

COURSE DESCRIPTION

Smart materials with biomedical, technological and environmental protection applications

Academic year . 2026 – 2027

1. Programme-related data

| | |
|---------------------------------------|---|
| 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 | Chemistry; Chemical Engineering (interdisciplinary) |
| 1.5. Level of study | Master's degree |
| 1.6. Degree programme / Qualification | Advanced process in chemical engineering/ Chemical engineer master's degree |
| 1.7. Form of education | Full-time education |

2. Course-related data

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|--------------------------|---|---------------|---|-------------------------|--|
| 2.1. Course title | Smart Materials with Biomedical, Technological and Environmental Protection Applications | | | Course code | CME6136 |
| 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 | 1 | 2.5. Semester | 1 | 2.6. Type of assessment | Progress check |
| 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. seminar / laboratory/ project | 2 |
| 3.4. Total of hours in the curriculum | 56 | of which: 3.5. course | 28 | 3.6. seminar / laboratory | 28 |
| Time allocation for individual study (IS) and self-taught activities (ST) | | | | | hours |
| Learning from textbooks, course materials, bibliography, and notes (IS) | | | | | 28 |
| Additional research in the library, on subject-specific electronic platforms, and on-site | | | | | 14 |
| Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays | | | | | 24 |
| Tutoring (professional guidance) | | | | | 2 |
| Examinations | | | | | 1 |
| 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)

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|-------------------------|--|
| 4.1. curriculum-related | |
| 4.2 skills-related | |

5. Specific conditions (where applicable)

| | |
|---------------------------------|--|
| 5.1. course-related | |
| 5.2. seminar/laboratory-related | |

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

| Professional competencies | |
|---------------------------|--|
| Competency code | Competency |
| PC1 | Description, analysis and use of elaborate theories and concepts in the fields of chemistry and process advanced chemical engineering. |
| PC5 | Identifying and defining a research theme in the field of chemical engineering process, elaboration and implementation of a plan for achieving the objectives proposed and valuing the scientific research results obtained. |
| Transversal competencies | |
| Competency code | Competency |
| TC2 | Planning, monitoring, and assuming the duties of a subordinate professional group. Demonstrating the capacity of coordination, analytical thinking, adaptability and flexibility, collaboration with team members. |
| TC3 | Self-assessment of professional performances and determining the continuous training needs, permanent information and documentation in the field of activity and related areas, according to the needs of the labour market. |

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, PC4, CT1 | Formulation of solutions to solve complex chemical engineering problems based on knowledge, identification and application of advanced concepts, methods and theories in the field of chemical engineering and chemistry | Critical analysis and application of advanced principles, methods, and techniques for the evaluation, design, and development of new products and technologies. |

7. Subject-specific learning outcomes

| Knowledge and comprehension |
|--|
| 1. Formulation of solutions to solve complex chemical engineering problems based on knowledge, identification and application of advanced concepts in the field of smart materials. |
| 2. Formulation of solutions to solve complex chemical engineering problems based on knowledge, identification and application of advanced methods in the field of smart materials |
| 3. Formulation of solutions to solve complex chemical engineering problems based on knowledge, identification and application of advanced and theories in the field of smart materials |
| 4. ... |
| Specific academic skills |
| 1. ... Critical analysis and application of advanced principles, methods, and techniques in the field of smart materials for the evaluation of new products and technologies. |
| 2. ... Critical analysis and application of advanced principles, methods, and techniques in the field of smart materials for the design of new products and technologies. |
| 3. ... Critical analysis and application of advanced principles, methods, and techniques in the field of smart materials for the development of new products and technologies. |

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. Contents

| 8.1. Course | Teaching and learning methods | Remarks ³ |
|--|---|----------------------|
| 8.1.1. The need to study 'smart' materials | Lecture, Explanation; Conversation, Description, Problem-solving; Debate. | 2 h |
| 8.1.2. From nano- to macro-scale - 'Smart' materials and their structure. Introduction. | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.3. "Smart" materials with piezoelectric properties. Applications | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.4. Electrostrictive materials. Applications | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.5. Magnetostrictive materials. Applications | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.6. Electro-rheological materials. Applications | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.7. Magneto-rheological materials. Applications | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.8. Shape memory materials. Applications | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.9. Electro-, photo-and thermo-chromic materials. Applications | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 8.1.10. Electro-, photo-and thermo-chromic materials. Applications (Continuation) | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| 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 | 2 h |
| 8.1.14. "Smart" bio / materials for medical applications: from diagnosis to treatment. | Lecture, Explanation; Conversation, Description, Problem | 2 h |
| Bibliography <ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 1. Bard A. J., <i>Integrated chemical systems. A chemical approach to nanotechnology</i>, John Wiley and Sons, Inc., 1994. 2. Fendler J. H., <i>Nanoparticles and nanostructured films. Preparation, characterization and applications</i>, John Wiley and Sons, Inc., 1998. 3. Frasner D. M., <i>Biosensors in the body. Continuous in vivo monitoring</i>, John Wiley and Sons Inc., 1997. 4. Ramsay G., <i>Commercial biosensors</i>, John Wiley and Sons Inc., 1998. 5. Fort C.I.. ppt presentation updated annually. | | |
| 8.2. Seminar/ laboratory | Teaching and learning methods | Remarks |
| 8.2.1. Labor protection instructions. Presentation of the laboratory (electroanalytical equipment and apparatus). Numerical methods for processing experimental results (graphical representations, errors statistics, regression and numerical calculation methods). | | 4h |

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

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| Specific work safety norms for physical-chemical analysis laboratories (Order no. 339/16.08.1996). | Experiment, explanation, conversation, description | 4h |
| 8.2.2. Choosing the project theme through individual discussions with each student, but with the participation of all; establishing the presentation schedule (the main points that will be followed in each presentation are established) | Explanation, conversation, description, Problematization. | 4 h |
| 8.2.3. Synthesis and investigation of a magnetorheological material. | Experiment, explanation, conversation, description, Problematization. | 4h |
| 8.2.4. Synthesis and characterization of polymeric materials obtained by electropolymerization. | Experiment, explanation, conversation, description, Problematization. | 4h |
| 8.2.5. Study of hydrogels. | Experiment, explanation, conversation, description, Problematization. | 4h |
| 8.2.6. Discussing in detail the strengths and weaknesses of each project with the aim of its continuous improvement (individual discussion with each student, but with the participation of all) | Explanation, conversation, description, Problematization. | 4h |
| 8.2.7. The elaboration by each student of a PowerPoint presentation and a 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. | 4 h |
| Bibliography <ol style="list-style-type: none"> 1. Turdean G. L., Sarmiza S.E., Popescu I. C., Biosenzori amperometrici. Teorie si aplicatii, Presa universitara clujana, Cluj-Napoca, 2005. 2. Popescu I.C., Turdean G., Nicoara A., Ilea P., Muresan L., Lucrari practice pentru Ciclul de studii aprofundate în Electrochimie Aplicata, Lito UBB, Cluj-Napoca, 1998. 3. Laboratory/work files, updated annually. | | |

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 the answers - the acquisition and correct understanding of the concept treated at the course 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 | 60 % |

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.

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| | | expulsion, according to the ECST regulation of UBB. | |
| 9.5. Seminar/ laboratory | The correctness of the answers - the acquisition and correct understanding of the concept treated at the seminar/laboratory | The reports with the interpretation of the results discussed and demonstrated during the laboratory sessions are submitted no later than the week following the actual seminar session. The intention of fraud/plagiarism of the submitted reports will condition the access to the oral exam. | 40 % |
| | Quality of the submitted reports | | |
| | The activity carried out in the laboratory | | |
| 9.6 Minimum standard for passing | | | |
| Note 5 (five) both to colloquium seminar / laboratory and the bibliographic report. | | | |
| Presentation of the bibliographic report - study case.. | | | |

10. SDG labels (Sustainable Development Goals)⁶

| | | | | | | | | |
|---|---|---|---|---|--|---|---|--|
|  | <input type="radio"/> | Eticheta generală pentru Dezvoltare durabilă | | | | | | |
|  |  |  |  |  |  |  |  |  |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
|  |  |  |  |  |  |  |  | Nu se aplică nici o etichetă |
| <input type="radio"/> | <input type="radio"/> | <input checked="" type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Date of entry:
03.04.2026

Signature of course coordinator
Assoc.Prof. dr. Carmen Ioana FORT

Signature of seminar coordinator
Assoc.Prof. dr. Carmen Ioana FORT

Date of approval in the department:
21.04.2026

Signature of the head of department
Prof. Habil. Dr. Eng. Graziella Liana Turdean

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."