



## COURSE DESCRIPTION

### 1. Programme Identification Data

1.1 Higher Education Institution	„ALEXANDRU IOAN CUZA” UNIVERSITY OF IAȘI
1.2 Faculty	FACULTY OF CHEMISTRY
1.3 Department / Doctoral School	DOCTORAL SCHOOL OF CHEMISTRY
1.4 Field of Study	CHEMISTRY
1.5 Cycle of Studies	DOCTORATE
1.6 Study Programme / Qualification	ADVANCED UNIVERSITY STUDIES – DOCTORAL SCHOOL OF CHEMISTRY / PhD IN CHEMISTRY

### 2. Course Identification Data

2.1 Course Title	FUNDAMENTAL CONCEPTS AND CURRENT TRENDS IN CHEMISTRY - MODULE II						
2.2 Course coordinator (lectures)	Prof. univ. dr. Ionel MANGALAGIU Prof. univ. dr. habil Romeo-Iulian OLARIU						
2.3 Seminar coordinator							
2.4 Year of study	I	2.5 Semester	1	2.6 Type of assessment	*C	2.7 Disciple regime	**CC

\*[E – exam / C – colloquium] \*\*[CC = Compulsory Course / OC = Optional Course]

### 3. Estimated Total Workload (hours per semester)

3.1 Hours per week	1	3.2 Lectures	1	3.3. Seminars	-
3.4 Total hours according to the curriculum	14	3.5 Lectures	14	3.6. Seminars	-
Time allocation					hours
Study based on textbooks, course materials, bibliographic sources, and other relevant resources					24
Additional research in the library, on specialized electronic platforms, and in the field					50
Preparation for seminars, assignments, papers, portfolios, essays					10
Academic tutoring					-
Assessment activities					2
Other activities					-
3.7 Total hours of individual study					86
3.8 Total hours per semester					100
3.9 Number of credits					4

### 4. Preconditions (if applicable)

4.1 Curriculum prerequisites	Completion of a Master's degree (or equivalent) and enrolment in the doctoral study programme in Chemistry, according to the regulations of the Doctoral School, as well as completion of Module I of the discipline Fundamental Concepts and Current Trends in Chemistry.
4.2 Competences prerequisites	Competence in the use of scientific language specific to the field of Chemistry; the ability to analyze and interpret information from specialized literature; competence in documentation, synthesis, and argumentation of an advanced research approach; as well as competence in using a personal computer and applications from the Microsoft Office package (Word, PowerPoint, Excel, Outlook).

### 5. Conditions (if applicable)

5.1 Conditions for lectures	Appropriate teaching spaces for doctoral activities, equipped with a video projector and PC, with access to the Internet, institutional IT infrastructure, and specialized resources (scientific databases relevant to the field of Chemistry). Compliance with institutional regulations regarding the organization of doctoral studies.
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**6. Specific competences accumulated**

<b>Professional competences</b>	<ul style="list-style-type: none"> <li>Competence to conceive, substantiate, and integrate original scientific research approaches in the field of Chemistry through the use of advanced methods and both fundamental and emerging concepts, with the aim of advancing scientific knowledge and research methodologies;</li> <li>Competence for in-depth, critical, and constructive evaluation of scientific research projects and results, in relation to the current state of theoretical and methodological knowledge and to strategic research priorities in the field;</li> <li>Competence to select, adapt, and apply advanced research principles, theories, and methods, including through interdisciplinary approaches and method transfer, to address complex theoretical and applied problems;</li> <li>Competence to explain and interpret complex chemical phenomena and processes from multiple perspectives, based on fundamental concepts and current trends in chemical research;</li> <li>Systematic and in-depth knowledge of current concepts, research methods, debates, and hypotheses in the field of Chemistry, as well as the ability to communicate and engage in advanced scientific dialogue with specialists in related fields.</li> </ul>
<b>Transversal competences</b>	<ul style="list-style-type: none"> <li>Competence to initiate, develop, and coordinate research projects with a creative and innovative component, as a foundation for professional development and research excellence;</li> <li>Competence to assume responsibility for, and to organize, coordinate, and lead activities specific to scientific research within teams, professional structures, or institutional projects;</li> <li>Competence to initiate, plan, and develop innovative theoretical and applied projects in academic and advanced research contexts, with relevant scientific impact..</li> </ul>

**7. Course Objectives** (derived from the acquired competences)

<b>7.1. General objective</b>	To deepen and integrate knowledge of fundamental concepts in the field of Chemistry and to develop the competence for advanced critical analysis of current trends in chemical research, in relation to specialized literature and the research directions promoted within the Doctoral School of Chemistry, in order to consolidate and substantiate the doctoral research approach.
<b>7.2. Specific objectives</b>	<p>Upon completion of the course, the doctoral student will acquire the competence to:</p> <ul style="list-style-type: none"> <li>use fundamental concepts of Chemistry in an integrated and in-depth manner for the advanced analysis and interpretation of phenomena and processes specific to the field;</li> <li>critically and comparatively analyze specialized scientific literature and identify current trends, emerging directions, and research priorities in the field of Chemistry;</li> <li>formulate, substantiate, and argue doctoral research themes and directions in relation to the current state of scientific knowledge and field-specific priorities;</li> <li>develop and critically evaluate syntheses and review analyses on relevant research topics using advanced methods of documentation and source evaluation;</li> <li>demonstrate a responsible, critical, and ethical approach in the use of fundamental concepts and scientific research results in order to achieve excellence in doctoral research.</li> </ul>

**8. Content**

8.1	Lecture Topics	Teaching methods*	Notes (hours / references)
1.	Sonochemistry: applications in materials chemistry	Interactive lecture, explanation and conceptual demonstration, academic conversation and debate, critical analysis of examples and problematization	(3.5 hours, [1]) C-CF&TAC-01
2.	Inorganic Materials	Interactive lecture, explanation, academic conversation and debate, critical analysis of concepts and applications	(3.5 hours [3-4])
3.	Multiple variable analysis techniques. Planning of experiences and	Interactive lecture, explanation, case analysis and applicative	(3.5 hours [5.6])

	optimization procedures.	problematization	
4.	Azaheterocyclic compounds with biological activity	Interactive lecture, explanation, conversation and academic debate, critical analysis of the literature	(3.5 hours [7.8])
<p>*In cases of force majeure, teaching activities may be conducted online, in accordance with current legislation.</p> <p><b>Bibliography:</b></p> <ol style="list-style-type: none"> <li>1. Mason, T. J. (ed.). Advances in Sonochemistry, Vols. 1–5. JAI Press, New York, <b>1990–1999</b>.</li> <li>2. Schubert, U.; Hüsing, N.; Laine, R. (eds.). Materials Syntheses: A Practical Guide. Springer, Wien–New York, <b>2008</b>.</li> <li>3. Lalena, J. L.; Cleary, D. A.; Carpenter, E. E.; Dean, N. F. Inorganic Materials: Synthesis and Fabrication. Wiley-Interscience, <b>2008</b>.</li> <li>4. Bruce, D. W.; O'Hare, D. Inorganic Materials. John Wiley &amp; Sons, <b>1997</b>.</li> <li>5. Arsene, C.; Olariu, R. I. Analytical and statistical methods in the investigation of chemical systems. Performantica, Iași, <b>2009</b>.</li> <li>6. Otto, M. Chemometrics: Statistics and Computer Applications in Analytical Chemistry. Wiley-VCH, <b>2017</b>.</li> <li>7. Zbancioc, G.; Mangalagiu, I. I.; Moldoveanu, C. A Review on the Synthesis of Fluorescent Five- and Six-Membered Ring Azaheterocycles. <i>Molecules</i>, <b>27</b>, 6321, <b>2022</b>.</li> <li>8. Amariuca-Mantu, D.; Mangalagiu, V.; Danac, R.; Mangalagiu, I. I. Microwave-Assisted Reactions of Azaheterocycles for Medicinal Chemistry Applications. <i>Molecules</i>, <b>25</b>, 716, <b>2020</b>.</li> </ol>			

## 9. Learning Outcomes

<b>Knowledge and understanding</b>	<ul style="list-style-type: none"> <li>• explain and integrate fundamental and advanced concepts in the field of Chemistry relevant to doctoral scientific research;</li> <li>• describe and critically analyze current trends and emerging research directions in modern Chemistry, based on up-to-date scientific literature;</li> <li>• demonstrate in-depth understanding of the principles, methods, and advanced techniques used to investigate the structure, properties, and behavior of chemical compounds;</li> <li>• recognize and effectively use the interdisciplinary role of Chemistry in complex research contexts, including materials chemistry and atmospheric chemistry..</li> </ul>
<b>Application and analysis</b>	<ul style="list-style-type: none"> <li>• apply advanced concepts and methods for the analysis and interpretation of complex chemical phenomena and processes;</li> <li>• critically use modern characterization techniques, synthesis strategies, and data analysis methods in the study of relevant research cases;</li> <li>• analyze and critically compare specialized scientific literature, identifying trends, priorities, and research gaps in the field of Chemistry;</li> <li>• correlate experimental data, theoretical results, and predictive models in order to elucidate the structure and behavior of chemical compounds..</li> </ul>
<b>Critical Assessment and Accountability</b>	<ul style="list-style-type: none"> <li>• critically and constructively evaluate scientific research results in relation to the current state of knowledge and accepted standards in the field;</li> <li>• assess the limitations, validity, and potential of methods used in advanced chemical research;</li> <li>• demonstrate autonomy, responsibility, and scientific rigor in guiding and substantiating the doctoral research approach;</li> <li>• justify the importance of the rigorous, ethical, and responsible use of fundamental concepts, data, and scientific research results.</li> </ul>
<b>Academic Communication</b>	<ul style="list-style-type: none"> <li>• communicate concepts, methods, and results of advanced chemical research clearly, critically, and in a well-argued manner, both orally and in writing;</li> <li>• use scientific language specific to the field of Chemistry appropriately and accurately when interacting with specialists in related fields;</li> <li>• participate actively and in a reasoned manner in academic discussions and debates on advanced topics related to current trends in Chemistry;</li> <li>• present research directions, results, and perspectives clearly, critically, and in context within academic and scientific settings.</li> </ul>

## 10. Correlation of the course content with the expectations of community representatives,

**professional associations, and representative employers in the field related to the program.**

The content of the course *Fundamental concepts and current trends in chemistry - Module II* is aligned with the expectations of the academic and research community, professional associations, and employers in the field of Chemistry by strengthening knowledge of fundamental concepts and current trends in chemical research that are relevant at both national and international levels.

Upon completion of the discipline, the doctoral student will acquire the competence to identify, substantiate, and critically argue a doctoral research topic, and to develop a research project on a given topic based on a documented and analytical review of the specialized literature, in accordance with the priorities and development directions of the field of Chemistry.

**11. Assessment**

<b>Activity</b>	<b>11.1 Assessment criteria</b>	<b>11.2 Assessment methods</b>	<b>11.3 Weight in final grade (%)</b>
<b>11.4 Lectures</b>	Correctness, coherence, and completeness of the acquired knowledge, demonstrating understanding and advanced application of fundamental concepts and current trends in the field of Chemistry; the ability to analyze and integrate scientific information; appropriate use of specialized scientific language.	Colloquium – oral and well-reasoned presentation of a research topic in the relevant field, based on specialized scientific literature.	100
<b>11.5 Seminars</b>			
<b>11.6 Minimum Performance Standard</b>			
In order to pass the discipline, the doctoral student must demonstrate:			
<ul style="list-style-type: none"><li>• knowledge and in-depth understanding of the fundamental concepts and the main current trends in the field of Chemistry;</li><li>• the ability to critically analyze and integrate scientific information from the specialized literature, using the language specific to the field;</li><li>• the ability to select and justify appropriate methods and approaches in relation to the objectives of a research topic;</li><li>• the ability to present a research topic coherently, critically, and in a well-argued manner, based on a documented review of the relevant literature.</li></ul>			

Date of completion  
25.09.2025

Course coordinator

Prof. univ. dr. Ionel MANGALAGIU

Prof. univ. dr. habil Romeo-Iulian OLARIU

Seminar coordinator

Date of approval  
29.09.2025

Director of the Doctoral School of Chemistry  
Prof. univ. dr. habil. Cecilia ARSENE