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
Str. Arany János nr. 11
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SYLLABUS

Ceramics, binders and vitreous materials and advanced processing methods

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babes-Bolyai University, Cluj Napoca
1.2. Faculty	Faculty of Chemistry and Chemical Engineering
1.3. Department	Department of Chemical Engineering
1.4. Field of study	Chemical Engineering
1.5. Study cycle	Master
1.6. Study programme/Qualification	Advanced Chemical Process Engineering
1.7. Form of education	Full-time education

2. Information regarding the discipline

2.1. Name of the discipline	**Ceramics, binders and vitreous materials and advanced processing methods**					Discipline code	**CME7134**
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 evaluation	E	2.7. Discipline regime	DS/Compulsory

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)					**20**
Additional documentation (in libraries, on electronic platforms, field documentation)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					20
Tutorship					6
Evaluations					3
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	-
4.2. competencies	-

5. Conditions (if necessary)

5.1. for the course	• Students should switch off the mobile phones during courses and seminars.

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	• Students should be present at the courses without any time delay.
5.2. for the lab activities	• The deadline for presenting the homework results will be agreed between the seminar holder and the students. No delay is accepted for the presentation of the homework results unless well-founded reasons are proven. • In case of presenting the homework with delay, the grade will be penalized by 0.5 points/day of delay. • Students should be present at the seminars without any time delay.

6. Specific competencies acquired [1]

Professional/essential competencies	• Defining the language and identification of advanced concepts for advanced materials realisation • Explaining and understanding operation of specific devices, equipments and processes for the production of advanced materials • Conducting a extensive bibliographic study related to the research topic chosen, organizing and synthesizing of data with aquiring specific terminology; general and specific knowledge of research methods • Use specialized knowledge to establish research strategy, realization of experiments and interpretation of results • Using conceptual and methodological research for new theoretical approaches in synthesis of materials • Selecting and using appropriate research methods for a correct interpretation of the results and formulation of pertinent conclusions • Using the basic and applicative concepts in the development of research projects
Transversal competencies	• Performing research and design activities in a autonomous way, using specific equipments (included computer aided techniques) and conforming to the ethical rules • Developing of self guided evaluation of own professional performance and self assessment of the needs for continuous professional improvement based on permanent knowledge update related to his/her activity field • Communicating the own points of view, in a clear and concise way, using communication means based on conventional and non-conventional information technology instruments

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

7.1 General objective of the discipline	• To familiarize students with the basic concepts, theories and models of the advanced oxidic materials
7.2 Specific objective of the discipline	• Providing the basic information regarding the synthesis and advanced processing methods of some special ceramics, binders and vitreous materials • Acquiring knowledge on the composition, microstructure, advanced processing methods in correlation with the function of using the oxide materials

8. Content

8.1 Course	Teaching methods	Remarks
8.1.1. High reliability ceramics. Processing methods, densification concepts, colloidal powder processing. Silicon nitride powders.	Lecture giving, explanation, conversation, exemplification, debate	2h

[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.

Powder synthesis and characterization. Powder dispersion. Surface properties. Powder sintering. Ceramic properties.		
8.1.2. Stabilized zirconia ceramics. Wet processing. Microstructure. Forming. Thermal treatment. Properties. Structural ceramics. Thin films- deposition methods.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.3. Electronic ceramics. Processing. Wet Forming. Slip Casting. Thermal treatment. Properties. Microwave processing of ceramics.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.4. Ceramic composites. Microstructure and processing. Sintering and Hot Forming. Reaction Processing. Melt Processing Methods. Chemical Vapor Deposition.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.5. Oxide-salt-water binders. A. Binders in system MgO-$MgCl_2$($MgSO_4$)-H_2O. Phase equilibrium, compositions, characteristics. B. Binders analogous to Sorel cement. Alkaline–earth and with other cationic elements binding systems.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.6. Oxide-acid-water binders. A. Phosphate binders. Phase equilibria. Reaction products. Hardening mechanism. B. Biocements. Types (calcium-phosphate, zinc-phosphate dental cement, magnesite-phosphate and silicate-phosphate).	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.7. Binders for high temperatures (refractories). Aluminate-phosphate, magnesite-phosphate and chromo-phosphate binders, etc.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.8. Oxidic materials with vitreous structure. Characterization of the vitreous structure. Correlation of composition-structure-properties-applications.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.9. Choosing the preparation process of products according to the shape and applications.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.10. Technical glasses: electrotechnical glasses, Vycor glasses, semiconducting glasses, isolating glasses.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.11. Technical glasses: optical and selective absorption glasses. The condition imposed to optical glasses, optical and selective absorption glasses, photosensitive glasses, optical fibers.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.12. Glass-ceramic materials: oxidic systems used to obtain glass-ceramic materials. Criteria for determining compositions for glass-ceramics with predefined properties.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.13. Glasses used in nuclear technology.	Lecture giving, explanation, conversation, exemplification, debate	2h
8.1.14. Vitreous biomaterials. Biological glasses with controlled corrosion, radio therapy	Lecture giving, explanation, conversation, exemplification,	2h

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glasses, glass-ceramics for hyperthermia.	debate	

Bibliography

1. R. Riedel, I.-Wei Chen (Eds.), ***Ceramics Science and Technology***, Wiley-VCH, **2008**, ISBN: 978-3-527-63196-4 (ePDF).
2. J. Heinrich, F. Aldinger (Eds.), ***Ceramic Materials and Components for Engines***, Wiley-VCH, **2001**, ISBN: 3-527-30416-9 (ePDF).
3. I. Teoreanu, ***Bazele tehnologiei lianților anorganici***, Editura Didactica și Pedagogica, București, **1993**, Biblioteca Centrală Universitară.
4. P. Balta, ***Tehnologia sticlei***, Editura Didactică și Pedagogică, Bucuresti, **1984**, Biblioteca Centrală Universitară, Biblioteca Facultății de Chimie.
5. F. Goga, ***Tehnici de analiză a materialelor oxidice***, Presa Universitară Clujeană, **2006**, Biblioteca Facultății de Chimie, ISBN: (13)978-973-610-495-4.
6. PowerPoint presentation, **2025**.

8.2 Laboratory	Teaching methods	Remarks
8.2.1. Presentation and discussion of experimental works. Work safety rules.	Explanation, conversation, exemplification	2h
8.2.2. Colloidal powders processing.	Experiment, conversation, learning by discovery, team working	2h
8.2.3. Stabilized zirconia and thin films deposition methods.	Experiment, conversation, learning by discovery, team working	2h
8.2.4. Microwave processing of electronic ceramics.	Experiment, conversation, learning by discovery, team working	2h
8.2.5. Sintering and hot pressing of ceramic composites.	Experiment, conversation, learning by discovery, team working	2h
8.2.6. Physical and chemical deposition of thin films.	Experiment, conversation, learning by discovery, team working	2h
8.2.7. Combustion method for binders obtaining.	Experiment, conversation, learning by discovery, team working	2h
8.2.8. Theoretical method for properties prediction of vitreous materials.	Experiment, conversation, learning by discovery, team working	2h
8.2.9. Composition and raw materials recipe design for special glasses.	Conversation method, learning by discovery, individual learning, team working	2h
8.2.10. Study of the melting processes in borate-silicate glasses.	Experiment, conversation, learning by discovery, team working	2h
8.2.11. Synthesis of low melting glasses. Synthesis and thermal analysis of a glass-ceramic.	Experiment, conversation, learning by discovery, team working	2h
8.2.12. Synthesis of colored glasses. Color characterization by dominant wavelength determination.	Experiment, conversation, learning by discovery, team working	2h
8.2.13. Recovery of lab works/Applications	Experiment, conversation, learning by discovery, team working	2h

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8.2.14. Evaluation of laboratory works.	Test	2h

Bibliography

1. L. Gagea, ***CERAMICĂ de laborator. Lucrări şi probleme***, Casa Cărţii de Ştiinţă, Cluj-Napoca, **2003**, BCU, Biblioteca Facultăţii de Chimie, Biblioteca Departamentului de Inginerie Chimică.
2. F. Goga, ***Tehnici de analiză a materialelor oxidice***, Editura Presa Universitară Clujeană, **2006**, Biblioteca Facultăţii de Chimie.

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

- Feedback from industry (Companies: Saint Gobain, HOLCIM) has been used to comply with the expected competencies desired by potential employers. By acquiring the theoretical and methodological concepts and approaching the practical aspects included in the ***Ceramics, binders and vitreous materials and advanced processing methods*** discipline the students acquire a consistent knowledge bag, in accordance with the competences of the Diploma Supplement and the qualifications of the ANC.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 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	Oral examination Access to examination is conditioned by the presentation of the prepared homework results. Intentional fraud in the exam is punishable by elimination from the exam. The fraud is punished by expulsion according to the ECTS regulations of UBB.	60%
10.5 Laboratory	The correctness of answers, assimilation and understanding of the issues treated to the laboratory The quality of the prepared laboratory reports The activity carried out in the lab	Labratory works 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.	40%
10.6 Minimum standard of performance			

- Minimum condition for exam promoting: 5(five) grade at laboratory test and 5(five) grade at oral examination.
- Knowledge of basic concepts; composition and microstructure of an oxidic product, main technological parameters, elaboration of a technologic flow for an advanced material with main stages, correlation of properties and applications.

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

Date:
26.03.2025

Signature of course coordinator

Conf. dr. ing. Liliana BIZO

Signature of seminar coordinator

Conf. dr. ing. Liliana BIZO

Date of approval:
14.04.2025

Signature of the head of department

Prof. dr. ing. Graziella Liana TURDEAN

[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*.".