SYLLABUS

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	**Molecular Biotechnology**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Modern Biochemical and Biophysical Methods**				
2.2 Course coordinator			**Lecturer Rauca Valentin-Florian, PhD**				
2.3 Seminar coordinator			**Lecturer Rauca Valentin-Florian, PhD**				
2.4. Year of study	**2**	2.5 Semester	**3**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Mandatory**
2.8. Code of the discipline		**BME1306**					

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	**56**	Of which: 3.5 course	**28**	3.6 seminar/laboratory	**28**
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					30
Additional documentation (in libraries, on electronic platforms, field documentation)					24
Preparation for seminars/labs, homework, papers, portfolios and essays					24
Tutorship					16
Evaluations					4
Other activities:					

3.7 Total individual study hours	98
3.8 Total hours per semester	154
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1. curriculum	• Biochemistry, Biophysics, Molecular Biology
4.2. competencies	• Use of laboratory equipment; • Application of modern techniques for biochemical and biophysical analysis of biological samples in medical, environmental and research laboratories.

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. Specific competencies acquired

Professional competencies	• Identification of the physical and chemical bases for the application of methods and the use of equipment to investigate biological processes; • Ability to recognize and understand the main steps in the investigation of biological structures using a range of advanced techniques and methods for the exploration of life at the cellular and molecular level. • Learning basic principles and practical skills in the use of advanced biophysical and biochemical techniques and methods. • Ability to perform advanced biophysical and biochemical analyses, to process and interpret experimental data.
Transversal competencies	• Providing the necessary information to assimilate the content of the subjects of Recombinant DNA Technology, Bionanotechnologies, Molecular Microbiology, Molecular Immunology. • Use of the concepts and notions specific to the methodology and handling of modern investigation equipment in various contexts (analytical laboratories, research and industrial laboratories, clinical laboratories). • Efficient use of information sources (Internet portals, specialized software applications, databases) both in Romanian and in English

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

7.1 General objective of the discipline	• Acquiring advanced knowledge of the techniques and principles of operation of modern equipment used in clinical and interdisciplinary research laboratories.
7.2 Specific objective of the discipline	• Knowledge of the principles of application and operation of biochemical methods (immunoblotting, high-performance chromatography) in the characterization of the composition and properties of biomolecules and biological structures. • Fundamentals of modern physical methods (fluorescence microscopy, atomic force microscopy, IR and Raman spectroscopy) for the exploration of life at the molecular and cellular level

8. Content

8.1. Course	**Teaching methods**	**Remarks**
1. Introduction to the fluorimetric study of cells and biomolecules. (2 hours)	Video-assisted frontal lecture **in English**. Recap of knowledge; Conversation	Students will recall the principle of fluorescence. Bibliography: [1], [2], [9]

2. Fluorescence microscopy: principles, techniques and equipment (2 hours).	Instruction by modeling. Problematization and Discovery Learning	Bibliography: [1], [2], [9]
3. Biological applications of fluorescence microscopy. Highlighting cellular structures (nucleus, cell organelles, cytoskeleton) and biomolecules (nucleic acids, proteins, lipid molecules) by using fluorescent markers (2 hours).	Frontal lecture with video support. Conversation. Instruction by modeling. Problematization and discovery learning	Bibliography: [1], [2], [9]
4. Scanning probe microscopy. Probe - specimen interaction, applications in the evaluation of biological samples (2 hours).	Frontal lecture with video support. Conversation. Instruction by modeling. Problematization and discovery learning	Bibliography: [3], [9]
5.Atomic force microscopy, constructive elements: scanner, cantilever-tip, laser - photodiode, electronic control, acquisition and processing of photodiode signals.	Frontal lecture with video support. Conversation. Instruction by modeling. Problematization and discovery learning	Bibliography: [3], [9]
6. 3D morphological imaging, color matrix attachment, 2D representation. Measuring nano-dimension image elements, relative positioning, nano-object section, haptically mediated mechanical nanomanipulation. (2 hours)	Frontal lecture with video support. Conversation. Instruction by modeling. Problematization and discovery learning	Bibliography: [3], [9]
7. General notions of chromatography-principles, types of chromatography (2 hours)	Frontal lecture with video support. Conversation. Instruction by modeling. Problematization and discovery learning	Bibliography: [7], [8], [9]
8. High Performance Liquid Chromatography (HPLC) -principles, types of HPLC techniques (2 hours).	Frontal lecture with video support. Conversation. Instruction by modeling. Problematization and discovery learning	Bibliography: [7], [8], [9]
9. Interaction of electromagnetic radiation with matter: general spectroscopy (2 hours)	Frontal lecture with video support. Conversation. Summarizing the knowledge gained.	Bibliography: [4], [5], [6], [9]
10. FTIR and Raman methods: principles and apparatus description (2 hours)	Frontal lecture with video support. Conversation.	Bibliography: [4], [5], [6], [9]
11. Biological and biomedical applications of FTIR and Raman methods. PCA analysis of FTIR spectra (2 hours).	Frontal lecture with video support.Conversation. Problematization and discovery learning	Bibliography: [4], [5], [6], [9]
11-12. Electrophoresis - general principle and types of electrophoresis (4 hours)	Frontal lecture with video support. Conversation. Problematization and discovery learning	Bibliography: [7], [8], [9]
13. Western blotting- principle, applications and techniques (2 hours)	Frontal lecture with video support. Conversation. Problematization and discovery learning	Bibliography: [7], [8], [9]

Bibliography

[1] Spring, K.R. (2003) Fluorescence microscopy. in Encyclopedia of Optical Engineering, Marcel Dekker, New York, New York, pag. 548-555.
[2] Lichtman, J.W., Conchello, J.A. (2005) Fluorescence microscopy. *Nature Methods* **2**: 910-919.
[3] Mironov, L.V. (2004) Fundamentals of scanning probe microscopy. Russioan Academy of Sciences, Institute of Physics of Microstructures, Nizhniy Novgorod.
[4] Leopold, N. (2009) Surface-enhanced Raman spectroscopy. Selected Applications, Editura Napoca Star, Cluj-Napoca.
[5] Iliescu, T., Cîntă Pînzaru, S., Maniu, D., Astilean, S., Grecu, R. (2002) Aplicaţii ale spectroscopiei vibraţionale, Ed. Casa Cărţii de Stiinţă, Cluj-Napoca.
[6] Siebert, F, Hildebrandt P. (2008) Vibrational Spectroscopy in Life Science, Wiley-VCH.
[7] Keith, W. (2010) Principles and techniques of biochemistry and molecular biology, Cambridge University Press, pag. 433-477.
[8] Robyt, J.R., White, B.J. (1990) Biochemical techniques Theory and Practice, Waveland Press, pag. 73-128.
[9] Electronic course material (Powerpoint presentations)
(Books and course materials can be found in the libraries of the Faculty of Biology and Geology and the Faculty of Physics respectively)

8.2 Seminar / Laboratory (Total 28 hours)	Teaching methods	Observaţii
1. Presentation of the laboratory; Working principles of applied fluorescence techniques. DNA staining with DAPI for cell staining and counting (2 hours).	Face-to-face seminar. Explanation, Conversation. Demonstrative practical activity	
2. Nile red staining to highlight lipid inclusions (2 hours)	Demonstrative practical activity	
3. Presentation of the AFM microscope, use in "contact mode" and "non-contact mode" for scanning standard samples. Haptic assisted mechanical nanomanipulation in contact mode. (6 hours)	Face-to-face seminar. Explanation. Conversation. Demonstrative practical activity	
4. HPLC quantitative determination of an oxidative stress marker in plasma (malondialdehyde) (4 hours)	Face-to-face seminar. Explanation. Conversation. Demonstrative practical activity	
5. Analysis of hydrogen atom spectra; X-ray fluorescence analysis; UV-Vis spectroscopy.	Explanation. Conversation. Demonstrative practical activity	
6. Semi-quantitative determination of the transcription factor NF-kB by polyacrylamide gel electrophoresis under denaturing conditions followed by western blotting (6 hours)	Face-to-face seminar. Explanation. Conversation. Demonstrative practical activity	
6. Evaluation (examination) of laboratory work. (2 hours)	Assessment by written test	

Bibliography

Collection of protocols for each lab work available in the department library.

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 is similar in content to courses in other European universities and takes into account the level of preparation of the students

- The course is fundamental for the development of skills to work in diverse laboratories, but in which modern methods of life investigation are applied at the cellular and molecular level.

.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Lecture	Assimilation of information content	Written examination	50%
	Ability to use concepts		
10.5 Seminar/laboratory	Skills in laboratory work and application of an experimental protocol	Written colloquium	50%
10.6 Minimum performance standards			
• Knowledge of 50% of the information contained in the course • Knowledge of 50% of the information contained in the laboratory/seminar work			

Date	Signature of course coordinator	Signature of seminar coordinator
11.07.2024	**Lecturer Valentin-Florian Rauca, PhD**	**Lecturer Valentin-Florian Rauca. PhD**

Date of approval	Signature of the head of department
16.07.2024	**Assoc. Prof. Beatrice Kelemen, PhD**