform the research project concerning the study of carbon materials adsorption properties. The students calculate based on the low-temperature (-196 °C) nitrogen adsorption isotherms the specific surface area, the total pore volume, the volume of micropores and the volume of mesopores of the selected carbon materials. The students determine CO2 adsorption capacity on the porous carbon materials and/or use the selected carbon materials as an adsorbents for the removal of dyes from aqueous solutions. It consist of literature studies, concept of project realization, selection of used materials, performing the selected process, characteristic of obtained products, control measurements using proper methods and instruments, calculations, discussion of the results, conclusions. Description of all this aspects should be given in the written project report. The students present results of literature studies, concept and progress of project realization.		
Assessment methods	discussion demonstrating measurements laboratory seminar activity assessment assessment of progress of the work discussion evaluation of presentation written final project report		
Recommended readings	1. Michio Inagaki, Feiyu Kang, Hidetaka Konno, Advanced Materials Science and Engineering of Carbon Book, Springer, 2014 2. Carlos P. Bergmann, Fernando Machado Machado, Carbon Nanomaterials as Adsorbents for Environmental and Biological Applications, Springer, 2015 3. Sergey P. Gubin, Magnetic Nanoparticles, Viley, 2009 4. C. N. R. Rao, P. J. Thomas, G. U. Kulkarni, Nanocrystals: Synthesis, Properties and Applications, Springer, 2007 5. Cooney, David O., Adsorption design for wastewater treatment, Boca Raton [etc.] : LewisPublishers, 1999 6. Thomas, W. John., Adsorption technology and design, Oxford : Butterworth-Heinemann, 1998		
Knowledge	Student knows how to apply chemical engineering fundamentals and instrumental analysis to the preparation of carbon adsorbents and characterization of carbon materials adsorption properties. Student has an extended knowledge about the issues related to the project.		
Skills	Student will be able to obtain information from library, online and literature resources that will support the solving of research problems. Student will be able to plan and carry out experiments, collect experimental data, analyze and interpret results, write technical reports and give presentations.		
Other social competences	Student understands the needs of continuous training and development in the field of carbon materials used as adsorbents. Student knows how to individually study the problem: from it formulate to the solution and also propose possible solutions. Student is able to work in an international team.		

Course title	RESEARCH PROJECT IN TWO PHASE SYSTEM FORMULATION		
Level of course	second cycle		
Teaching method	project		
Person responsible for the course	Halina Murasiewicz	**E-mail address to the person**	Halina.Murasiewicz@zut.edu.pl
Course code (if applicable)	WTiICH-2-13	**ECTS points**	15
Semester	winter/summer	**Language of instruction**	english
Hours per week	8	**Hours per semester**	120
Objectives of the course	Learn how to conduct the case study based on literature Learn how to present complex data or situations clearly Learn how to review and analyze research findings that affect the process Learn how to prepare a preliminary research design for projects in their subject matter areas		
Entry requirements	Fundamentals of Chemical Engineering Chemical engineering reaction Physics, mathematics Numerical or process simulation tools: CFD, Aspen Plus, Matlab		
Course contents	Literature review of the subject of a research project Identify an appropriate research design Conduct the appropriate research activities to formulate lquid two phase systems: measurements, numerical simulation, design or calculation Data analysis Write the final research paper according to identified guidelines Meeting with the instructor to discuss research and writing methods and to review progress on his/her research paper		
Assessment methods	activating methods: didactic discussion practical methods - numerical/simulation study assessment of progress of the work - monthly written reports written final project report		
Recommended readings	1. McCabe W.L., Smith J.C., Harriott P., Unit Operations of Chemical Engineering, McGraw-Hill, New York, 2005 2. Sinnott R.K., Coulson & Richardson’s Chemical Engineering, Vol. 6: Chemical Engineering Design, Butterworth-Heinemann, Oxford, 2003 3. Moin, P., Fundamentals of Engineering Numerical Analysis, Cambridge University Press, Cambridge, 2010		
Knowledge	Student knows how to apply basic chemical engineering fundamentals involving energy and mass balances, fluid mechanics, heat and mass transfer, thermodynamics, etc. to the analysis and design processes, part of process and process equipment.		
Skills	Student will have the following skills in the field of: - design experiments to obtain relevant data -utilize numerical software packages to simulate transport phenomena and thermodynamics -analyze data appropriately to extract parameters of interest -characterize, quantify, and report error in results and calculations -present technical information effectively in written and verbal form		
Other social competences	Student knows how to individually study the problem: from it formulate to the solution and also propose possible solutions.		

Course title	RESEARCH PROJECT ON PHOTOCATALYTIC WATER TREATMENT		
Level of course	second cycle		
Teaching method	internship / seminar		
Person responsible for the course	Ewelina Kusiak-Nejman	**E-mail address to the person**	Ewelina.Kusiak@zut.edu.pl
Course code (if applicable)	WTiICh-2-14	**ECTS points**	15
Semester	winter/summer	**Language of instruction**	english
Hours per week	8	**Hours per semester**	120
Objectives of the course	To familiarise the student with the mechanisms of advanced oxidation processes. To familiarise the student with the photocatalysts preparation methods. Teaching the student how to design photoactive materials for water treatment. Teaching the student how to calculate photoacivity of (nano)materials.		
Entry requirements	English language skills at B2 level		
Course contents	Introduction to laboratory classes: safety training, presenting of rules for working in laboratory, safety data sheets presentation. Practical familiarisation of the student with the apparatus used for photocataytic water treatment: simple and advanced photoreactors. Preparation of photoactive (nano)materials, i.e. semidonductor-based photocatalysts. Physicochemical characterisation of photoacive (nano)materials. Photosorption studies. Introduction to photocatalytic water treatment. Advanced oxidation processes in water treatment- theory. Advanced oxidation processes in water treatment - practical application. Semiconductors as photocatalysts for water treatment - UV- and visible light-driven photocatalysts. Final assessment.		
Assessment methods	Clarification or explanation Practical methods: seminars with multimedial presentations Activating methods: discussion Formative evaluation: evaluation of the student's preparation for classes, student attendance, active participation of the student in classes, preparation and delivery of a presentation on a given topic. Final evaluation: average note of activities indicated in the formative evaluation.		
Recommended readings	1. Suresh C. Ameta, Rakshit Ameta (Eds.), Advanced Oxidation Processes for Wastewater Treatment - Emerging Green Chemical Technology, Elsevier Inc., London EC2Y 5AS, United Kingdom, 2018, ISBN: 978-0-12-810499-6 2. Elvis Fosso-Kankeu, Sadanand Pandey, Suprakas Sinha Ray (Eds.), Photocatalysts in Advanced Oxidation Processes for Wastewater Treatment, John Wiley & Sons, Inc., New York, US, 2020, ISBN 978-1-119-63139-2 3. Dionysios D Dionysiou, Gianluca Li Puma, Jinhua Ye, Jenny Schneider, Detlef Bahnemann (Eds.), Photocatalysis - Applications, y The Royal Society of Chemistry, Cambridge, UK, 2016, EPUB eISBN: 978-1-78262-798-2		
Knowledge	The student has assimilated the knowledge in the subject of the implemented project		
Skills	Student will be able to find information from the literature that will support the solving of scientific problems. Student will be able to plan and carry out experiments, collect experimental data, analyse and interpret obtained results, write laboratory reports and presented the obtained results.		
Other social competences	Student understands the needs of continuous training and development in the field of advanced oxidation processes for water treatment.		

Course title	SLUDGE MANAGEMENT		
Level of course	second cycle		
Teaching method	auditory class / laboratory class / lecture		
Person responsible for the course	Ewelina Kusiak-Nejman	**E-mail address to the person**	Ewelina.Kusiak@zut.edu.pl
Course code (if applicable)	WTiICh-2-15	**ECTS points**	15
Semester	winter/summer	**Language of instruction**	english
Hours per week	10	**Hours per semester**	150
Objectives of the course	Student will get theoretical knowledge on the sludge treatment and management Student will get practical skills in the area of treatment of wastwater slugde and recycling methods		
Entry requirements	English language skills at B2 level		
Course contents	Introduction to auditory classes Fundamentals of chemical calculations - Repetition and consolidation Typical calculations used in the determination of selected physicochemical parameters of sewage sludge Biochemical Methane Potential (BMP) calculations Basis for the calculation of process equipment used in sludge management - activated sludge equipment, sludge balancing, sludge thickeners, aerobic and anaerobic sludge stabilisation chambers, sludge hygienization and dewatering equipment, sludge drying and incineration Final test Introduction to laboratory classes: safety training, presentng of rules for working in laboratory, safety data sheets presentation. Determination of selected physicochemical parameters in wastewater. Determination of dry matter and organic and mineral substances in sediments Determination of total mineral and volatile suspended solids by weight Biogas production from liquid sludge Microbiological analysis of sewage sludge Final test Classification and characterisation of sediments Chemical composition of sewage sludge Hygienic and sanitary characteristics of sludge Chemical and microbiological methods for the examination of sediments Methods of preparing sludge for natural management Thickening of sewage sludge Sludge stabilisation Sewage sludge composting Sludge conditioning Sludge dewatering Methods for the natural management of sewage sludge: agrotechnical treatment of sludge to compost, vegetated surface treatment of land, reclamation of degraded land using sewage sludge, soil fertilisation and plant nutrition Final test		
Assessment methods	Informative lecture Clarification or explanation Practical methods - auditory classes Practical methods - laboratory classes Formative evaluation: evaluation of the student's preparation for classes, student attendance, active participation of the student in classes, preparation of laboratory reports and homeworks. Final evaluation: achieving a positive grade in the final tests		
Recommended readings	1. Satinder Ahuja (Ed.), Water Reclamation and Sustainability, Elsevier Inc., Amsterdam, Boston, Heidelberg, London, New York, Oxford, Paris, San Diego, San Francisco, Singapore, Sydney, Tokyo, 2014, First edition, Chapter 7.5.4 Sludge Management 2. Cleverson Vitorio Andreoli, Marcos von Sperlingand, Fernando Fernandes (Eds.), Sludge Treatment and Disposal, IWAPublishing, London (UK), 2007, Chapter 1. Introduction to Sludge Management 3. L.O. KOLARIK, A.J. PRIESTLEY (Eds.), Modern Techniques in Water and Wastewater Treatment, CSIRO Cataloguing in-Publication Entry, Australia, 1995, Chapter 25.2 Sewage Sludge Management Practices 4. Carolina Feliciana Machado, J. Paulo Davim (Eds.), Sustainable Management for Managers and Engineers, y ISTE Ltd and John Wiley & Sons, Inc., London (UK) andHoboken (US), 2020, Chapter 1.3.2.9 Reducing Sludge		
Knowledge	The student has knowledge of sediments classification and composition		

	The student has knowledge of sediments recultivation methods
Skills	Students will be able to experimentally determine the basic physicochemical parameters of sediments Students will be able to correctly select and calculate the parameters of equipment used in slugde management
Other social competences	The student is aware of the need to develop sludge management technologies

Course title	SURFACTANTS IN CHEMICAL AND PROCESS ENGINEERING		
Level of course	second cycle		
Teaching method	laboratory class / lecture		
Person responsible for the course	Ewa Janus	**E-mail address to the person**	Ewa.Janus@zut.edu.pl
Course code (if applicable)	WTiICh-2-16	**ECTS points**	6
Semester	winter/summer	**Language of instruction**	english
Hours per week	4	**Hours per semester**	60
Objectives of the course	Student has knowledge about properties and other criteria influencing surfactant choice to the process Student has knowledge about manufacturing and application of different surfactants Student is able to determine the properties of surfactants, choose surfactants to the process or products		
Entry requirements	organic chemistry		
Course contents	Tensiometer, goniometer, viscosimeter - practical rules of using the devices in surfactants laboratory Emulsification of natural oils and petroleum oils - determination of the interfacial tension at the liquid-liquid interface, effect of surfactants type and concentration Emulsification of natural and petroleum oils - selection of emulsifier and the method of emulsification; effect of surfactant on the emulsion stability Selection of the deemulsifier to breakdown of emulsions Determination of foaming properties of surfactants - correlation of foamability with interfacial parameters Selection of surfactants for wetting different surfaces - contact angle as a function of surfactant type and concnetration Determination of viscosity and density of surfactant solutions - effect of surfactants structure and additives The basic theory of surfactants - surface activity, self-assembled surfactants agregates, adsorption at surfaces Applied theory of surfactants - detergency, phase behavior, emulsions, foaming and defoaming, rheology Anionic surfactants - production and application Non-ionic surfactants - production and applications Cationic surfactants - manufacturing and applications Amphotheric surfactants Silicone surfactants - structures, synthesis, properties and applications Polymeizable surfactants and fluorinated surfactants Final test		
Assessment methods	informative lecture with discussion laboratory exercises with the use of devices and computer programs for their operation and analysis of the results Assessment of preparation for the laboratories and involvement in the laboratory practice assessment of the prepared laboratory reports Evaluation of the knowledge on the written test		
Recommended readings	1. Ed. by Richard J.Farn, Chemistry and Technology of Surfactants, Blackwell Publishing, Oxford, UK, 2006		
Knowledge	Student is able to characterize the manufacturing methods of surfactants and describe their industrial application with explaining their function in the processes/products		
Skills	Student is able to analyze properties of surfactants and their solutions and based on this characteristic to match surfactant to the process or product, and find the respective correlations		
Other social competences	Student can reflect on the different solutions for a specific problem; express oneself in scientifically correct manner		