COURSE DESCRIPTION

Techniques and methods in protein and genetic engineering

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeș-Bolyai University
1.2. Faculty	Chemistry and Chemical Engineering
1.3. Department	Chemistry
1.4. Field	Chemistry
1.5. Level of study	Master
1.6. Degree programme / Qualification	Chemical biology in life and medical sciences
1.7. Form of education	Full-time education

2. Course-related data

2.1. Course title	Techniques and methods in protein and genetic engineering			Course code	CME6110
2.2. Course coordinator					
2.3. Seminar coordinator	Conf. Dr. Laszlo Csaba Bencze				
2.4. Year of study	1	2.5. Semester	1	2.6. Type of assessment	Progress check
2.7. Course status	Compulsory			2.8. Course type	Core subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Hours per week	**4**	of which: 3.2 course	**0**	3.3 seminar/laboratory	**4**
3.4. Total hours in the curriculum	56	of which: 3.5 course	0	3.6 seminar/laborator	**56**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
3.5.1. Learning using manual, course support, bibliography, course notes (SA)					20
3.5.2. Additional documentation (in libraries, on electronic platforms, field documentation)					20
3.5.3. Preparation for seminars/labs, homework, papers, portfolios and essays					10
3.5.4. Tutorship					16
3.5.5. Evaluations					4
3.5.6. Other activities:					--
3.7. Total individual study hours	**70**				
3.8. Total hours per semester	**126**				
3.9. Number of ECTS credits	**5**				

4. Prerequisites (where applicable)

4.1. curriculum-related	Fundamentals of recombinant protein technology, DNA analysis
4.2 skills-related	

5. Specific conditions (where applicable)

5.1. for the course	• Video logistic support, MS Teams platform, Teaching board • Students will not use mobile phones during the course
5.2. for the seminar /lab activities	• The deadline for submitting assignment results will be agreed upon between the seminar/laboratory coordinator and the students. Delays will not be accepted unless justified by valid reasons. • In the case of late submission, the grade will be penalized by 0.5 points per

	day of delay.

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
PC1	Formulating solutions for solving complex issues of biochemistry and applications of chemistry and its methods and tools in biological systems based on the knowledge and application of advanced concepts, methods from the field of biochemistry, genetics, molecular biology, and bioinformatics.
PC3	Development and application of the recombinant protein technology for the laboratory or microproduction scale protein isolation.
Transversal competencies	
Competency code	**Competency**
TC2	Familiarization with new scientific research strategies: systematic research of specialized literature, design and practice of experiments.
TC3	Designing, planning and performing an individual scientific, multidisciplinary research project.

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
CP1, CP6	1. Knowledge of advanced bioanalytical techniques for understanding of specific interactions in biological systems.	1. Creative use of knowledge of the bioanalytical techniques for the structural and functional analysis of biomacromolecules.
CP6	1. The student/graduate knows the basic principles of a (bio)process, the stages of technology development, and methods for separating useful products. 2. The student/graduate knows the basic principles of a recombinant DNA technology, genetic engineering and the stages of technology development for the production of proteins	1. The student/graduate proposes technologies for obtaining useful products, including their separation/purification steps. 2. The student/graduate proposes technologies for obtaining useful protein products, including their separation/purification steps.

7. Subject-specific learning outcomes

Knowledge and comprehension
1. Understanding and comprehending fundamental concepts in genetic and protein engineering, including essential biological processes and modern technologies used in analysis.
2. Identifying and utilizing specific concepts, methods, and strategies to solve problems related to optimizing protein structure and function through genetic engineering techniques.
3. Applying genetic manipulation and molecular optimization methods to develop mutant proteins/enzymes with enhanced properties.

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

4. Designing and conducting experiments to optimize protein structure and function using genetic and protein engineering methods.
5. Critically evaluating and applying principles, methods, and specific techniques for generating and characterizing mutant protein variants with optimized properties in the laboratory.
Specific academic skills
1. The capacity to design and execute a protein engineering experiment at a laboratory scale,
2. The ability to interpret experimental data regarding enzyme fitness, enzyme stability, clone library quality, etc
3. Design and perform mutagenesis experiments to obtain focused or large directed evolution based mutant protein libraries

8. Contents

8.1. Laboratory	Teaching methods	Remarks
8.1.1.-8.1.3. Site-Directed Mutagenesis – Primer design, PCR reaction, verification of the PCR product by agarose gel electrophoresis, sequencing result analysis.	Explanation, conversation	
8.1.4. Molecular cloning 1 – plasmidic DNA purification	Modeling, explanation, conversation, description, problematization.	
8.1.5.-8.1.8. Molecular cloning 2 - targeted Cloning using two restriction enzymes and T4 DNA ligase. Transformation by heat shock and electroporation into competent cells. Calculation of transformation efficiency.	Experiment, explanation, conversation, description, problematization.	
8.1.9. Colony PCR screening for the identification of colonies with recombinant plasmid.	Experiment, explanation, conversation, description, problematization.	
8.1.10. Error-prone PCR for randomization of the PAL enzyme sequence.	Modeling, explanation, conversation, description, problematization.	
8.1.11.-8.1.12. Iterative Saturation Mutagenesis – primer design, PCR experiment design and execution, sequencing result analysis.	Modeling, explanation, conversation, description, problematization.	
8.1.13-8.1.14. Preparation and oral presentation of the laboratory report.	Explanation, conversation, problematization	

Bibliography:

1. *Stefan Lutz, Uwe Bornscheuer, Protein Engineering Handbook Volume 1-2, 2008, 2009, Wiley-VCH*
2. *Glick, B.; Pasternak, J.; Molecular biotechnology, ASM Press, Washington, 2003 – research laboratory 54;*
3. *Course material*

9. Evaluation

Type of activity	9.1 Evaluation criteria[3]	9.2 Evaluation methods[4]	9.3 Percentage in the final grade
9.4. Laboratory	The correctness of the interpretation of the actual laboratory results and the technical procedure used. Understanding the significance of the results obtained. Ability to identify and solve practical problems	The laboratory reports corresponding to all practical work must be submitted within 1 week of performing the laboratory activities, while in the last week the academic activity an oral exam will be held.	100%

[3] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[4] Both final evaluation methods and ongoing evaluation strategies should be established.

	Understanding the significance of the results obtained. Compliance with safety rules in the laboratory The activity carried out during the seminar sessions, the correctness of the homework carried out	Exam fraud is punishable by expulsion, in accordance with the ECTS regulations of UBB.	
9.6 Minimum standard for passing			
✓ Minimum condition for passing the exam: grade 5 (five) the exam, participation at min. 80% of laboratories and having submitted in time all the laboratory reports.			

10. SDG labels (Sustainable Development Goals)[5]

	○	Sustainable Development Generic Label						
								
○	○	◉	◉	○	○	○	○	◉
								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
22.04. 2026

Signature of course coordinator

Conf. Dr. Laszlo Csaba Bencze

Signature of seminar coordinator

Conf. Dr. Laszlo Csaba Bencze

Date of approval in the department:
24.04.2026

Signature of the head of department
Prof. Dr. Eng. Monica Ioana TOŞA

[5] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*