SYLLABUS

PROTEOMICS

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeş-Bolyai University
1.2. Faculty	Faculty of Biology and Geology
1.3. Department	Department of Molecular Biology and Biotechnology
1.4. Field of study	Biology
1.5. Study cycle	Master
1.6. Study programme/Qualification	Bioinformatics applied in life sciences
1.7. Form of education	Full-time education

2. Information regarding the discipline

2.1. Name of the discipline	**Proteomics** **Proteomică**					Discipline code	**BME1125**
2.2. Course coordinator				Lect. Viorica Alina Sesărman, PhD			
2.3. Seminar coordinator				Lect. Pătraş Laura Ioana, PhD			
2.4. Year of study	1	2.5. Semester	2	2.6. Type of evaluation	E	2.7. Discipline regime	Elective

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	**4**	of which: 3.2 course	**2**	3.3 seminar/laboratory	**2**
3.4. Total hours in the curriculum	126	of which: 3.5 course	28	3.6 seminar/laborator	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					24
Additional documentation (in libraries, on electronic platforms, field documentation)					18
Preparation for seminars/labs, homework, papers, portfolios and essays					14
Tutorship					8
Evaluations					4
Other activities:					2
3.7. Total individual study hours	**70**				
3.8. Total hours per semester	**126**				
3.9. Number of ECTS credits	**5**				

4. Prerequisites (if necessary)

4.1. curriculum	Statistics, Molecular Biochemistry and Biophysics, Cell and Molecular Biology
4.2. competencies	• Average skills in operating laboratory equipment; • Average computer skills.

5. Conditions (if necessary)

5.1. for the course	Beamer Online meeting platform
5.2. for the seminar /lab activities	Attendance of a minimum of 90% of practical/ seminar classes, Computers, specific development environment

6. Learning outcomes

Knowledge	The student knows: The notions, concepts, and principles specific to structural and functional proteomics. The importance of the structure-function relationship and its particularities in the case of protein molecules. Molecular analysis methods and techniques applicable in proteomics, relevant to medical, industrial, and research laboratories. The operating principle of the mass spectrometer, the use of the m/z ratio for ionized peptide fragments, and their application in protein identification. The stages involved in designing a proteomics study, for both simple and complex samples, and the ability to describe and discuss these aspects. The essential information required for integrating disciplines such as Applied Genomics in Human Health, Metabolomics, and Individual Bioinformatics Projects.
Skills	The student is able to: Prepare biological samples for analysis by mass spectrometry. Identify proteins using data obtained through mass spectrometry. Analyze post-synthetic modifications of proteins and protein-protein interactions. Apply advanced proteomics concepts and methods in practical molecular analysis activities. Evaluate the effectiveness and applicability of different proteomics methods and techniques in fields such as medicine, industry, and scientific research. Use proteomics concepts and methodologies for data analysis and result interpretation, contributing to the resolution of theoretical and experimental problems.
Responsibility and autonomy:	The student has the ability to work independently to obtain: Conduct complex proteomics analyses, from planning to result interpretation. Integrate proteomics data with information from applied genomics, metabolomics, and bioinformatics. Adapt proteomics methods to the requirements of medical, industrial, or research laboratories.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	Developing an integrated perspective on the structure-function relationship of proteins in the cellular context and the essential stages of a proteomics experiment, from sample processing to data acquisition and interpretation, by acquiring theoretical and practical knowledge of mass spectrometry-based proteomics techniques, rigorous experimental design, and the analysis of proteomics samples and data.
7.2 Specific objective of the discipline	To explain why and how the proteins and peptides must be fractionated before de mass-spectrometry analysis; To describe the main components of a mass-spectrometer and the working principles; To understand the mechanisms behind mass-fingerprinting and spectral-matching techniques for protein identification; The students will learn various data analysis techniques and will apply these techniques for solving data mining problems using special software systems and tools.

8. Content

8.1 Course	**Teaching methods**	**Remarks**
1. Introduction to Proteomics	Interactive presentation, explanation	2 hrs
2. Protein Structure	Interactive presentation, explanation, practical examples	2 hrs
3. Designing a Proteomics Study	Interactive presentation, explanation, practical examples, case study discussions	2 hrs
4. Methods for Isolation and Purification of Proteins from Biological Samples	Interactive presentation, explanation, practical examples	4 hrs
5. Protein Digestion Methods for Mass Spectrometry Analysis	Interactive presentation, explanation, practical examples, case study discussions	2 hrs
6. Overview of Current Proteomic Techniques: Mass Spectrometry, NMR, X-ray Crystallography, and Microarrays	Interactive presentation, explanation, practical examples	4 hrs
7. Mass Spectrometry for Protein/Peptide Analysis – General Principles and Tools	Interactive presentation, explanation, practical examples	4 hrs

8. Protein Identification Using Mass Spectrometry – Mass Fingerprinting vs Peptide Sequencing	Interactive presentation, explanation, practical examples	2 hrs
9. Types of Proteomics Analyses - Protein Expression Analysis (Global quantitative proteomics) - Post-translational Modifications - Protein-Protein and Protein-Ligand Interaction Networks (Interactomics)	Interactive presentation, explanation, practical examples, case study discussions	4 hrs
10. Applications of Proteomics in Biomedical and Related Fields	Interactive presentation, case study discussions	2 hrs
Bibliography 1. Dunn M.J., From genome to proteome : advances in the practice and application of proteomics. Weinheim, Wiley-VCH, 2000 2. Issaq, H.J., Proteomic and metabolomic approaches to biomarker discovery. Amsterdam : Elsevier/AP, 2013. URL: http://www.sciencedirect.com/science/book/9780123944467 Informaţii minimale. URL: https://portal.anelisplus.ro/ Acces fulltext. URL: http://www.worldcat.org/oclc/847139875 . 3. Kahl G., The dictionary of gene technology: genomics, transcriptomics, proteomics. Weinheim, Wiley-VCH, 2001 4. Rehm H., Protein biochemistry and proteomics. Amsterdam, Academic Press, 2006 5. Tramontano A., The ten most wanted solutions in protein bioinformatics. Boca Raton, Chapman & Hall/CRC, 2005 6. Dupree E.J., Jayathirtha M., Yorkey H., Mihasan M., Petre B.A. & Darie C.C. 2020. A Critical Review of Bottom-Up Proteomics: The Good, the Bad, and the Future of This Field. Proteomes. 8: 14 7. Gu J., Bourne P.E., Structural Bioinformatics, 2nd Edition, Hoboken: Wiley-Blackwell, 2009 8. Lovric Josip, Introducing Proteomics: From Concepts to Sample Separation, Mass Spectrometry and Data Analysis. Oxford: Wiley Blackwell, 2011. References (1, 3-5) are available in printed form at the libraries of the Faculty of Biology and Geology and at the Central University Library "Lucian Blaga" in Cluj-Napoca. Reference (2) is accessible in electronic format. References (6-8) are available in electronic format to course holders and will be made available to students		
8.2 Seminar / laboratory	**Teaching methods**	**Remarks**
Introductory lab. Basics of pipetting and lab work. Sample preparation in proteomics.	Interactive exposure Explanation Conversation Practical demonstration	4 hrs
Protein overexpression in *E. Coli* and purification by Immobilized Metal Affinity Chromatography (IMAC) for further preparation for MS analysis. • Setting up precultures, induction of protein overexpression • Target protein purification by IMAC • SDS-PAGE verification of purified protein	Interactive exposure Explanation Conversation Practical demonstration	10 hrs
Cleaning, organization and normalization of processed MS data for further proteomic analyses	Interactive exposure Explanation Conversation Practical demonstration	4 hrs
Databases and bioinformatics strategies for proteomic analysis: • proteomic data vizualization (heatmaps) • proteomic data analysis using online tools: differential expression analysis, gene ontology, reactome analysis, protein-protein interactions, etc.	Interactive exposure Explanation Conversation Practical demonstration Case study	4 hrs
Evaluation of an individual project on proteomics data analysis – case study	Evaluation	6 hrs
Bibliography 1. Dunn M.J., From genome to proteome : advances in the practice and application of proteomics. Weinheim, Wiley-VCH, 2000		

2. Sparkman O.D., Penton, Z., Gas chromatography and mass spectrometry : a practical guide. Amsterdam, Elsevier, 2011. URL: http://www.sciencedirect.com/science/book/9780123736284 Informaţii minimale. URL: https://portal.anelisplus.ro/ Acces fulltext. URL: http://www.worldcat.org/oclc/713322669.
3. Electronic resources, databases and bioinformatics tools available online
Reference (1, 2) are available in electronic and printed formats, respectively, at the Central University Library "Lucian Blaga" in Cluj-Napoca.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The course promotes the gaining of theoretical knowledge and practical skills required for teamwork in the field of research and development in academic entities, but also in R&D units in private companies;

The course is listed in the curriculum of similar specializations at Romanian and foreign Universities.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Knowledge of concepts and methods from the topics of the course	Written exam	50%
10.5 Seminar/laboratory	Evaluation of a short individual project on the topic of proteomics	Oral colloquium	50%
10.6 Minimum standard of performance			
Each student should obtain minimum 5 at the written exam and oral colloquium. To obtain the minimum grade 5, the student must demonstrate the mastery of the basic concepts described during the course and practicum classes.			

11. Labels ODD (Sustainable Development Goals)[1]

								

Date:
06.12.2024

Signature of course coordinator

Lect. Viorica Alina Sesărman

Signature of seminar coordinator

Lect. Laura Ioana Pătraş

Date of approval:
09.12.2024

Signature of the head of department

Assoc. Prof. Beatrice Kelemen

[1] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable.*”.