Course name: Plant and microbial proteomics

ECTS	*4*
Course status	*facultative*
Course final assessment /evaluation of outcomes	*exam*
Prerequisite	*basic knowledge and skills in biology, cell physiology, biochemistry, genetics*

Main field of study:
Agriculture and Horticulture, Biology and Biotechnology (Erasmus+)

Educational profile	*general academic*
Code of studies and education level	*bachelor/engineer (SI) or master of science (SM)*
Semester of studies	*winter or summer*
Language of instruction	*English*

Course offered by:

Name of faculty offering the course	Faculty of Biotechnology and Horticulture
Name of department offering the course	Dept. Plant Biology and Biotechnology
Course coordinator	dr hab. Paweł Kaszycki, prof. URK

Learning outcomes:

Symbol of outcome	Description of the learning outcome	Reference to main field of study outcomes	Area symbol*
KNOWLEDGE – student knows and understands:			
PMProt_W1	the term "proteome" and "proteomics" as an interdisciplinary scientific area dealing with systemic analysis of proteins: their mapping together with functional characterization	EPB2_W02	R, P
PMProt_W2	scope and research strategies of proteomics, while comparing them with the scope of genomics, transcriptomics and protein chemistry	EPB2_W02	R, P
PMProt_W3	basic elements of proteomic analysis and standard procedure schemes	EPB2_W02	R, P
PMProt_W4	tools of proteomics – main study methods and techniques related to protein expression and functional proteomics	EPB2_W01 EPB2_W04 EPB2_W06	R, P
PMProt_W5	research strategies and methodology typical of proteomics approach	EPB2_W01 EPB2_W04	R, P
PMProt_W6	theoretical background of electrophoretic techniques, mass spectrometry, fractionation methods, studies of protein structure and function – all applied to proteome analyses	EPB2_W01 EPB2_W04 EPB2_W06	R, P
PMProt_W7	current directions of proteomics development: use of bioinformatic tools, nanomethods and protein microarrays	EPB2_W01 EPB2_W04	R, P
SKILLS – student is able to:			
PMProt_U1	apply chosen methods to obtain protein extracts from plant and microbial biological material	EPB2_U01 EPB2_U02 EPB2_U05	R, P
PMProt_U2	apply basic protein fractionation techniques using liquid chromatography	EPB2_U01 EPB2_U02 EPB2_U05	R, P
PMProt_U3	work employing modern equipment and laboratory instrumentation used in functional analysis of plant and microbial proteins	EPB2_U01 EPB2_U02 EPB2_U05	R, P
PMProt_U4	use of specialized software for control of research equipment and	EPB2_U01	R, P

	analysis of results	EPB2_U02 EPB2_U03 EPB2_U05	
PMProt_U5	plan a scientific experiment and select the optimal research strategy for studies of the yeast proteome	EPB2_U01 EPB2_U02 EPB2_U03 EPB2_U05	R, P
SOCIAL COMPETENCIES – student is ready to:			
PMProt_K1	develop skills of well-organized team work, respecting his/her own work as well as that of the others	EPB2_K02	R, P
PMProt_K2	appreciate advantages resulting from the use of novel scientific research achievements in proteome analysis practice	EPB2_K01	R, P
PMProt_K3	take responsibility for the safety of own and the other students' work as well as for the entrusted instrumentation	EPB2_K05	R, P
PMProt_K4	understand the need for evaluation of the risk and results of laboratory work	EPB2_K01 EPB2_K05	R, P
PMProt_K5	develop invention and creativity while solving particular practical problems emerging upon performance of the planned research scheme	EPB2_K01	R, P

Teaching contents

Lectures	15 hours
Topics	Biosynthesis and regulation of protein expression, protein life cycle – from its synthesis till final degradation. Proteome determination based on the genome knowledge and analysis, comparison of proteomes of different plant and microbial organisms. Functional vs. expression proteomics. Basic stages of proteomic analysis: procedural workflows and schemes. Electrophoretic methods in proteomics: description of selected techniques including 2-DE (two-dimensional electrophoresis); methods for data acquisition and visualization; construction of 2D maps, data bases. Mass spectrometry (MS) in proteomics: theoretical background and the use in practice of proteome analysis. Efficacy and performance of proteome analyses: automation, robotization, use of bioinformatic tools, systems informatization and construction of databases. Methods for protein fractionation, purification and studies in proteomics with particular regard to plant, bacterial and yeast proteomes. New trends in proteomics: development of bioinformatics, novel protein identification techniques: recognition chips, protein microarrays, lab-on-a-chip; ultrasensitive detection and nano-methods. Examples of research studies involving proteome analyses.
Accomplished learning outcomes	*PMProt_W1-W7, PMProt_K2*
Means of verification, rules and criteria of assessment	*time-restricted written exam (70% participation to the final score)*
Classes	15 hours
Topics	Elements of functional proteomics: studying enzymes induced by environmental stress. Induction of enzymes of the yeast methylotrophic pathway, yeast culture cultivation and biomass growth in a laboratory biofermenter. Optimization of biofermenter process parameters, biomass assessment with turbidimetric method, collection of cellular protein extracts: biomass centrifugation, disintegration of cellular suspension. Isolation and purification of the methylotrophic pathway enzymes: fractionation of cell protein extracts with the FPLC chromatography, determination of protein concentration in fractions enriched with particular enzymes, kinetic analysis of selected enzymatic activities.
Accomplished learning outcomes	*PMProt_U1-U5, PMProt_K1-K5*
Means of verification, rules and criteria of	*evaluation of the preparedness for classes; written report on*

assessment	*laboratory work (30%)*

References:

Basic	*1. Liebler, D. C. Introduction to Proteomics: Tools for the New Biology. Humana Press, 2002* *2. Dunn M. J. (Ed.) Proteomics Reviews 2001. John Wiley & Sons, 2001* *3. Campbell, A. M., Heyer, L. J. Discovering Genomics, Proteomics, and Bioinformatics. Benjamin Cummings, 2002*
Supplementary	*4. Pennington S. Proteomics: From Protein Sequence to Function. Dunn M. J. (Ed.) Springer-Verlag New York, Inc., 2000* *5. Westermeier R. Naven T. Proteomics in Practice: A Laboratory Manual of Proteome Analysis. John Wiley & Sons, 2002* *6. Bodzon-Kulakowska A., Bierczynska-Krzysik A., Dylag T., Drabik A., Suder P., Noga M., Jarzebinska J., Silberring J. Methods for samples preparation in proteomic research (2007) Journal of Chromatography B 849: 1-31* *7. Rose J.K.C., Bashir S., Giovannoni J.J., Jahn M.M., Saravanan R.S. (2004) Tackling the plant proteome: practical approaches, hurdles and experimental tools. The Plant Journal 39: 715-73*

Structure of learning outcomes

Area of academic study: agriculture and horticulture	2.0 ECTS**
Area of academic study: biological sciences	2.0 ECTS**

Structure of student activity

Contact hours		37	hrs.	1.5	ECTS**
Including:	lectures	15	hrs.		
	classes and seminars	15	hrs.		
	consultations	5	hrs.		
	participation in research	…	hrs.		
	obligatory traineeships	…	hrs.		
	participation in examination	2	hrs.		
e-learning		…	hrs.	….	ECTS**
student own work		63	hrs.	2.5	ECTS**

*areas of academic study in the fields of: P – biological sciences; R – agriculture and horticulture

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