UNIVERSITATEA BABEŞ-BOLYAI
BABEŞ-BOLYAI TUDOMÁNYEGYETEM
BABEŞ-BOLYAI UNIVERSITÄT
BABEŞ-BOLYAI UNIVERSITY
TRADITIO ET EXCELLENTIA

Tradiție și Excelență prin
Cultură - Știință - Inovație din 1581

Facultatea de Chimie și Inginerie Chimică

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SYLLABUS

"Smart" materials with biomedical, technology and environmental protection applications

University year 2025 – 2026

1. Information regarding the programme

1.1. Higher education institution	Babes Bolyai University of Cluj-Napoca
1.2. Faculty	Chemistry and Chemical Engineering
1.3. Department	Chemical Engineering
1.4. Field of study	Chemistry; Chemical Engineering (interdisciplinary)
1.5. Study cycle	Master's degree
1.6. Study programme/Qualification	Advanced process in chemical engineering/ master's degree
1.7. Form of education	Full-time education

2. Information regarding the discipline

2.1. Name of the discipline	**"Smart" materials with biomedical, technology and environmental protection applications**					Discipline code	**CME 6136**
2.2. Course coordinator	Assoc.Prof. dr. Carmen Ioana FORT						
2.3. Seminar coordinator	Assoc.Prof. dr. Carmen Ioana FORT						
2.4. Year of study	I	2.5. Semester	2	2.6. Type of evaluation	VP	2.7. Discipline regime	DS/Op

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/laborator	28
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					32
Additional documentation (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					12
Tutorship					3
Evaluations					2
Other activities:					
3.7. Total individual study hours	**69**				
3.8. Total hours per semester	**125**				
3.9. Number of ECTS credits	**5**				

4. Prerequisites (if necessary)

4.1. curriculum	• Not necessary
4.2. competencies	• Not necessary

5. Conditions (if necessary)

5.1. for the course	• Students will switch off their cell phones during classes. • Students will arrive on time - no late arrivals will be accepted.

5.2. for the seminar /lab activities	• Students will switch off mobile phones during classes. • Delays will not be allowed.

6.1. Specific competencies acquired [1]

Professional/essential competencies	• Use of creative expertise, methods and concepts for analysis and synthesis of new chemical processes. • Use of integrated chemical analysis and synthesis for process development and production of innovative products; • Use of smart materials with biomedical, technological and environmental protection in advanced process in chemical engineering; • Application of performance evaluation of new modern facilities to improve the decision concerning processes and synthesis.
Transversal competencies	• The execution of complex professional tasks, the independent conduct of research, the use of computer-assisted techniques and compliance with the rules of professional ethics and moral conduct according to an own work plan, with proposals for innovative solutions to specific problems. • Planning, monitoring, solving and undertaking professional tasks. Demonstrating the ability to coordinate the activity, to have analytical thinking, adaptability and flexibility, ability to collaborate with team members. • Permanent information and documentation in the field of activity in Romanian/English. • Self-evaluation of professional performance and concern for the identification of continuous training and documentation needs in one's own field and in related fields, in accordance with the labor market needs. • Demonstration of activity coordination capacity, analytical thinking, adaptability and flexibility, collaboration with team members.

6.2. Learning outcomes

Knowledge	The student knows, learns and understands the principles, methods and mechanisms specific of the smart materials with biomedical, technological and environmental protection in advanced process in chemical engineering;
Skills	The student is able to develop abilities to apply research methods, evaluation and solving problems specific to the smart materials with biomedical, technological and environmental protection in advanced process in chemical engineering

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

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Responsibility and autonomy:	The student has the ability to work independently for the obtaining, analysis and characterization of smart materials with biomedical, technological and environmental protection in advanced process in chemical engineering m.

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

7.1 General objective of the discipline	• To know, to learn and to understand the principles, methods and mechanisms specific of the smart materials with biomedical, technological and environmental protection in advanced process in chemical engineering;
7.2 Specific objective of the discipline	• To develop the ability to apply research, evaluation and problem solving methods specific to the smart materials with biomedical, technological and environmental protection in advanced process in chemical engineering. • To form skills for the experimental synthesis, characterization and use of the smart materials with biomedical, technological and environmental protection in advanced process in chemical engineering

8. Content

8.1 Course	Teaching methods	Remarks
8.1.1. The need to study 'smart' materials	Lecture, Explanation; Conversation, Description, Problem-solving; Debate.	2h
8.1.2. From nano- to macro-scale - 'Smart' materials and their structure	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.3. "Smart" materials with piezoelectric properties. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.4. Electrostrictive materials. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.5. Magnetostrictive materials. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.6. Electro-rheological materials. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.7. Magneto-rheological materials. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.8. Shape memory materials. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.9. Electro-, photo-and thermo-chromic materials. Applications	Lecture, Explanation; Conversation, Description, Problem	2h

8.1.10. Electro-, photo-and thermo-chromic materials. Applications (Continuation)	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.11. Smart Polymers, polymer gels. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.12. "Smart" materials based on carbon allotropes. Applications	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.13. Smart textile materials	Lecture, Explanation; Conversation, Description, Problem	2h
8.1.14. "Smart" bio / materials for medical applications: from diagnosis to treatment.	Lecture, Explanation; Conversation, Description, Problem	2h

Bibliography
1. Schwarts M., Encyclopedia of „smart" materials, John Wiley and Sons, Inc, 2002, vol 1-3.
2. L.G. Bujoreanu, Materiale inteligente, Ed. Junimea, Iași, 2002

Supplementary references
1. Bard A. J., Integrated chemical systems. A chemical approach to nanotechnology, John Wiley and Sons, Inc., 1994.
2. Fendler J. H., Nanoparticles and nanostructured films. Preparation, characterization and applications, John Wiley and Sons, Inc., 1998.
3. Frasner D. M., Biosensors in the body. Continuous in vivo monitoring, John Wiley and Sons Inc., 1997.
4. Ramsay G., Commercial biosensors, John Wiley and Sons Inc., 1998.
5. Fort C.I.. PP presentations updated annually.

8.2 Laboratory	Teaching methods	Remarks
8.2.1. Labor protection instructions. Presentation of the laboratory (equipment and apparatus). Numerical methods for processing experimental results (graphical representations, errors statistics, regression and numerical calculation methods). Specific work safety norms for physical-chemical analysis laboratories (Order no. 339/16.08.1996).	Explanation, conversation, description Problematization.	4h
8.2.2. Synthesis of ferrofluids from ferromagnetic particles.	Explanation, conversation, description Problematization.	4h
8.2.3. Investigation of some magnetorheological materials.	Explanation, conversation, description Problematization..	4h
8.2.4. Synthesis and characterization of polymeric materials obtained by electropolimerization.	Explanation, conversation, description Problematization.	4h
8.2.5. Study of hydrogels	Explanation, conversation, description Problematization.	4h
8.2.6. Final seminar. Correlation of obtained results with different techniques, highlighting the advantages and disadvantages of various investigated materials.	Explanation, conversation, description Problematization.	4h

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8.2.7. The elaboration by each student of a Powerpoint presentation and report, on the chosen topic, which will be presented and discussed together with the whole group. Case studies: the analysis of some representative articles in the field.	Explanation, conversation, description Problematization.	4h

Bibliography

1. Laboratory/work files, updated annually.
2. M.M. Mekhzoum et al, Introduction: different types of smart materials and their practical applications, Polymer Nanocomposite-Based Smart Materials, From Synthesis to Application, Woodhead Publishing Series in Composites Science and Engineering, 2020, Pages 1-19
3. Scientific articles from the website www.scincedirect.com

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

- By acquiring theoretical and methodological concepts and practical aspects included in ""Smart" materials with biomedical applications, technological and environmental protection" course, students will aquire vast knowledge, in accordance with required competencies from Diploma supplement and ANC's qualifications.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	The ability to know and understand the importance of smart materials with biomedical applications, technological and environmental protection in the advanced process in chemical engineering, to apply the knowledge gained in solving problems in a real world. Correct problems solving	The oral exam consists of the presentation and discussion of bibliographic reports. The access to the oral exam is conditioned by the presentation of the papers prepared for the laboratory assignments. Fraud when presenting the report is punishable by removal from the evaluation session and by expulsion, according to the ECST regulation of UBB.	60%
10.5 Seminar/laboratory	The correctness of the answers - the acquisition and correct understanding of the concept treated at the seminar. Quality of the submitted reports. The activity carried out in the seminar./laboratory	The students will also be evaluated during the semester (at the seminar/laboratory) in order to verify the interest in the individual study, the correctness of the learning and the reproduction of the accumulated knowledge. The intention of fraud/plagiarism of the submitted reports will condition the access to the oral exam.	40%

10.6 Minimum standard of performance
• • Grade 6 (six) in the seminar and in the exam according to the scale. • Presentation of the bibliographic report - study case..

11. Labels ODD (Sustainable Development Goals)[2]

Date:
27.03.2025

Signature of course coordinator
...

Signature of seminar coordinator
...

Date of approval:
...15.04.2025

Signature of the head of department
.....

[2] 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*.".