

FACULTY OF CHEMISTRY					
<b>SUBJECT CARD</b>					
Name of subject in English:	Bioproducts separation and purification				
Main field of study (if applicable):	BIOTECHNOLOGY				
Specialization (if applicable):					
Profile:	academic				
Level and form of studies:	1 <sup>st</sup> 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		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	crediting with grade		crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	3		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		1,4		
<b>*PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES</b>					
1. Knowledge of such courses as chemical engineering, microbiology, biochemistry. 2. Ability to manually operate laboratory equipment such as spectrophotometer, analytical balance, automatic pipettes. 3. The ability to create diagrams for different types of functions (by computer), determining the function equation.					
<b>SUBJECT OBJECTIVES</b>					
C1 Getting familiar with the composition (homo- and heterogeneous systems) and the approach to the separation of post-reaction streams. C2 Understanding the basics of using processes for the separation of heterogeneous systems. C3 Learning the basics of diffusion processes application. C4 Getting familiar with basic membrane techniques. C5 Understanding the principles of multi-stage separation process designing.					
<b>SUBJECT EDUCATIONAL EFFECTS</b>					
<b>related to knowledge:</b>					
PEK_W01 student knows and understands the basics of construction and the clue of the operation performed on apparatus components in processes conducted in both: laboratory and industrial scale, used for separating bioproducts and wastewater treatment.					
PEK_W02 student has basic knowledge of separation techniques of heterogeneous and homogeneous systems.					
PEK_W03 student knows the basic equations, which describe the kinetics of a given process.					
PEK_W04 student has knowledge enabling him to select a given process (or cascade of processes) for a given application.					
<b>related to skills:</b>					
PEK_U01 student is able to carry out an experiment on laboratory scale equipment, develop the obtained results and present them in the form of a written report.					

PEK_U02 student is able to purify biomolecules using a given separation method. He can measure the concentrations of the test ingredient and determine the degree of purification.		
PEK_U03 student can assess profits of a given separation method for a given application and apply known equations to describe its kinetics.		
<b>related to social competences:</b>		
PEK_K01 student is ready to critically evaluate his/her knowledge and received content		
PEK_K02 student is able to work in a group, performing various roles including group leader		
PEK_K03 student is aware of the importance of theoretical and practical knowledge acquired during the course and is ready to apply his general and engineering skills in practice.		
<b>PROGRAMME CONTENT</b>		
<b>Lectures</b>		<b>Number of hours</b>
Lec 1	Introduction to the separation of bioproducts. Division of methods.	2
Lec 2	Filtration - the fundamentals of the process, apparatus, application.	2
Lec 3	Division of suspensions. Sedimentation - the fundamentals of the process, apparatus, application.	2
Lec 4	Filtration - the basics of the process, types of partitions.	2
Lec 5	Filtration - apparatus, application.	2
Lec 6	Micro, ultrafiltration - the idea of membrane processes, apparatus, application.	2
Lec 7	Filtration and sediment centrifuge. Emulsions - structure, formation and disintegration.	2
Lec 8	Flotation - the fundamentals of the process, apparatus, application.	2
Lec 9	Introduction to diffusion processes. Extraction in a liquid-liquid system - the basics of the process, description of kinetics.	2
Lec 10	Extraction in a liquid-liquid system - apparatus. Solid-liquid extraction - the basics of the process, application	2
Lec 11	Classic and membrane distillation - the basics of the process, application.	2
Lec 12	Sorption - the basics of the process, description of kinetics, application.	2
Lec 13	Pervaporation - the basics of the process, description of kinetics, application apparatus.	2
Lec 14	Crystallization - process conditions, apparatus. Co-crystallization - the idea of the process, application.	2
Lec 15	Passing test	2
	<b>Number of hours</b>	<b>30</b>
<b>Laboratory</b>		<b>Number of hours</b>
Lab 1	Adsorption - determination and mathematical description of the adsorption rate and equilibrium state.	6
Lab 2	Extraction - determination of extraction kinetics and division coefficient in a batch system extraction (mixing); determination of working effectiveness in continuous system extraction (extraction column).	6
Lab 3	Flotation - determination of the enrichment and recovery factors gained during separation process.	6
Lab 4	Vacuum filtration - measuring the variability of the filtrate stream in time, description of the process with determination of compressibility index of the filter cake and determination of the liquid purification degree.	6
Lab 5	Sedimentation - determination of the sinking velocity of suspensions with different solid content. Distillation - determination of the composition of the distillate during periodic distillation	6

	duration, determination of the total alcohol mass obtained in the fermentation bottle subjected to distillation, process balance.	
	<b>Number of hours</b>	<b>30</b>
<b>TEACHING TOOLS USED</b>		
N1. Lecture N2. Performing the experiment N3. Description of results using computer graphics programs N4. Consultations		
<b>EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT</b>		
<b>Evaluation</b> (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1(lecture)	PEK_W01 - PEK_W04	Written test for maximum 10 points.
P (lecture) = F1= 10 pkt. 9.5 - 10 pkt. + bdb 9.0 – 9.4 pkt. bdb 8.0 – 8.9 pkt. + db 7.0 – 7.9 pkt. db 6.0 – 6.9 pkt. + dst 5.0 - 5.9 pkt. dst		
F1-F5 (Laboratory classes)	PEK_U1 – PEK_03	Points for each classes - quiz + report (max 5 points for each lab)
P (laboratory) = (F1 + F2 + F3 + F4 + F5 + F6)  P = 3.0 if the sum of points is in the range of 60-67.9% 3.5 if the sum of points is in the range of 68-75.9% 4.0 if the sum of points is in the range of 76-83.9% 4.5 if the sum of points is in the range of 84-89.9% 5.0 if the sum of points is in the range of 90-98% 5.5 if the sum of points is > 98%		
F3		
P		
<b>PRIMARY AND SECONDARY LITERATURE</b>		
<b><u>PRIMARY LITERATURE:</u></b>		
[1] R. Gawroński- Procesy oczyszczania cieczy- Oficyna Wydawnicza Politechniki Warszawskiej, W-wa 1996 [2] Pod redakcją P. Lewickiego- Inżynieria procesowa i aparatura przemysłu spożywczego Wyd. Naukowo-Techniczne, W-wa 1999 [3] E. Pijanowski, M. Dłużewski – Ogólna technologia żywności – Wyd. NaukowoTechniczne, W-wa 1997 [4] R. Rautenbach – Procesy membranowe, Wyd. Naukowo-Techniczne, W-wa 1996		
<b><u>SUPPLEMENTARY LITERATURE:</u></b>		
[5] W.W. Blanch, D.S. Clark – Biochemical Eng.- rozdz.6, NY 1996 [6] P. Better, E. Cussler – Bioseparations-downstream processing for biotechnology – Wiley&Sons Publication 1988		
<b>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</b>		
<b>ANNA TRUSEK, <a href="mailto:anna.trusek@pwr.edu.pl">anna.trusek@pwr.edu.pl</a></b> <b>DAMIAN SEMBA, <a href="mailto:damian.semba@pwr.edu.pl">damian.semba@pwr.edu.pl</a></b>		