Nazwa zajęć/*Course title*:	**Enzymologia i techniki biochemiczne**	**ECTS**	**3**
Nazwa zajęć w j. angielskim/ *Course title in English*:	**Enzymology and biochemical techniques**		
Zajęcia dla kierunku studiów/ *Degree program name*:	**Biotechnology**		

Język kursu/ *Course language*: English			Poziom studiów/*Study level:*		
Typ studiów/ *Form of studies*: ☒ intramural ☐ extramural	Status zajęć/ *Course status* ☒podstawowe/ *basic* ☐kierunkowe/ *major*	☒obowiązkowe/ *mandatory* ☐ do wyboru/ *elective*	Semestr/*Semester:* 4		☐ semestr zimowy/ *winter semester* ☒semestr letni/ *summer semester*
Rok akademicki/*Academic year:*			**2022/2023**	Numer katalogowy/ *Catalogue number:*	**BBT_BTa-1S-4L-32**

Koordynator zajęć/Course coordinator:	**Dr hab. Urszula Jankiewicz**
Prowadzący zajęcia/ *Teachers responsible for the co*urse:	Employees of the Department Biochemistry and Microbiology , Institute Biology, SGGW
Założenia, cele i opis zajęć/ *Aims, objectives and description of the course:*	Assumptions and objectives of the subject: The learning objective is to explain the structure, specificity and action of enzymes and their mechanisms of catalysis, regulation and kinetics. In addition, students will be introduced to the phenomena of enzymatic inhibition and how to determine them. Techniques for purification and measurement of enzyme activity will also be discussed, as well as the importance of enzymes in metabolism and applications of enzyme systems in biotechnological processes. Lecture topics: Introductory concepts of enzymology; structure of enzymes and active center. Substrate specificity and relative to the catalyzed reaction, factors affecting enzyme activity, coenzymes and inhibitors. Enzyme kinetics: activation energy, transition states, kinetic constants and their biological significance, graphical ways of representing hyperbolic and non-hyperbolic enzyme kinetics, kinetics with one, two and more substrates. Mechanisms of regulation of enzymatic activity: allostery, covalent modifications (zymogens and proenzymes), regulatory proteins. Regulation at the level of cellular structures - compartmentalization of the cell and its importance for the control of metabolic pathways. Multi-enzyme complexes. Mechanism of action of typical enzymes using proteases as an example: acid-base catalysis, nucleophilic catalysis, electrophilic catalysis. Determination and stabilization of enzyme activity. Enzyme assay techniques: physicochemical and molecular biology. Importance of enzymes in metabolism - selected metabolic blocks. Application of enzymes in biotechnology and selected methods of enzyme protein engineering. Topics of exercises: 1. extraction of enzymes (invertase from yeast cells). Study of substrate specificity using invertase as an example. 2. Isolation and fractionation of glutamate dehydrogenase, measurement of oxido-reducing enzyme activity 3. Use of electrophoresis (SDS PAGE) to control enzyme purification and protein molecular weight determination. 4. Enzyme Inhibition, graphical determination of Inhibition Type and Inhibition Constant for Invertase. 5. Enzyme immobilization (carrier-chitin) as an example of its technological application, determination of the efficiency of enzyme immobilization (glucoamylase) and measurement of its activity 6. Ion exchange chromatography on the example of compounds containing phosphate groups.
Formy dydaktyczne, liczba godzin/ *Teaching forms, number of hours*:	a) lecture; number of hours 15 b) laboratory classes; number of hours 30…;
Metody dydaktyczne/*Teaching methods:*	Lecture in the form of a multimedia presentation, discussion, consultation Practical activities in the laboratory, discussion of the results, the possibility of using distance learning in cases of necessity
Wymagania formalne i założenia wstępne/ *Formal requirements and prerequisites*	Completed courses in chemistry and biochemistry (exercises and lectures) Laboratory work skills gained from biochemistry exercises

Efekty uczenia się/*Learning outcomes:*		treść efektu przypisanego do zajęć/*the content of the effect assigned to the course:*	Odniesienie do efektu kierunkowego /*Relation to the course outcomes*	Siła dla ef. kier* /*Impact on the course outcomes* *
Wiedza (absolwent zna i rozumie) /*Knowledge*: *(the graduate knows and understands)*	W1	The Student knows the chemical, physical, molecular and thermodynamic basis of enzyme action	K_W05 K_W07	3 3
	W2	understands the mechanisms of action of inhibitors	K_W05 K_W07 K_W08	3 3 3
	W3	knows how to purify enzymes and measure their activity	K_W04 K_W05 K_W07	3 3 3

			K_W08	3
	W4	knows the apparatus considerations for working with enzymes	K_W04 K_W07	3 3
Umiejętności (absolwent potrafi) /*Skills*: *(the graduate is able to)*	U1	Knows how to study the kinetics and inhibition of an enzymatic reaction	K_U05 K_U06 K_U21 K_U20	3 3 3 3
	U2	Knows how to calculate concentrations of solutions used for enzymatic determinations	K_U16 K_U21 K_U20	3 3 3
Kompetencje (absolwent jest gotów do) /Competences: (The graduate is ready to)	K1	The student is ready to cooperate	K_K02 K_K05	1 1

Treści programowe zapewniające uzyskanie efektów uczenia się: */Program contents ensuring the achievement of the learning outcomes:*	To explain the structure, specificity and action of enzymes and their mechanisms of catalysis, regulation and kinetics. Familiarization with the phenomena of enzymatic inhibition and how to determine them. Techniques for purification and measurement of enzyme activity and the importance of enzymes in metabolism and the application of enzyme systems in biotechnological processes
Sposób weryfikacji efektów uczenia się/ *Methods of the verification of the learning outcomes:*	Written tests in laboratory classes, evaluation of performed practical exercises, written reports on performed exercises, written exam, The possibility of using distance learning when necessary
Szczegóły dotyczące sposobów weryfikacji i form dokumentacji osiąganych efektów uczenia się /Details on the verification methods and of the ways of documenting the learning outcomes:	Individual student evaluation sheets that record the results of the written test, grades for the accuracy and correctness of the experiment performed and grades for the preparation of the report on the exercise held; the content of the examination questions with a grade; the content of the test questions with a grade, the possibility of using distance learning in cases of necessity
Elementy i wagi mające wpływ na ocenę końcową/*Elements and weights influencing the final grade:*	- evaluation of the experiment performed during the exercises - 15% - preparation of written reports from exercises -10% - colloquium (test) at exercises - 25% - written exam on the lecture material - 50%
Miejsce realizacji zajęć/ *Teaching place:*	lecture hall, exercise room,

Literatura/Literature:

1. Handbook of Food Enzymology, Edited ByJohn R. Whitaker, Alphons G. J. Voragen, Dominic W.S. Wong
2. Fundamentals of Enzymology Price, Nicholas C.; Dwek, Raymond A.; Wormald, Mark; Ratcliffe, R.G.; University of Oxford
3. Harper's Illustrated Biochemistry, Victor Rodwell, David Bender David Bender Kathleen Botham , Peter Kennelly, P. Anthony Wei
4. Instructions for exercises in the laboratory
5. Lecture materials
6. You can use any textbook on enzymology and biochemistry to supplement your knowledge

UWAGI/*ANNOTATIONS*

*) 3 – zaawansowany i szczegółowy, 2 – znaczący, 1 – podstawowy/ *3 – significant and detailed, 2 – considerable, 1 – basic,*

Wskaźniki ilościowe charakteryzujące moduł/przedmiot/*Quantitative summary of the course:*

Szacunkowa sumaryczna liczba godzin pracy studenta (kontaktowych i pracy własnej) niezbędna dla osiągnięcia zakładanych dla zajęć efektów uczenia się - na tej podstawie należy wypełnić pole ECTS */Estimated number of work hours per student (contact and self-study) essential to achieve the presumed learning outcomes - basis for the calculation of ECTS credits:*	110 h
Łączna liczba punktów ECTS, którą student uzyskuje na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich lub innych osób prowadzących zajęcia/ *Total number of ECTS credits accumulated by the student during contact learning:*	1.8 ECTS