Course name:

OPTIONAL COURSE III - APPLIED INDUSTRIAL ENZYMOLOGY

ECTS	*3*
Course status	**optional**
Course final assessement/evaluation of outcomes	**examination**
Prerequisites	**no prerequisites**

Main field of study:

field of study name (capital letters)

Profile of study	**academic**
The code of studies (education level)	**SM**
Semester of studies	**1**
Language of instruction	**English**

Course offered by:

Name of faculty offering the course	**Faculty of Food Technology**
Name of department offering the course	**Department of Biotechnology and General Technology of Food**
Course coordinator	**prof. dr hab. inż. Krzysztof Żyła**

Learning outcomes of the course:

Symbol of outcome	Description of learning outcome	Reference to	
		main field of study outcomes	discipline#
KNOWLEDGE – student knows and/or understands:			
AIE_W01	Defines and understands differences between a mineral catalyst and a biocatalyst. Knows the basics of catalysis and points to the means of controlling the enzyme catalyzed reaction.	TŻ2_W01 TŻ2_W12	R/P7S_WG/1 R/P7S_WG/4
AIE_W02	Student knows the basic processes and operations that are characteristic for distilleries, starch syrups industry, fruits and vegetables processing, winemaking, feed manufacturing, milk and meat processing. Recognizes the machinery and equipment of the main industrial plants.	TŻ2_W04 TŻ2_W06 TŻ2_W12	R/P7S_WG/1 R/P7S_WG/4 R/P7S_WK/1
AIE_W03	Understands the types and generations of soluble and immobilized biocatalysts. Student also knows the most important parameters that determine selection of a proper immobilized biocatalyst and recognizes basic differences in operation of the stirred tank (STR) and packed bed (PBR) bioreactor.	TŻ2_W01 TŻ2_W04 TŻ2_W12	R/P7S_WG/1 R/P7S_WG/4
AIE_W04	Student identifies final products of the food industry that can be manufactured exclusively using biocatalysis as well as their main applications.	TŻ2_W01 TŻ2_W04 TŻ2_W12	R/P7S_WG/1 R/P7S_WG/4
AIE_W05	Recognizes the specificity of biocatalysis in the feed industry where the animals intestine forms a specific type of a bioreactor with constantly changing parameters that cannot be controlled. Identyfies the possibilities of modulation of eggs and meat quality by using enzymes as feed supplements.	TŻ2_W01 TŻ2_W04 TŻ2_W12	R/P7S_WG/1 R/P7S_WG/4

AIE_W06	Understands the specificity and complexity of enzymatic maceration of plant tissues and the importance of the enzymatically aided extraction for the release of valuable intracellular compounds.	TŻ2_W01 TŻ2_W04 TŻ2_W12	R/P7S_WG/1 R/P7S_WG/4
AIE_W07	Points to the importance of biocatalysis in optimal utilization of the raw materials and wastes processing in the food industry as well as in the manufacturing of the aroma compounds and bioactive food constituents from plant raw materials.	TŻ2_W01 TŻ2_W04 TŻ2_W12	R/P7S_WG/1 R/P7S_WG/4
	SKILLS – student is able to:		
AIE_U01	Student is able to choose properly an analytical method for the determination of enzyme activity in selected commercial enzyme preparations.	TŻ2_U01 TŻ2_U07	R/P7S_UW/1 R/P7S_UW/2
AIE_U02	Can design an experiment necessary for the laboratory simulation of processing a starch syrup with desired characteristics.	TŻ2_U02 TŻ2_U07	R/P7S_UW/1 R/P7S_UW/2 R/P7S_UW/3
AIE_U03	Is able to analyze and interpret experimental data and draw proper conclusions from the data obtained.	TŻ2_U01 TŻ2_U07	R/P7S_UW/1 R/P7S_UW/2 R/P7S_UW/3
	SOCIAL COMPETENCE- student is ready to:		
AIE_K01	Knows the hazards of chemicals utilization in research and is responsible for personal safety and safety of the group.	TZ2_K04	P7S_KR/1
AIE_K02	Demonstrates the ability of individual work as well as to be an effective member of a team, to be a leader of a team, ma king decisions, plan and organize own and the team work.	TZ2_K03 TZ2_K05	P7S_KO/1 P7S_KO/2 P7S_KK/1
AIE_K03	Is conscious about the environmental hazards of modern biotechnology	TZ2_K04	P7S_KR/1
AIE_K04	Is able to use computer hardware and software for the text and data processing.	TZ2_K03 TZ2_K06	P7S_KO/1 P7S_KO/2 P7S_KK/1

Teaching contents:

Lectures	**30 hours**
Topics of the lectures	Introduction to food enzymology. Food technologies that make use of enzymatic conversion – an overview. The history, present and perspectives of biocatalysis and novel applications Enzymatic starch conversion in distilleries. The chemistry of starch and basic steps of its enzymatic modifications. Dry and wet grain milling. German and American system of mashing. Economic and technological aspects of portable ethanol and bioethanol manufacturing Distillers' dried grains (DDG) and fermentation yield. Fungal protease in distilleries. Economic analysis of proteolysis implications as they depend on the production scale Enzymatic starch conversion in the starch syrups manufacturing. The technology of glucose, maltose, high maltose, high conversion and iso-glugose syrups production. Enzyme preparations that may be applied in the starch syrups industry. Fungal lysolecithinase and its impact on the filtration yield of glucose syrup produced from wheat starch. Immobilized glucose isomerase of the first, second and third generation. Application of commercial enzymes In the fruit and vegetables processing. The plant cell wall and its enzymatic degradation. Plant cell wall and its enzymatic degradation. Pulp maceration and juice clarification with the aid of enzymes. Pectinases in the citrus fruit processing. The application of enzymes in the apple juice concentrate manufacturing. Enzyme – aided extraction of pectin from the apple pomace. The chemistry of aroma compounds in wine. Enzymatic modification of wine aroma. Technologies applied in white and red wine manufacturing. "On skin" fermentation and thermovinification. The overview of enzymes application in wineries. Enzymes In the feed industry. Phytase, beta-glucanase and xylanase as the feed additives for monogastric animals. The gastrointestinal tract as a specific bioreactor. The requirements for enzymes that may be applied to the mash-type Leeds and granulates. Perspectives of New applications of enzymes in the feed industry. Modifications of chemical compositions of poultry meat and eggs by means of enzymatic feed additives.

	Enzymes in the meat and dairy industries. Proteolysis and lipolysis and their consequences for the quality of the final product. Enzymatic acceleration and modulation of ripening processes in the meat and dairy industries. Transglutamise and areas of its applications. Enzymes in the meat and dairy industries. Proteolysis and lipolysis and their consequences for the quality of the final product. Enzymatic acceleration and modulation of ripening processes in the meat and dairy industries. Transglutamise and areas of its applications. Industrial applications of immobilized biocatalysts. Different methods of enzyme immobilization and different generations of immobilized biocatalysts.
Accomplished learning outcomes	*TŻ2_W01, TŻ2_W04, TŻ2_W12, TŻ2_K03, TŻ2_K04, TŻ2_K05 TŻ2_K06*
Verification methods, rules and criteria of outcome assessment	*Written exam test – single choice questions (positive result- pass-with the score of more than 51% points. Proportions in the final course assessment: 50% in the term 1, 90% in the term 2, 90% in the term 3*

Classes **15** **hours**

Topics of the classes	Determination of activation energy for the enzymatically catalyzed and non-catalyzed reactions. The effects of rising temperature on both types of reactions. Amylases in enzymatic starch modifications. Determination of activity of the enzymes, their effective dosages and optimization of parameters for starch liquefaction and saccharification. Determination of basic characteristics the experimental enzymatically modified starch products: glucose syrup, maltose syrup and high conversion syrup.
Accomplished learning outcomes	*TŻ2_U01, TŻ2_U02, TŻ2_U07,*
Verification methods, rules and criteria of outcome assessment	*Lab trainings are evaluated on the basis of students activity and lab protocols – for the passed (3.0) mark. Written test will be used for a mark higher than 3.0. Proportions in the final course assessment: 50% in the term 1, 10% in the term 2, 10% in the term 3.*

Seminars **0** **hours**

Topics of the seminars	
Accomplished learning outcomes	*symbol of learning outcomesof the seminars*
Verification methods, rules and criteria of outcome assessment	*together with participation in the final asessement (in %)*

References:

Basic	*1. Chandrasekaran, M., 2016. Enzymes in Food and Beverage Processing, CRC Press, Boca Raton, Florida* *2. Whitaker, J.R., Voragen, A.G.J., Wong, D.W.S. 2003. Handbook of Food Enzymology. Marcel Dekker, Inc., New York, Basel*

	3. Uhlig, H. 1998. Industrial Enzymes and their Applications. John Wiley & Sons, Inc., New York
Supplementary	*1. Buchholz, K., Kasche V., Bornscheuer, U.T. 2012. Biocatalysts and Enzyme Technology* *2. Whitaker, J.R., Law, B.R., 2002. Enzymes in Food Technology. CRC Press, Boca Raton.*

Structure of learning outcomes:

Discipline: food technology and nutrition (DZ0104N)				*3*	ECTS**
Discipline: # (*provide appripriate symbol - if the course relates to more than one academic discipline*)				*0*	ECTS**
Structure of student activities:					
Contact hours		47	hours	1,9	ECTS**
including:	lectures	30	hours		
	classes and seminars	15	hours		
	consultations	1	hours		
	participation in research	…	hours		
	mandatory trainerships	…	hours		
	participation in examinations	1	hours		
e-learning		…	hours	…	ECTS**
student own work		28	hours	1,1	ECTS**

Syllabus valid from the academic year 2021/2022

*** where 10 hours of classes = 1 ECTC (in case of 15 h → 2 ECTS)**

** stated with an accuracy to 0.1 ECTS, where 1 ECTS = 25 - 30 hours of classes

academic discipline code: RZ - animal science and fishery, PB - biological sciences, etc.