SYLLABUS[1]

1. Information about the program

1.1 Higher education institution	Politehnica University of Timisoara
1.2 Faculty[2] / Department[3]	Faculty of Industrial Chemistry and Environmental Engineering / Applied Chemistry and Inorganic Compounds and Environmental Engineering
1.3 Chair	—
1.4 Field of study (name/code[4])	Chemical Engineering / 10.30.20
1.5 Study cycle	Master Degree
1.6 Study program (name/code)/Qualification	**Micro and Nanomaterials** /10.30.20.20/Chemical Engineer, Micro and Nanomaterials

2. Information about the discipline

2.1 Name of discipline			Synthesis and Processing of Micro and Nanomaterials				
2.2 Coordinator (holder) of course activities			Lecturer. Dr. Eng. IANOȘ Robert				
2.3 Coordinator (holder) of applied activities [5]			Lecturer. Dr. Eng. IANOȘ Robert				
2.4 Year of study[6]	I	**2.5** Semester	1	**2.6** Type of evaluation	Exam	**2.7** Type of discipline	mandatory

3. Total estimated time (hours / semester of didactic activities)

3.1 No. of hrs. / week	4 , of which:	**3.2** course	2	**3.3** seminar/laboratory/ project/training	0/2/0/0
3.4 Total no. of hrs. in the education curricula	56 , of which:	**3.5** course	28	**3.6** applied activities	28
3.7 Distribution of time for individual activities related to the discipline					hrs.
Study using a manual, course materials, bibliography and lecture notes					28
Additional documentation in the library, on specialized electronic platforms and on the field					14
Preparation for seminars / laboratories, homeworks, assignments, portfolios, and essays					14
Tutoring					5
Examinations					3
Other activities					
Total hrs. of individual activities					64

3.8 Total hrs. / semester[7]	120
3.9 No. of credits	8

[1] The form corresponds to the Syllabus promoted by OMECTS 5703/18.12.2011 (Annex3).
[2] The name of the faculty which manages the educational curriculum to which the discipline belongs.
[3] The name of the department entrusted with the discipline, and to which the course coordinator / holder belongs.
[4] Fill in the code provided in GD no. 493/17.07.2013.
[5] The applied activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[6] The year of study to which the discipline is provided in the curriculum.
[7] It is obtained by summing up the number of hrs. from 3.4 and 3.7.

4. Prerequisites (where applicable)

4.1 Curriculum	• Chemistry, Physics, Mathematics
4.2 Competencies	•

5. Conditions (where applicable)

5.1 of the course	• Classroom, video projector system
5.2 to conduct practical activities	• Laboratory infrastructure

6. Specific competencies acquired

Professional competencies[8]	• 1. Description, analysis and use of modern concepts and theories, which represent the basic principles of micro and nanomaterials synthesis and processing. • 2. Identifying and defining a research topic as well as the development of a schedule to achieve the desired objectives in the field of micro and nanomaterials synthesis and processing. • 3. Applying the principles of scientific research typical to micro and nanomaterials. Presentation of the obtained results using a clear and convincing oral/written communication. • 4. Literature study and continuous documentation in the field of synthesis and processing of nanomaterials as well as associated fields related to social and professional needs.
Transversal competencies	•

7. Objectives of the discipline (based on the grid of specific competencies acquired)

7.1 General objective of the discipline	• Understand the major features and benefits of applying modern unconventional synthesis methods in the preparation of micro and nanomaterials with tailored properties.
7.2 Specific objectives	• Development of skills and competencies that enable choosing the optimal processing and synthesis methods of micro and nanomaterials according to their required properties. • Development of competencies in terms of understanding and using the correlations between chemical composition – synthesis method – structure – material properties. •

8. Content

8.1 Course	No. of hours	Teaching methods
1. General terms concerning the specific features of micro and nanomaterials. 1.1. Definitions and classifications. 1.2. Characteristics of solid-state reactions. 1.3. Advantages and drawbacks of the classical synthesis method of oxide compounds. 1.4. Prospects offered by unconventional synthesis methods for obtaining micro and nanomaterials with tailored properties.	4	Dashboard, oral presentation, multimedia techniques
2. Combustion synthesis of oxide powders. 2.1. Theoretical basis of the combustion method. 2.2. Oxidizing agents and reducing	4	Dashboard, oral

[8] The professional competencies and the transversal competencies will be treated according to the Methodology of OMECTS 5703/18.12.2011. The competencies listed in the National Register of Qualifications in Higher Education [Registrul Naţional al Calificărilor din Învăţământul Superior RNCIS] (http://www.rncis.ro/portal/page?_pageid=117,70218&_dad=portal&_schema=PORTAL) will be used for the field of study from 1.4 and the program of study from 1.6 of this form, involving the discipline.

agents, establishing the redox reactions stoichiometry which allow the preparation of de designed oxide compounds. 2.3. Factors that influence combustion synthesis reactions: type of the oxidizing agent, type of the fuel, fuel / oxidizer ratio, reaction ignition temperature, volume of the reaction mixture etc. 2.4. Examples of synthesis of nanocrystalline powders of practical interest.		presentation, multimedia techniques
3. Sol-gel method. 3.1. Theoretical basis of the sol-gel method. 3.2. Factors that influence the sol-gel processes: type of alkoxides, presence of catalysts, type of solvent, water/alkoxide molar ratio, temperature, etc. 3.3. Gel maturation and drying. 3.4. Gel porosity, aerogels and xerogels. 3.5. Sol-gel applications: nanoporous films and membranes, nanocrystalline powders.	4	Dashboard, oral presentation, multimedia techniques
4. Organic precursors annealing. 4.1. Pechini method. 4.2. Polymeric routes. 4.3. Method based on the oxidation of polyols with metal nitrates. 4.4. Factors that influence the formation of the designed compounds by organic precursors annealing.	4	Dashboard, oral presentation, multimedia techniques
5. Hydrosilicate precursor's method. 5.1. Theoretical basis of the hydrosilicate precursors preparation. 5.2. Factors that influence the formation of the designed compounds by hydrosilicate precursors annealing. 5.3. Micro-powder preparation in the SiO_2-MO systems.	4	Dashboard, oral presentation, multimedia techniques
6. Hydrothermal synthesis. 6.1. Theoretical basis of hydrothermal synthesis of nanocrystalline powders. 6.2. Factors that influence the characteristics of the compounds obtained by hydrothermal synthesis. 6.3. Applications of the hydrothermal method.	4	Dashboard, oral presentation, multimedia techniques
7. Micro ad nanopowder processing. 7.1. Isostatic pressing. 7.2. Hot pressing. 7.3. Pressure casting. 7.4. Doctor Blade. 7.5. Chemical vapor deposition. 7.6. Thermal spray..	4	Dashboard, oral presentation, multimedia techniques

Bibliography[9]

1. I. Lazău, R. Ianoş, C. Păcurariu, Synthesis and processing of micro an nanomaterials, Politehnica Press Timişoara, 2011.
2. R. Ianoş, I. Lazău, C. Păcurariu, Combustion synthesis of oxide compounds, Politehnica Press Timişoara, 2008.
3. I. Lazău, C. Păcurariu, Z. Ecsedi, R. Ianoş, Unconventional synthesis methods of oxide compounds, Politehnica Press, Timişoara, 2006.
4. P.A. Webb, C. Orr, Analytical Methods in Fine Particle Technology, Micromeritics Instrument Corporation, Norcross, GA USA, 1997.
5. A.C. Ianculescu, L. Mitoşeriu, Advanced ceramics with applications in microelectronics – Micro- and nanostructured systems based on barium titanate, Politehnica Press, Bucureşti, 2007.

8.2 Applied activities[10]	No. of hours	Teaching methods
1. Laboratory: Sol-gel synthesis of nanoporous Al_2O_3 films: 1.1. Aluminum triisopropoxide sol preparation, hydrolysis and	12	Practical work

[9] At least one title must belong to the department staff teaching the discipline, and at least 3 titles must refer to national and international works relevant for the discipline, and which can be found in the Politehnica University Library.
[10] The types of applied activities are those specified in footnote 5. If the discipline contains several types of applied activities, then these will be written consecutively in the lines of the table below. The type of activity will be written in a distinct line, as „Seminar:", „Laboratory:", „Project:" and/or „Practice/Training:".

condensation, xerogel preparation by drying the applied layers on glass substrate. 1.2. Preparation of Al_2O_3 films by annealing at temperatures between 800 °C and 1100 °C, influence of temperature and PVA content on S_{BET} (m^2/g) and D_m (nm) of the obtained films.		
2. Laboratory: Combustion synthesis of beta-aluminas.	4	Practical work
3. Synthesis of nanopowders in the $CaO-Al_2O_3$ system via polymeric precursors method.	4	Practical work
4. Study of the sintering behavior of Al_2O powders.	8	Practical work
Bibliography [11] Individual laboratory essays available in electronic format		

9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

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10. Evaluation

Type of activity	**10.1** Evaluation criteria	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	Knowing the basic concepts of micro and nanomaterials. Capacity of application of these concepts. To correlate the properties of the obtained materials with the used method and synthesis conditions.	Final examination	66 %
10.5 Applied activities	**S:**		
	L: The ability to setup laboratory experiments and adjust the experimental conditions according to the	Discussions, exercises, tests.	34 %

[11] At least one title must belong to the staff teaching the discipline.

	desired specifications.		
	P:		
	Pr:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified)			
• Resolving at least 50% of written evaluation subjects and at least mark 5 to laboratory activity			

D ate of completion

20.11.2015

Course coordinator

(signature)

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Coordinator of applied activities

(signature)

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Head of Department

(signature)

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Date of approval in the Faculty Council[12]

Dean

(signature)

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[12] Avizarea este precedată de discutarea de care aparţine programul de disciplinei.