COURSE DESCRIPTION

Biochemistry of antibiotics and antimicrobial resistance

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	Biochemistry of antibiotics and antimicrobial resistance			Course code	CMR6245
2.2. Course coordinator	Dr. Jurgen Brem, Prof. Dr. Monica Ioana Toșa				
2.3. Seminar coordinator	Lect. Dr. Madalina Moisă, Prof. Dr. Monica Ioana Toșa				
2.4. Year of study	2	2.5. Semester	1	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			2.8. Course type	Specialisation subject

3. Total estimated time (hours per semester of teaching 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/laborator	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**68 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)					15
3.5.3. Preparation for seminars/labs, homework, papers, portfolios and essays					20
3.5.4. Tutorship					9
3.5.5. Evaluations					4
3.5.6. Other activities:					--
3.7. Total individual study hours	**68**				
3.8. Total hours per semester	**126**				
3.9. Number of ECTS credits	**5**				

4. Prerequisites (where applicable)

4.1. curriculum-related	Basic knowledge from undergraduate level courses
4.2 skills-related	Minimum kinesthetic-motor skills

5. Specific conditions (where applicable)

5.1. for the course	• Video logistic support • Students will not use mobile phones during the course
5.2. for the seminar /lab activities	• The students have the following responsibilities for the course and laboratory component: ○ Periodic documentation using existing sources in specialized libraries, in international electronic databases as well as those

	made available by the course instructor. ○ To know the objectives, the means, the equipment, the instruments and the stages of the laboratory work that they are going to perform. ○ Compliance with the labor protection and behavior standards established by the institution/faculty. ○ Completion of assignments, case studies and their support. • Students will have at their disposal, written courses and laboratory logistical support and other scientific materials (articles, studies, books). • Attending at least 80% of the laboratory activities is a condition for participating in the exam.

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	Rational drug design & development, drug metabolism and metabolite identification.
PC5	Biomedical therapies based on small- and medium-sized molecules.
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, CP2, CP6	1. Knowledge on complex issues of biochemistry and applications of chemistry and it's methods and tools in biological systems based on knowledge, identification and application of advanced concepts, methods, and theories in the field of biochemistry.	1. Application of modern chemical and biochemical methods and techniques in the study of biological systems
CP3, CP5, CP6	1. Knowledge on rational drug development, drug metabolism and metabolite identification, biomedical therapies based on small- and medium-sized molecules	1. Creative use of knowledge for the development of bioactive compounds, based on the mechanism of action at molecular level.
CT3	2. Designing, planning and performing an individual personal scientific research project by integrating knowledge of biochemistry.	3. Managing and transforming work or study situations that are complex, unpredictable, and require new strategic approaches.

[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.

7. Subject-specific learning outcomes

Knowledge and comprehension
Knowledge of bacterial cell structure and metabolism, different classes of antibiotics, mechanisms of action and antibiotic resistance.
Systematic and critical thinking through selecting appropriate antibiotics, understanding pharmacokinetics and pharmacodynamics, recognizing emerging resistance patterns.
Understanding minimum inhibitory concentrations for bacterial eradication and interpretation of antibiotic susceptibility results.
Continuous scientific documentation with understanding of research methodologies
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
Learning specific laboratory techniques: sterile working methods, isolation of bacterial cultures, microscopy and bacterial identification, testing and interpretation of antibiotic susceptibility.
Ability to correctly interpret data obtained through detailed analysis of the main mechanisms of bacterial resistance, analysis of bacterial growth patterns and critically evaluate the optimal timing of antibiotic administration.

8. Contents

8.1 Course	Teaching methods	Remarks
8.1.1. Antibiotics - general introductions	Frontal lecture;	2 hours / course
8.1.2. History of antibiotics	Frontal lecture;	2 hours / course
8.1.3. Targets of antibiotics	Explanation;	2 hours / course
8.1.4. Classes of antibiotics – general overview	Frontal lecture;	2 hours / course
8.1.5. Antibiotics that target the bacterial cell wall	Frontal lecture;	2 hours / course
8.1.6. Antibiotics that target the bacterial cell membrane	PPT-video support;	2 hours / course
8.1.7. Antibiotics interfere with essential bacterial enzymes	Explanation;	2 hours / course
8.1.8. Antibiotics that inhibit protein synthesis	Explanation; Case study;	2 hours / course
8.1.9. Antibiotic resistance	Description; Explanation;	2 hours / course
8.1.10. Case study: beta lactam resistance	Frontal lecture;	2 hours / course
8.1.11. Novel classes of antibiotics	Critical thinking. Case study;	2 hours / course
8.1.12. New emerging technologies to discover novel antibiotics	Problematization;	2 hours / course
8.1.13. Antibiotics in the agriculture	Case study;	2 hours / course
8.1.14. Antibioitcs – failed business case	Case study; Problematization;	2 hours / course

Bibliography:

- Atlas, R.M., 2004, Handbook of Microbiological Media, 3rd edition, CRC Press, New York.
- Technical manuals of the instruments used.
- Note: The bibliographical elements can be consulted at the Library of the Department of Chemical Engineering, at the Library of the Faculty of Chemistry and Chemical Engineering – extension of the "Lucian Blaga" Central Library of the "Babeș-Bolyai" University., and the "Lucian Blaga" Central Library.

8.2. Laboratory / Seminar	Teaching methods	Remarks
8.2.1. Laboratory norms specific to the microbiology laboratory	Frontal laboratory activity	1 hours
8.2.2. Selective, differential and specific culture media	Individual practical work	2 hours

8.2.3. Techniques for determining bacterial resistance to antibiotics	Individual practical work	2 hours
8.2.4. Bacterial multiplication kinetics under the action of antibiotics	Individual practical work	2 hours
8.2.5. Bacterial survival test by combinatorial treatments with antibiotics	Individual practical work	2 hours
8.2.6. Bacterial cell membrane penetration tests of antibiotics	Individual practical work	4 hours
8.2.7. Methods for the determinations of MIC values	Individual practical work	4 hours
8.2.8. Case study – individual presentations	Seminar- individual presentations	4 hours
8.2.9. Assessment of knowledge through laboratory tests	Evaluation	1 hours

Bibliography:

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9. Evaluation

Type of activity	9.1 Evaluation criteria[3]	9.2 Evaluation methods[4]	9.3 Percentage in the final grade
9.4. Course	Understanding, assimilating and knowing the information content. The ability to use the information in a new context. Knowing the information content. The ability to use the information in a new context both theoretically and practically	Written exam	70%
9.5 Seminar	Understanding the significance of the results obtained. The correctness of the interpretation of the actual laboratory results and the technical procedure used. Ability to identify and solve practical problems Compliance with safety rules in the laboratory The activity carried out during the seminar sessions, the correctness of the homework carried out	Evaluation test: written	30%
9.6 Minimum standard for passing			
✓ Minimum condition for passing the exam: grade 5 (five) in the laboratory and seminar tests and grade 5 (five) in the exam.			

[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.

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

	○	Sustainable Development Generic Label

								
○	○	◉	◉	○	○	○	○	◉
								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
22.04. 2026

Signature of course coordinator

Dr. Jurgen Brem, Prof. Dr. Monica Ioana Toşa

Signature of seminar coordinator

Lect. Dr. Madalina Moisă, Prof. Dr. Monica Ioana Toşa

Date of approval in the department:
24.04.2026

Signature of the head of department
Prof. Dr. Ing. 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."*