Unit title	Code	Module title	Details	Hours number	ECTS Credits
	BIOREF C1				
Chemistry in Biorefinery	C1A	Introduction to industrial catalytic processes	**Content :** Within the module, the student will gather knowledge in a field of basic concepts of catalysts, methods of preparation and characterization of industrial catalysts, basic catalytic mechanisms and the most utilized industrial catalytic processes. Overview of the global market of polymers and plastics, surfactants, selected oxidation, halogenation, hydration, dehydration and esterification reactions. Technologies for inorganic fertilizers production and overview of new directions in inorganic chemistry technologies, including diversification of raw materials. Production and global market of liquid and gaseous biofuels, closely linked with the laboratory practical part, including synthesis of biodiesel (from vegetable and animal fats), fermentation of starch to bioethanol, analysis of their composition in the light of actual standards; preparation and testing the composition of biogas and fractions from solid biomass pyrolysis. **Knowledge:** -On the basic concepts of catalysis including methods of preparation and characterization of catalysts, -On the basic mechanisms in heterogeneous catalysis, -On the most utilized industrial catalytic processes -On basic technologies and new directions in organic and inorganic industry (both the large and the medium scale technologies) -On the methods of biofuels synthesis and identification of their critical properties -On the existing law-regulations concerning the biofuels market **Competences:** After completing the module student is able to: - Describe the basics of catalytic activity, selectivity and explain mechanisms for heterogeneous catalytic processes; - Describe chemical and physical properties of industrial catalysts and the methods for their preparation; - Exemplify industrial applications that utilize heterogeneous catalysts, - Identify the raw materials and production methods used in chemical technology - Predict the characteristic features of main chemical technologies and their influence on environment - Synthesize various types of liquid and gaseous biofuels and characterize them in respect of current EU standards.	75	9
	C1B	Chemical Technology			
	C1C	Biofuels and bioresources			

	BIOREF C2				
Engineering in Biorefinery	**C2A**	Calculation methods in chemical engineering	The course covers basics topics on chemical reaction and chemical reactors engineering such as: stoichiometry; extent, yield and selectivity of chemical reaction; chemical equilibrium; kinetics of chemical reactions and rate laws; influence of temperature on the rate equation; kinetics of multiple chemical reactions; introduction to chemical reactor design; homogeneous chemical reactions in ideal isothermal reactors. Within the module the student will get the general information on computational methods in chemical engineering, including an application of the algebraic linear equations systems, Lagrange, Newton and spline methods of interpolation, genetic algorithms, Monte Carlo methods, as well as graphic interpretation of results. Overview of technical and economic importance of biotechnological processes and bio-engineering, with the classification of bioprocesses and their characteristics. Kinetic models of microbiological processes will be shown, as well as unstructured and structured models of microbiological processes. Experimental methods used in kinetic research of microbiological processes will be explained with the use of mathematical modelling of batch reactors dynamics, continuous flow bioreactors, single- and multi-substrate processes, biochemical cascades and bubble bioreactors. Theoretical knowledge will be verified by technological project of chosen biotechnological processes. **Knowledge:** - on basic numerical methods used in engineering calculations, students knows how to use mathematical knowledge to solve practical problems from the fields of chemical engineering, chemistry and technique, - on proper selection of calculation tool that is adequate to the problem to be solved, - understanding fundamentals of chemical reaction and chemical reactor engineering; - understanding the principles of processes occurring in biochemical reactors of various types **Competences:** - Ability to formulate mathematical models of processes occurring in basic types of bioreactors. - Choice of proper types and design of biochemical reactors for selected processes of industrial significance. - Skill in methods of solutions of nonlinear equations describing bioreactors with lumped state variables. - Can use ready-to-use programs to solve numerical problems, - have an ability to interpret the kinetic data and determine the rate equations using various techniques	**60**	**10**
	C2B	Biochemical reactors engineering			
	C2C	Basic CAD simulations and processing			
	BIOREF C3				
Calculations in Biorefinery	**C3A**	Computer modeling in chemical technology	**Knowledge:** - Student knows the basic possibilities of advanced simulators used in the chemical engineering and technology, recognize the basic principles governing the projects proposals, including safety restrictions, environmental consequences and principle of technologic moderation - Have better understanding of key chemical technology concepts and should know how to solve numerical problems by computational software. - On basic automatic control methods used in chemical engineering. **Competences:** - Ability to project and simulate a complex apparatus system in order to obtain specified a product of desired purity and yield -Ability to use general computational software to solve basic chemical (engineering) problems. - Ability to develop, analyze and critically evaluate results of computational experiments (simulations).	**90**	**11**
	C3B	Process control and industrial measurements			