

FACULTY OF CHEMISTRY					
<b>SUBJECT CARD</b>					
Name of subject in Polish	Mikrobiologia przemysłowa				
Name of subject in English	Industrial microbiology				
Main field of study (if applicable):	Biotechnology				
Specialization (if applicable):					
Profile:	academic				
Level and form of studies:	1st level, 2nd level – supplementary semester*, full-time				
Kind of subject:	obligatory				
Subject code					
Group of courses	NO				
	Lecture*	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course	-				
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes	-		2		
including number of ECTS points for direct teacher-student contact (BU) classes	1,3		2,1		
<b>*PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES</b>					
1. Biological background at academic level					
2. Microbiological knowledge at academic level.					
3. Laboratory practice in microbiological work.					
<b>SUBJECT OBJECTIVES</b>					
C1 Understanding the morphological and physiological characteristics of major groups of microorganisms of industrial importance.					
C2 To learn how to acquire, improve and identify new strains of microorganisms					
C3. Knowledge of the microflora of raw materials and food products.					
C4. Knowledge of methods of testing microbiological purity of samples of various origins.					
C5. Teaching methods of practical examination of a specific feature of microorganisms.					

PROGRAMME CONTENT		
SUBJECT LEARNING OUTCOMES		
relating to knowledge:		
PEK_W01 The student has knowledge about the morphology and physiology of microorganisms of industrial importance;		
PEK_W02 The student knows the techniques used to perform the isolation, identification and improvement of desired microorganisms;		
PEK_W03 The student has knowledge about the microflora of various raw materials and food products as well as its impact on putrefactive processes;		
PEK_W04 The student knows the methods for the determination of selected groups of microorganisms samples of various origins		
PEK_W05 Student is able to characterize microorganisms that cause food poisoning		
relating to skills:		
PEK_U01 Student is able to design and carry out an experiment that allows to study a specific enzymatic activity of a microorganism and analyse the obtained results;		
PEK_U02 The student is able to carry out the process of disintegration of biological material and check its effectiveness;		
PEK_U03 The student can isolate a new species of microorganisms from the natural environment and make their basic characteristics;		
PEK_U04 Student is able to examine the sensitivity of microorganisms to antibiotic substances;		
PEK_U05 The student is able to carry out the basic microbiological analysis of a specific sample;		
PEK_U06 The student is able to carry out the process of microorganisms immobilization and apply the biocatalyst thus obtained in a particular process.		
Lectures		Number of hours
Lec 1	<b>Selection of microorganisms useful or potentially useful industrially.</b> Collections of microorganisms. Isolation of microorganisms from the natural environment. Methods of increasing the number of microorganisms with desired characteristics, in the environmental samples. Examples of rational choice of selection factors in enriched cultures. Selection and fermentation tests of newly isolated strains.	4
Lec 2		
Lec 3	<b>Identification of microorganisms.</b> Basic concepts: microorganism identification process, reference strain, species, pure culture. Criteria for identification of prokaryotic microorganisms. Criteria for identification of eukaryotic microorganisms. Biochemical, biophysical, molecular biology, immunological methods used in the process of microbial identification.	2
Lec 4	<b>Improvement of commercial strains.</b> The technique of protoplast fusion - obtaining protoplasts, forcing fusions, selection of recombinants. Examples of the use of recombinant microorganisms in biotechnology.	2
Lec 5	<b>Microflora of raw materials and products of plant and animal origin.</b> Microflora of cereals and cereal products. Baker's starters (composition, order of chemical transformation during fermentation). Microflora of fruits and vegetables. Different methods of preserving fruit and vegetables. Milk microflora. Biochemical changes occurring during milk fermentation.	2
Lec 6	<b>Microflora of raw materials and products of plant and animal origin - meat microflora.</b> Distribution of microbial substrates in meat. Ways of meat stabilization. Microflora of eggs. Egg protection system against infection. Microflora of fish, spices and sugar Microbiological spoilage of food.	2
Lec 7	<b>Food poisoning.</b> Differences between intoxication and toxoinfection. Examples of microorganisms that cause intoxication - molds, <i>Clostridium botulinum</i> , <i>Staphylococcus aureus</i> . Characteristics of selected microorganisms that cause toxoinfections. Dietary intoxication with nitrites and intoxication with biogenic amines. Circumstances conducive	4
Lec 8		

	to an increase in the frequency of food poisoning	
Lec 9	<b>The production of food that is safe for health.</b> Control systems. Microbiological analysis of food. Detecting the presence of coliform bacteria in food. Determination of pathogenic staphylococci in food. Detection of anaerobic spore-producing microbes with the capability of sulfate reduction, in food samples. Methods for determining the presence of <i>Salmonella</i> bacteria in food.	2
Lec 10	<b>Morphological and physiological characteristics of major groups of microorganisms of industrial importance.</b> Yeast - cell morphology and physiology, reproduction, classification, cultivation methods.	2
Lec 11	<b>Morphological and physiological characteristics of major groups of microorganisms of industrial importance.</b> Fungi - cell morphology and physiology, reproduction, classification, cultivation specifics. Characterization of fungi important biotechnologically.	2
Lec 12	Raw materials and auxiliary materials in biotechnology. A culture medium composition for industrial applications. Types of microbial media. Water as a basic component of microbial medium. Different carbon sources used in cultivation media. Different sources of nitrogen used in cultivation media. Other substrate components necessary for microorganisms growth. Controlling the metabolism of microorganisms with the composition of the medium. Auxiliary materials in the culture medium (detergents and defoamers)	4
Lec 13		
Lec 14	Repetition of the material. Final test - 1st term	2
Lec 15	Repetition of the material. Final test – 2 st term	2
	Total hours	<b>30</b>
<b>Laboratory</b>		<b>Number of hours</b>
Lab 1	The form of passing the classes. Conditions for safe work in a microbiological laboratory. Description of basic work tools..	4
Lab 2	<b>The process of disintegration of microorganisms.</b> Mechanical methods: comparison of the process of disintegration of yeast cells using a ball mill and manual grinding of cells in a mortar.	4
Lab 3	<b>The process of disintegration of microorganisms.</b> Non-mechanical methods: comparison of the process of disintegration of bakery yeast cells by freezing with the disintegration process using detergents.	4
Lab 4	<b>Water purity testing.</b> Testing of water samples for the content of fungi and bacteria. Coli test. Searching for microorganisms with a cellulolytic activity in water.	4
Lab 5	Analyzing and discussing the results of experiments from previous laboratory. <b>Enzymes.</b> Examination of bacteria's ability to produce extracellular amylases. Examination of proteolytic activity of selected microorganisms. Examination of bacterial lipolytic activity.	4
Lab6	Reading and discussing the results of experiments from previous laboratory. <b>Enzymes.</b> Determination of the activity of selected enzymes from the oxidoreductase class, in plant material.	4
Lab7	<b>Isolation of microorganisms from various soil samples.</b> Morphological characteristics of isolates. Determination of the isolates ability to ammonification. Study of isolates in the production of antibiotic substances.	4
Lab8	<b>Enzymes.</b> Quantitative examination of lipolytic activity of newly isolated microorganisms, using the colorimetric method.	2
Lab9	Written test on theoretical and practical knowledge from classes 2-8.	
Lab10	<b>Immobilization of microorganisms.</b> The method of cross-linking baker's yeast in calcium	

	alginate.	
Lab11	<b>Biocatalysis.</b> Comparison of reducing activity of baker's yeast (free cells and immobilized yeast) to acetophenone.	
Lab12	<b>Antibiotics.</b> Sensitivity study of selected bacterial species on commercially available antibiotics. Determination of the inhibitory concentration of antibiotics on bacteria. The method of Szybalski. Synergistic action of drugs.	
Lab13	<b>Colorimetric determination of lactic acid content in silage.</b> Examination of food samples for the content of lactic acid produced by bacteria capable of lactic fermentation.	
Lab14	Complementary laboratory allowing to make up for outstanding exercises resulting from justified absence from classes.	
Lab15	Written test of theoretical and practical knowledge from classes 10-13.	
	Total hours	<b>45</b>
<b>TEACHING TOOLS USED</b>		
N1. Multimedia presentation		
N2. Performing tasks in the laboratory		
<b>EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT</b>		
<b>Evaluation</b> (F – forming (during semester), P – concluding (at semester end))	Learning outcomes number	Way of evaluating learning outcomes achievement
C (lecture)	PEK_W01-W05	Written colloquium (max. 20 points) 3.0 if 10-11 points 3.5 if 12 points 4.0 if 13-14 points 4.5 if 15-16 points 5.0 if 17-19 points 5.5 if 20 points
F1 (laboratory)	PEK_U01 – U03	Written test 1(max 30 points)
F2 (laboratory)	PEK_U04 – U06	Written test 2 (max 30 points)
C (laboratory) = 3.0 (F1+F2) = 50% - 58% points 3.5 (F1+F2) = 59% - 65% points 4.0 (F1+F2) = 66% - 75% points 4.5 (F1+F2) = 76% - 85% points 5.0 (F1+F2) = 86% - 95% points 5.5 (F1+F2) = 96% - 100% points		
<b>PRIMARY AND SECONDARY LITERATURE</b>		
<b>PRIMARY LITERATURE:</b>		
[1] Enzymy w technologii spożywczej, red. Robert J. Whitehurst, Maarten Van Oort, PWN, 2017		
<b>SECONDARY LITERATURE:</b>		
[1] Enzymes In Industry – Production and Application, red.W.Aehle, Wiley-VCH, 2004		
[2] Biocatalysts and Enzyme Technology, red. K. Bucholtz, V. Kasche, U. Bornscheuer, Wiley-VCH, 2005		
<b>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</b>		
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