COURSE DESCRIPTION

Nanomaterials: applications in biochemistry

Academic year 2026-2027

1. Programme-related data

1.1. Higher Education Institution	Babeş-Bolyai University
1.2. Faculty	Faculty of Chemistry and Chemical Engineering
1.3. Department	Department of 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	**Nanomaterials: applications in biochemistry**			Course code	**CME6109**
2.2. Course coordinator	Conf. dr. ing. Liliana BIZO				
2.3. Seminar coordinator	Conf. dr. ing. Liliana BIZO				
2.4. Year of study	II	2.5. Semester	3	2.6. Type of assessment	Exam
2.7. Course status	Optional			2.8. Course type	Specialisation subject

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

3.1. Number of hours per week	4	of which: 3.2. course	2	3.3. laboratory	2
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. laboratory	28
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					20
Additional research in the library, on subject-specific electronic platforms, and on-site					20
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					20
Tutoring (professional guidance)					5
Examinations					4
Other activities					-
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**69**	
3.8. Total hours per semester				**125**	
3.9. Number of credits				**5**	

4. Prerequisites (where applicable)

4.1. curriculum-related	-
4.2 skills-related	-

5. Specific conditions (where applicable)

5.1. course-related	• Students will come to class with their mobile phones turned off.
5.2. laboratory-related	• Students will report to the laboratory with their mobile phones turned off • Students will report to the laboratory with a lab coat, gloves and a lab cloth • Students may not leave a working installation unattended • The laboratory report must be submitted no later than the week following the actual completion of the work • Late submission of reports is penalized with 0.5 points/day • Food is prohibited in the laboratory

	• Delays are not accepted unless good reasons are proven.

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 it's 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.
PC2	Knowledge and application of advanced bioanalytical techniques for understanding of specific interactions in biological systems.
Transversal competencies	
Competency code	**Competency**
TC1	Carrying out a continuous self-improvement project in order to ensure the adjustment of an interdisciplinary professional training to the requirements of the labour market and to the scientific progress
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**
PC1, PC2	Knowledge of advanced bioanalytical techniques for understanding of specific interactions in biological systems.	Creative use of knowledge of the bioanalytical techniques for the structural and functional analysis of biomacromolecules.

7. Subject-specific learning outcomes

Knowledge and comprehension
1. The student knows the specialized language and advanced concepts necessary for the production and characterization of nanomaterials with applications in biochemistry.
2. The student understands the operating principles of the equipment and processes used in the production and analysis of nanomaterials, as well as their impact in a biochemical context.
3. The student uses the acquired knowledge to select and apply appropriate research methods, to perform experiments, interpret the results and formulate relevant conclusions in the field of nanomaterials applied in biochemistry.
Specific academic skills
1. The student has the ability to conduct an extensive bibliographic study and synthesize relevant information from the specialized literature on nanomaterials applied in biochemistry.
2. The student has the ability to select and use appropriate experimental methods for the synthesis, characterization and testing of nanomaterials in biochemical contexts.
3. The student has the ability to interpret and correlate experimental data, to formulate relevant conclusions and to write scientific reports specific to the field of nanomaterials.

8. Contents

[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.

8.1. Course	Teaching and learning methods	Remarks[3]
8.1.1. Introduction. Course organization. Historical development of nanomaterials. Definition and classification of nanomaterials. *Top down* and *bottom-up* approaches.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.2. Zero-Dimensional nanostructures: Nanoparticles. Nanoparticles through homogeneous and heterogeneous nucleation. Kinetically confined synthesis of nanoparticles.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.3. One-dimensional nanostructures: nanowires and nanorods. Spontaneous growth. Template-based synthesis. Electrospinning. Lithography.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.4. Two-dimensional nanostructures: thin films. Fundamentals of film growth. Physical vapor deposition (PVD). Chemical vapor deposition (CVD). Atomic layer deposition (ALD). Self-assembly. Langmuir-Blodgett films. Electrochemical deposition. Sol-gel films.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.5. Special nanomaterials. Carbon fullerenes and nanotubes. Micro and mesoporous materials. Core-shell structures. Organic-inorganic hybrids. Intercalation compounds. Nanocomposites and nanograined materials.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.6. Nanostructures fabricated by physical techniques. Lithography. Nanomanipulation and nanolithography. Assembly of nanoparticles and nanowires. Other methods for microfabrication.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.7. Characterization and properties of nanomaterials. Characterization of size of nano-powders/particles using BET method and laser diffraction.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.8. Characterization and properties of nanomaterials. Structural characterization: X-ray diffraction (XRD); transmission electron microscopy (TEM); scanning electron microscopy (SEM); energy dispersive X-ray spectroscopy (EDX).	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.9. Chemical characterization. Optical spectroscopy. Electron spectroscopy. Ionic spectrometry.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.10. Physical properties of nanomaterials. Mechanical properties. Optical properties. Electrical conductivity. Ferroelectrics and dielectrics. Superparamagnetism.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.11. Applications of nanomaterials. Biological/biomedical applications. Artificial carriers: liposomes and nanoparticles.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.12. Magnetic nanoparticles and biomedical applications. Magnetic nanoparticles as MRI contrast agents. Magnetic nanoparticles and treatment of tumors.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.13. Other applications of nanomaterials. Nano-electronics. Nano-optics. Nanoscale chemical- and bio-sensing. Nanoenergetic materials.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.14. Perspectives in nanomaterials science with applications in biochemistry.	Lecture giving, explanation, conversation, exemplification, debate	2h
Bibliography 1. G. Cao, Nanostructures & Nanomaterials. Synthesis, Properties & Applications, 2004, Imperial College Press, ISBN 1-86094-4159 2. C. Bréchignac, P. Houdy, M. Lahmani (Eds.), Nanomaterials and Nanochemistry, 2007, Springer, ISBN 978-3-540-72992-1 3. PowerPoint presentation, 2026.		
8.2. Laboratory	**Teaching and learning methods**	**Remarks**
8.2.1. Presentation and discussion of experimental works. Labor protection rules.	Explanation, conversation	2h

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

8.2.2. Synthesis of nanomaterials by coprecipitation.	Experiment, explanation, conversation, description, problematization	2h
8.2.3. Synthesis of nanomaterials by sol-gel method.	Experiment, explanation, conversation, description, problematization	2h
8.2.4. Synthesis of nanomaterials by electrospinning.	Experiment, explanation, conversation, description, problematization	4h
8.2.5. Structural characterization of nanomaterials obtained by X-ray diffraction (XRD).	Experiment, explanation, conversation, description, problematization	2h
8.2.6. Morphological characterization of synthesized nanomaterials by scanning electron microscopy and energy dispersive X-rays (SEM/EDX).	Experiment, explanation, conversation, description, problematization	2h
8.2.7. Particle size analysis by laser diffraction (LD) and dynamic light scattering (DLS).	Experiment, explanation, conversation, description, problematization	4h
8.2.8. Application of UV-VIS and IR spectroscopy in the characterization of obtained nanomaterials.	Experiment, explanation, conversation, description, problematization	4h
8.2.9. Thermogravimetric analysis in the characterization of nanomaterials.	Experiment, explanation, conversation, description, problematization	2h
8.2.10. Recovery of lab works/Applications/Discussions.	Experiment, explanation, conversation, description, problematization	2h
8.2.11. Evaluation of lab works.	Test	2h

Bibliography

1. M. Aluaş, S. Simon, Metode experimentale avansate pentru studiul şi analiza bio-nano-sistemelor, 2012, Casa Cărţii de Ştiinţă, Cluj-Napoca, ISBN 9786061701155
2. Software Match! (https://www.crystalimpact.com/match/)
3. F. Goga, Tehnici de analiză a materialelor oxidice, 2006, Editura Presa Universitară Clujeană, ISBN: 973-610-495-8

9. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4 Course	The correctness of answers, assimilation and understanding of the issues treated in class The ability to particulate the overall phenomena to a specific product	Written examination. Access to examination is conditioned by the presentation of the prepared homework results. Intention to exam fraud is punished by elimination from the exam. Exam fraud is punishable by expulsion according to the UBB ECTS regulations.	70%
9.5 Laboratory	The correctness of answers, assimilation and understanding of the issues treated to the laboratory The quality of the laboratory works prepared The activity carried out in the laboratory	Labratory reports corresponding to lab activities are delivered in the last week of teaching activity. Laboratory test will take place in the last week of teaching activity.	30%
9.6 Minimum standard for passing			
• Minimum condition for exam promoting: 5 grade at laboratory test and 5 grade at written examination. • Knowledge of concepts about preparation methods, specific properties and applications of nanomaterials.			

[4] 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.

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

10. SDG labels (Sustainable Development Goals)[6]

	○	Sustainable Development Generic Label

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

Date of entry:
22.04.2026

Signature of course coordinator
Conf. dr. ing. Liliana BIZO

Signature of seminar coordinator
Conf. dr. ing. Liliana BIZO

Date of approval in the department:
24.04.2026

Signature of the head of department
Prof. dr. habil. Monica Ioana Toşa

[6] 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."*