SYLLABUS

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	Chemical Engineering
1.5 Study cycle	Master
1.6 Study programme / Qualification	Advanced Chemical Process Engineering

2. Information regarding the discipline

2.1 Name of the discipline	**Ceramics, binders and vitreous materials and advanced proccesing methods – CME7134**						
2.2 Course coordinator	Conf.dr.ing. Gorea Maria; lector dr. Goga Firuta						
2.3 Seminar coordinator	Conf.dr.ing. Gorea Maria; lector dr. Goga Firuta						
2.4. Year of study	2	2.5 Semester	3	2.6. Type of evaluation	E	2.7 Type of discipline	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	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					36
Additional documentation (in libraries, on electronic platforms, field documentation)					32
Preparation for seminars/labs, homework, papers, portfolios and essays					32
Tutorship					4
Evaluations					4
Other activities:					

3.7 Total individual study hours	108
3.8 Total hours per semester	150
3.9 Number of ECTS credits	6

4. Prerequisites (if necessary)

4.1. curriculum	Basic science, or engineering knowledge
4.2. competencies	-

5. Conditions (if necessary)

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

	Students should be present at the courses without any time delay.
5.2. for the seminar /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/ week of delay. Students should be present at the seminars without any time delay.

6. Specific competencies acquired

Professional competencies	- Defining the language and identification of advanced concepts for mathematical modelling and programming for the process engineering applications - Understanding and explaining the operation of the chemical process engineering equipment and installations using complex dynamic mathematical models and statistical data processing - Development of competencies of using information technology techniques for data processing, modelling and simulation of chemical and biochemical processes by abstracting and representing the system in the form of a mathematical models, using conventional and artificial intelligence methods - Developing the competencies for understanding and interpreting the time and space evolution of the chemical and biochemical system by the use of modelling methods originating from the biological systems and implementing the artificial intelligence instruments. - Developing dynamic mathematical models with lumped and distributed parameters and their implementation in simulators used for the process performance assessment in order to identify operation and control solutions for economic benefits, improved energetic efficiency and safety while reducing the negative impact on the environment
Transversal competencies	• Performing research and design activities in a autonomous way, using 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	Developing the competencies of understanding and interpretation of the for time and space evolution of the chemical and biochemical oxide system, abstracting and representing the system in the form of a mathematical model and building software simulators to illustrate the real system behaviour
7.2 Specific objective of the discipline	Providing the basic information regarding the synthesis and processing of some special ceramics, binders, vitreous and vitreous ceramics materials Presenting the importance of particle size and specific surface in materials processing and final microstructure formation of crystalline solids and the new modern processing methods.

8. Content

8.1 Course	Teaching methods	Remarks
1. High reliability ceramics. Processing methods, densification concepts, colloidal powder processing. Silicon nitride powders. Powder Synthesis and Characterization. Powder Dispersion. Surface properties. Powder sintering. Ceramic Properties.	Lecture giving, explanation, conversation, exemplification, debate	
2. Stabilised zirconia ceramics. Wet processing. Microstructure. Forming. Thermal treatment. Properties. Structural ceramics. Thin films – deposition methods.	Lecture giving, explanation, conversation, exemplification, debate	
3. Electronic ceramics ($BaTiO_3$). Processing. Wet Forming. Slip Casting. Thermal treatment. Properties. Microwave processing of ceramics.	Lecture giving, explanation, conversation, exemplification, debate	
4. Ceramic composites. Microstructure and processing. Sintering and Hot Forming. Reaction Processing. Melt Processing Methods. Chemical Vapour Deposition.	Lecture giving, explanation, conversation, exemplification, debate	
5. Oxide-salt-water binders. A. Binders in system $MgO-MgCl_2(MgSO_4)-H_2O$. Phase equilibria, compositions, characteristics. B. Binders analogous to Sorel cement. Alkaline – earth and with other cationic elements binding systems.	Lecture giving, explanation, conversation, exemplification, debate	
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	
7. Binders for high temperatures (refractories). Aluminate-phosphate, magnesite-phosphate and chromo-phosphate binders. Compositions. Characteristics. Obtaining methods.	Lecture giving, explanation, conversation, exemplification, debate	
8. Oxide vitreous materials. Characterization of the vitreous structure. Oxides role in obtaining of the vitreous structure.	Lecture giving, explanation, conversation, exemplification, debate	
9. Correlation composition-structure-properties. Silica glasses. Borate glasses. Phosphate glasses.	Lecture giving, explanation, conversation, exemplification, debate	
10. Technical glasses. Chemical and thermal resistant glasses. Electrical glasses. Vycor glasses. Semiconducting glasses. Isolating	Lecture giving, explanation, conversation,	

glasses.	exemplification, debate	
11. Technical glasses. Optical and selective absorption glasses. Optical and selective absorption glasses characteristics. Photosensitive glasses characteristics. Optical fibers.	Lecture giving, explanation, conversation, exemplification, debate	
12. Vitreous ceramics materials: oxide base systems, calculation of the glasses compositions (criteria), physical – chemical processes (homogeneous of melts, nucleating and growing of crystals, types of nucleates).	Lecture giving, explanation, conversation, exemplification, debate	
13. Vitreous ceramics materials obtaining: compositions, diagrams, properties, thermal treatment of melting and crystallization, materials characterization	Lecture giving, explanation, conversation, exemplification, debate	
14. Vitreous biomaterials. Biological glasses with controlled corrosion. Radio therapy glasses. Vitreous ceramics for hyperthermia.	Lecture giving, explanation, conversation, exemplification, debate	

Bibliography. 1. Luk'yanchuk, I., Mezzane, D., – *Smart Materials for Energy, Communications and Security*, Springer, 2008, www.springerlink.com

2. Innocenzi, P, Zub, Y., Kessler, V., *Sol-Gel Methods for Materials Processing*, Springer, 2008, www.springerlink.com

3. Lazau, I., Pacurariu, C., Ecsedi, Z., Ianos, R., *Metode neconvenţionale utilizate în sinteza compuşilor oxidici*, Ed. Politehnica, Timişoara, 2006, BCU

4. I.Teoreanu, *Bazele tehnologiei lianţilor anorganici*, Ed.Did.Pedag., Bucureşti, 1993, BCU

5. *Klaus Dieter Kuhn (2005)* - What is the bone cement, The Well-Cemented Total Hip Arthroplasty, Part II, Pages 52-59 www.springerlink.com

6. *A. El. Zohairy, A. J. Feilzer (2005)* Dental Hard Tissues and Bonding, Part II, Pages 155-173 www.springerlink.com

7. D.Vasilescu, *Tehnologia liantilor anorganici*, UBB, Cluj-Napoca, 2000, Biblioteca de Chimie

8. P.Balta, *Tehnologia sticlei*, Editura Didactica si Pedagogica, Bucuresti, 1984.

9. I.Ardelean, *Introducere in studiul materialelor oxidice cu structura vitroasa*, Editura Napoca Star, Cluj Napoca, 2002

10.Al.Szep, Fl. Bandrabur, *Sticla de constructii*, Editura Cermi, Iasi, 2005

11.Viorica Simon, *Fizica biomaterialelor*, Presa Universitara Clujeana,2002

12.F.Goga, *Tehnici de analiza a materialelor oxidice*, Presa Universitara Clujeana,2006

13. H.Scholze, *Glass-Nature, Structure and Properties*, Editura Springer-Verlag,1990

14. Strnad Z, *Glass-Ceramics Material* Elsevier, Amsterdam, 1986

15.McMillan P.W. *Glass-ceramics*, Academic Press, New York,1976, Biblioteca de Chimie

16. Joon B. Park, Joseph D. Bronzino, *Biomaterials-Principles and Applications*, CRC Press, 2003

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Presentation and discussion of experimental works. Work protection rules.	Conversation method, learning by discovery, individual learning, team working	
2. Colloidal powders processing	Conversation method, learning by	

	discovery, individual learning, team working	
3. Stabilised zirconia and thin coating deposition method	Conversation method, learning by discovery, individual learning, team working	
4. Microwave processing of electronic ceramics	Conversation method, learning by discovery, individual learning, team working	
5. Sintering and hot pressing of ceramic composite	Conversation method, learning by discovery, individual learning, team working	
6. Physical and chemical deposition of thin films	Conversation method, learning by discovery, individual learning, team working	
7. Burning method for obtaining of binders	Conversation method, learning by discovery, individual learning, team working	
8. Theoretical method for properties prediction of vitreous materials	Conversation method, learning by discovery, individual learning, team working	
9. Projecting composition and raw materials receipt for special glasses	Conversation method, learning by discovery, individual learning, team working	
10. Study of the melting procceses in borate- silicate glasses	Conversation method, learning by discovery, individual learning, team working	
11. Synthesis of low melting glasses	Conversation method, learning by discovery, individual learning, team working	
12. Synthesis of coloured glasses. Colour characterization by dominant waveleight determination	Conversation method, learning by discovery, individual learning, team working	
13. Synthesis of crystallised glasses	Conversation method, learning by	

	discovery, individual learning, team working	
14. Thermal analyses of crystallised glasses: Tg temperature, crystallisation interval, melting point of new crystals	Conversation method, learning by discovery, individual learning, team working	

Bibliography

1. Alan G. King, *Ceramic Technology and Processing*, William Andrew Publishing, New York, 2002, www.sciencedirect.com
2. I. Teoreanu, I. Nicolescu, N. Ciocea, V. Moldovan, *Introducere în ştiinţa materialelor anorganice*, Ed. Tehnică, Bucureşti, 1987, BCU, Biblioteca 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: Azomures, Oltchim, ChimComplex, Saint Gobain) has been used to comply with the expected competencies desired by potential employers.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Final examination consisting in a written work which will evaluate the way knowledge of the course has been acquired, the way of thinking, correctness and argumentation for the solutions to the examination subjects	Written examination. Access to examination is conditioned by the presentation of the homework solutions. Examination fraud: the student is expelled from the exam according the ECTS regulations	70 %
10.5 Seminar/lab activities	Correctness of the answers as proof of: understanding and applying the knowledge taught at the seminar/laboratory, active participation to the seminar/laboratory activities	The solutions of the homework problems should be presented at the very next laboratory/seminar meeting	30 %
10.6 Minimum performance standards			
➢ Capability to critically analyse own approach for solving problems; use computer and English language for continuous learning.			

Date — Signature of course coordinator — Signature of seminar coordinator

30.03.2015 ....

Date of approval — Signature of the head of department

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