

# SYLLABUS

## 1. Information regarding the programme

1.1 Higher education institution	„Babeş-Bolyai University, Cluj-Napoca
1.2 Faculty	Chemistry and chemical engineering
1.3 Department	Department of chemical engineering
1.4 Field of study	Chemical engineering
1.5 Study cycle	Master degree
1.6 Study programme / Qualification	Advanced Chemical Process Engineering / Masters degree in Chemical Engineering

## 2. Information regarding the discipline

2.1 Name of the discipline		Smart materials with biomedical, technology and environmental protection applications - CME6136					
2.2 Course coordinator		Lect. dr. eng. Lucian-Cristian Pop					
2.3 Laboratory coordinator		Lect. dr. eng. Lucian-Cristian Pop					
2.4. Year of study	<b>I</b>	2.5 Semester	<b>1</b>	2.6. Type of evaluation	<b>VP</b>	2.7 Type of discipline	<b>SD/Opt</b>

## 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	0/2
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	0/28
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					22
Additional individual research (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					22
Tutorship					2
Evaluations					3
Other activities: not applicable					-
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	• No request
4.2. competencies	• No request

## 5. Conditions (if necessary)

5.1. for the course	<ul style="list-style-type: none"> <li>During the lecture students are asked to mute their mobile phones</li> <li>Students are asked to respected the allocated hours for the lecture. Unpunctuality will not be tolerated.</li> </ul>
5.2. for the seminar /lab activities	<ul style="list-style-type: none"> <li>Students will mute their mobile phones during the seminar / laboratory</li> <li>Students are required to use their own protective equipment (lab coat, gloves, lab cloth) during the laboratory</li> <li>To attend the laboratory, students are required to present a summary report for the experiment and to prove their theoretical knowledge on the subject</li> <li>Students may not leave the experiment unattended</li> </ul>

	<ul style="list-style-type: none"> <li>• The terms for turning in the laboratory reports (interpretation of the experimental data) is the next laboratory meeting. Delayed delivery is subject to a penalty of 0.5 points / week</li> <li>• Eating, drinking, smoking, gum chewing, applying cosmetics, and taking medicine in laboratories should be strictly prohibited</li> </ul>
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## 6. Specific competencies acquired

<b>Professional competencies</b>	<ul style="list-style-type: none"> <li>• Use of methods, equipment and technologies for environmental measuring and monitoring activities;</li> <li>• Use of the conceptual and methodological framework for solving specific problems and defined situations;</li> <li>• The ability to conduct research;</li> <li>• The ability to clearly and concisely communicate ideas, arguments and opinions, using different modes of written and oral communication;</li> <li>• The ability to understand and use information</li> <li>• The ability to establish positive interpersonal relationships in a team;</li> <li>• The ability to use a widely used foreign language;</li> <li>• The ability to apply advanced knowledge in intelligent materials science</li> <li>• The ability to formulate and implement creative solutions to problems related to intelligent materials science (elaboration of synthesis and analysis strategies, finding potential biomedical, technological and environmental protection applications);</li> <li>• The ability to propose, develop and support a scientific project / study of chemistry through presentation and practical demonstration;</li> <li>• The ability to develop and write scientific papers for publication in journals.</li> </ul>
<b>Transversal competencies</b>	<ul style="list-style-type: none"> <li>• Execution of complex professional tasks, carrying out independent research in the field of intelligent materials science, respecting the rules of professional ethics and moral conduct according to their own work plan, with proposals for innovative solutions to specific problems.</li> <li>• Planning, monitoring solving and assuming professional tasks. Demonstrate the ability to coordinate the activity, to have analytical thinking, adaptability and flexibility, ability to collaborate with team members.</li> <li>• Permanent documentation in its field of activity in Romanian / English language.</li> <li>• Self-assessment of professional performance and concern for identifying the needs for continuous training and documentation in one's own domain and in related fields, in accordance with the needs of the labor market.</li> </ul>

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

7.1 General objective of the discipline	<ul style="list-style-type: none"> <li>• Acquiring theoretical and practical knowledge about smart materials with biomedical, biotechnological and environmental protection applications.</li> </ul>
7.2 Specific objective of the discipline	<ul style="list-style-type: none"> <li>• Training skills for dealing with experimental aspects, characterization and use of various smart materials.</li> </ul>

## 8. Content

8.1 Course	Teaching methods	Remarks
8.1.1. Introduction, Classification and Applications of Smart materials	Lecture, Explanation; Conversation, Description, Problem-solving; Debate.	
8.1.2. Smart materials from nano- to macro-scale and their structure	Lecture, Explanation; Conversation, Description, Problem	

8.1.3. Smart materials having piezoelectric properties.	Lecture, Explanation; Conversation, Description, Problem	
8.1.4. Electrostrictive materials	Lecture, Explanation; Conversation, Description, Problem	
8.1.5. Magnetostrictive materials	Lecture, Explanation; Conversation, Description, Problem	
8.1.6. Electro-rheological materials		
8.1.7. Magneto-rheological materials	Lecture, Explanation; Conversation, Description, Problem	
8.1.8. Shape memory materials		
8.1.9. Electro-, photo-and thermo-chromic materials	Lecture, Explanation; Conversation, Description, Problem	
8.1.10. Smart polymers, polymer gels		
8.1.11. Smart materials based on carbon: from fullerenes to carbon nanofibres, nanotubes and graphene	Lecture, Explanation; Conversation, Description, Problem	Key-words: fullerene, nanofiber of carbon, carbon nanotubes de carbon, nanomaterials.
8.1.12. Smart textile materials		
8.1.13. Smart bio / materials for medical applications: from diagnosis to treatment.	Lecture, Explanation; Conversation, Description, Problem	Key-words: diagnosis, monitoring, implants, prothesis, drugs and therapy, biocompatibility.
8.1.14. Smart ceramic materials. Smart materials in architecture		
<b>References</b> 1. L.G. Bujoreanu, <i>Materiale inteligente</i> , Ed. Junimea, Iași, 2002 2. A.K. Bajpai, J. Bajpai <i>et al.</i> , <i>Smart biomaterial devices polymers in biomedical sciences</i> , Taylor and Francis Group, 2017 3. P. Wang, <i>Smart materials for advanced environmental applications</i> , ISBN: 978-1-78262-108-9, RSC, 2017 4. A. Filimon, <i>Smart Materials Integrated Design, Engineering Approaches, and Potential Applications</i> , 13: ISBN: 978-1-77188-687-1, Taylor and Francis Group, 2018 5. E. Hey-Hawkins, M. Hissler, <i>Smart Inorganic Polymers Synthesis, Properties, and Emerging Applications in Materials and Life Sciences</i> , ISBN: 978-3-527-34484-0, Wiley-VCH, 2019 6. S. Badylak, F. Cao, <i>Smart Materials for Tissue Engineering Applications</i> , ISBN: 978-1-78262-484-4 RSC, 2017 7. L.C. Pop, PowerPoint course presentation, 2022		
<b>8.2 Laboratory</b>	<b>Teaching methods</b>	<b>Remarks</b>
8.2.1. Safety instructions. Presentation of laboratory. Numerical methods for processing experimental results (graphics, error statistics, regression and numerical methods for calculating parameters).	Experiment, explanation, conversation, description, Problematization.	Required references: Specific security rules for work in physical, chemical analysis and mechanical laboratories (Order no. 339/16.08.1996).  The laboratory hours were distributed in 7 sessions of 4 hours, one session every 2 weeks.
8.2.2. Synthesis of ferrofluids made of nanoscale ferromagnetic particles	Experiment, explanation, conversation, description, Problematization.	
8.2.3. Investigation of some magneto-rheological or magneto-strictive materials	Experiment, explanation, conversation, description, Problematization.	
8.2.4. Synthesis and characterization of polymeric materials obtained by electropolymerization.	Experiment, explanation, conversation, description, Problematization.	
8.2.5. Study of hydrogels	Experiment, explanation, conversation, description, Problematization.	

8.2.6. Final seminar. Correlation of obtained results with different techniques, highlighting the advantages and disadvantages of various investigated materials.	Experiment, explanation, conversation, description, Problematisation.	
8.2.7. Presentation of a bibliographic report – the topic at student's choice.	Debate	
<b>References</b> <ol style="list-style-type: none"> <li>1. Synthesis of Ferrofluids Made of Iron Oxide Nanoflowers: Interplay between Carrier Fluid and Magnetic Properties, Nanomaterials (Basel). 2017, 7(11): 373.</li> <li>2. V. R. Remya, et al., Nanostructured Smart Materials: Synthesis, Characterization, and Potential Applications, ISBN 1000291588, CRC Press, 2021</li> </ol>		

Laboratories are held weekly until all the allocated hours are exhausted.

## 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, technological and environmental protection applications* course, students acquire a significant amount of knowledge, in accordance with required competencies from Diploma supplement and ANC's qualifications.

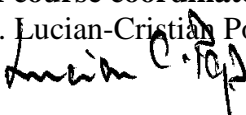
## 10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	The correctness of the answers - the proper understanding of the issues dealt with in the course	On-line or on-site examination according to the regulations in force. Bibliographic report. Access to final examination is conditioned by the presentation of the reports and the interpretation of the results of the laboratory experiments.  Intention to fraud the examination is punishable.  Examination fraud is punishable by expulsion, according to ECST rules of UBB.	80%
	Correct problem solving		
10.5 Seminar/lab activities	The correctness of the answers - the proper understanding of the issues addressed at the seminar / laboratory	Laboratory reports having the interpretation of the results will be presented at the next laboratory meeting.	20%
	Quality of the prepared reports		
	Laboratory activity		
10.6 Minimum performance standards			
➤ Mark 5 (five) both at the seminar/laboratory colloquium and the bibliographic report.			

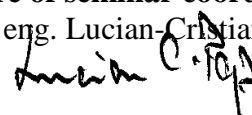
➤ Presentation of the bibliographic report containing information about a class of smart materials.

**Date**  
2023, 12th April

**Signature of course coordinator**  
Lect. dr. eng. Lucian-Cristian Pop



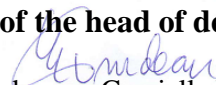
**Signature of seminar coordinator**  
Lect. dr. eng. Lucian-Cristian Pop



**Date of approval**  
**25.04.2023**

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**Signature of the head of department**



Prof. habil. dr. eng. Graziella L. Turdean