BIOTECH-E03:	**PROTEIN PURIFICATION**
GENERAL INFORMATION	
Course Coordinator(s)	Ivica Strelec, PhD, full prof.
Associate(s)	-
Study Programme	Interdisciplinary Graduate Study Programme in English: Biotechnology
Course Status	Elective
Year of Study, Semester	1st Year / 2nd Semester
Credits (ECTS)	**3**
Teaching Method (number of classes)	Lectures 15; Seminars 5; Exercises 10
Expected Number of Students in the Course	25-30

COURSE DESCRIPTION

Course Aims

The aim of this course is to provide advanced knowledge on biochemical and molecular biology techniques and methods used for protein purification on different scales of production (from laboratory to large-scale production), as well as to introduce the students to up-to-date techniques and methods of protein purification. In addition, course provides understanding of molecular interactions underlying protein separation processes, enables rational planning of protein purification, as well as acquisition of practical skills in protein purification and qualitative and quantitative evaluation of experimental data of purification process.

Prerequisites for Enrolment and the Entry Competencies Required for the Course

Completed undergraduate university study programme of Natural sciences (chemistry, biology), Biotechnical sciences, Biomedicine or Health.

Learning Outcomes at the Programme Level Contributed by the Course

BIOTECH-3; INDBIOT-3

Learning Outcomes at the Course Level

After successful completion of this course students should be to:

1. Critically evaluate from start to finish the entire process of protein purification on different scales of production (from laboratory to large-scale production)
2. Recommend methods of protein isolation, extraction, concentration and purification
3. Plan and explain protein purification process with respect to protein molecular properties and demands of its purity
4. Select and design protein purification with respect to starting material and production scale
5. Know how to choose and use different methods for qualitative and quantitative analysis (evaluation) of protein purification process in respect to demands of protein purity and production costs
6. Critically examine large scale industrial protein production process and suggest improvements
7. Perform protein purification and critically evaluate experimental results by qualitative and quantitative analysis of protein purification process

Course Content

Lectures. Protein purification strategies – general guidelines and principles. Protein extraction and subcellular fractionation. Protein concentration and/or fractionation. Chromatographic methods of protein purification: Ion-exchange chromatography, Gel filtration, Hydrophobic and Reverse-Phase chromatography, Affinity and Immuno-affinity chromatography, Multidimensional chromatography of intact proteins, High performance liquid chromatography. Biomagnetic protein purification. Electrophoretic methods of protein purification and characterisation: one-dimensional electrophoretic techniques, 2D-electrohoresis. Protein quantification methods and techniques. Strategic planning for large-scale protein production (upstream and downstream

processing). Common methods and techniques in large-scale protein production.
Seminars. Protein purification in biotechnological and pharmaceutical industry.
Laboratory exercises. Isolation and purification of specific protein of animal, plant or microbial origin. Qualitative and quantitative evaluation of experimental data of protein purification process.

Teaching Methods

Lectures; seminars; laboratory exercises

Students' Obligations

Attendance at all forms of classes is mandatory and the students are obligated to attend all knowledge tests. The students may be absent from 30% (full-time students) and 50% (part-time students) of each of the forms of classes, provided that the absence is justified. An exercise or a seminar which has not been completed must be made up.

Monitoring the Activity of the Students (Connecting Learning Outcomes, Teaching Methods, and Grading)

Class-related activity	ECTS	Learning outcome	Student activity	Evaluation method	Grade points	
					Min.	Max.
Classes	0.25	1-7	Attendance to classes	Keeping records	2	10
Seminars	0.25	1-7	Preparation of seminar presentation	Seminar presentation	5	15
Laboratory exercises	0.50	3, 7	Work in laboratory	Written report	13	25
Final exam	2.00	1-7	Studying for the final exam	Written exam	30	50
Total	**3**				**50**	**100**

Evaluation of the written part of the final exam

Percentage of correct answers (%)	Grade points
99.00 – 100.00	50
97.00 – 98.99	49
95.00 – 96.99	48
93.00 – 94.99	47
91.00 – 92.99	46
89.00 – 90.99	45
87.00 – 88.99	44
85.00 – 86.99	43
83.00 – 84.99	42
81.00 – 82.99	41
79.00 – 80.99	40
77.00 – 78.99	39
75.00 – 76.99	38
73.00 – 74.99	37
71.00 – 72.99	36
69.00 – 70.99	35
67.00 – 68.99	34
65.00 – 66.99	33
63.00 – 64.99	32
61.00 – 62.99	31
60.00 – 60.99	30

Forming the final grade:
The points granted for the final exam are added to the grade points awarded during class attendance. The grading process is conducted by absolute distribution, i.e. based on total achievements, and compared to the numerical system in the following manner:
A – Excellent (5): 90-100 grade points; B – Very Good (4): 80-89.99 grade points; C – Good (3): 65-79.99 grade points; D – sufficient (2): 50-64.99 grade points

Mandatory Literature (available in the library and via other media)

Title	Number of copies in the library	Availability via other media
Simpson RJ, Adams PD, Golemis EA: Basic Methods in Protein Purification and Analysis, Cold Spring Harbor Laboratory Press, New York, 2009	-	-
Dennison C: A Guide to Protein Isolation, 2nd Ed., Kluwer Academic Publishers, London, 2003	-	-

Additional Literature

1. Labrou NE: Protein Downstream Processing: Design, Development and Application of High and Low-Resolution Methods. Humana Press, London, 2014.
2. Roe S: Protein Purification Techniques, 2nd Ed., Oxford University Press, Oxford, 2001.
3. Healthcare GE: Strategies for Protein Purification Handbook, GE Healthcare, Uppsala, 2010.
4. Healthcare GE: Design of Experiments in Protein Production and Purification Handbook, GE Healthcare, Uppsala, 2014.
5. Healthcare GE: Purifying Challenging Proteins. Principles and Methods, GE Healthcare, Uppsala, 2007.
6. Healthcare GE: Protein Sample Preparation Handbook, GE Healthcare, Uppsala, 2014
7. Scientific and professional papers related to the specific areas of the course

Quality Assurance Procedures Designed to Ensure the Acquisition of Outcomes and Competencies

Anonymous, quantitative, standardised student survey on the course and the teacher's work implemented by the Quality improvement office of the Faculty of Food Technology Osijek and/or the Faculty of Medicine Osijek.

Note

E-learning is not included in the class quota, but it is used in teaching and it contains links to various sites and video and audio materials available on websites.