

MINISTRY OF EDUCATION AND TRAINING
QUY NHON UNIVERSITY

DOCTORAL PROGRAM

Level: **Doctoral**

Major:: **Theoretical and Physical Chemistry**

Code: **9440119**

Mode of study: **Full-time**

Binh Dinh, 2023

DOCTORAL PROGRAM

*(Issued together with Decision No. 2017/QĐ-ĐHQN dated July 31, 2023
of the Rector of Quy Nhon University)*

Level: Doctoral

Major: Theoretical and Physical Chemistry

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1. PROGRAM OBJECTIVES (POs)

1.1. General objectives

The doctoral program in Chemistry aims to train graduates who possess advanced and specialized theoretical knowledge, as well as practical expertise, in Theoretical Chemistry and Physical Chemistry within the discipline of Physical Sciences and the broader field of Natural Sciences. Graduates are expected to develop strong competencies in synthesizing and critically analyzing information, identifying and solving complex problems creatively, and conducting independent, original, and innovative research that contributes to the generation of new knowledge. They should also be capable of disseminating and transferring scientific knowledge, establishing and maintaining national and international collaborative networks, and effectively managing and implementing professional and research activities. Furthermore, graduates are expected to demonstrate creativity, leadership, and self-direction in their professional endeavors, as well as the ability to formulate expert scientific conclusions and provide evidence-based recommendations for research, education, and practical applications.

1.2. Specific objectives (POs):

– Knowledge

PO1: To provide PhD students with advanced and in-depth knowledge in areas of Theoretical and Physical Chemistry, including computational chemistry, quantum chemistry, chemical thermodynamics, chemical kinetics, catalysis, electrochemistry, colloid chemistry, and polymer physical chemistry.

PO2: To update PhD students with current knowledge and recent scientific achievements in Theoretical and Physical Chemistry, as well as related fields in research and practical applications.

– Skills

PO3: To develop the ability to solve complex problems and collaborate within disciplinary and interdisciplinary contexts; analytical and synthetic skills; critical thinking and evaluation skills; skills in organization, management, and team development; and expert-level decision-making skills in research and applications related to Theoretical and Physical Chemistry and associated fields.

PO4: To develop skills for generating new knowledge and technologies, and for communicating and disseminating knowledge in Theoretical and Physical Chemistry and related disciplines.

– Autonomy and Responsibility

PO5: To develop the ability for self-direction and adaptation to changing environments; the capability to guide others in performing professional tasks; and the ability to manage, evaluate, and improve working methods to enhance professional effectiveness.

PO6: To demonstrate professional ethics and academic integrity; to take responsibility toward oneself, professional teams, and the community; and to maintain professional conduct and cultural awareness.

2. JOB OPPORTUNITIES AND PROFESSIONAL DEVELOPMENT

Upon graduation, graduates may pursue careers as lecturers at universities, colleges, and academies; researchers at research institutes, research centers, and industrial or manufacturing organizations; and professional managers at educational institutions, scientific organizations, and technological enterprises in the field of Chemistry, particularly in Theoretical Chemistry and Physical Chemistry. In addition, graduates may undertake postdoctoral research positions and participate in international fellowship programs at leading universities and research institutions worldwide.

3. PROGRAM LEARNING OUTCOMES (PLOs)

3.1. Knowledge

PLO1: Analyze and evaluate advanced and specialized knowledge in a scientific area within Theoretical and Physical Chemistry, such as computational chemistry,

quantum chemistry, chemical thermodynamics, chemical kinetics, catalysis, electrochemistry, colloid chemistry, and polymer physical chemistry.

PLO2: Apply core and fundamental knowledge of Theoretical and Physical Chemistry and related disciplines to address research problems and practical applications; apply relevant interdisciplinary knowledge to the field of Theoretical and Physical Chemistry.

PLO3: Generate new knowledge and develop new technologies in Theoretical and Physical Chemistry and related fields.

PLO4: Apply knowledge of research group management and research organization in scientific activities.

3.2. Skills

PLO5: Apply and analyze scientific theories, methods, and tools used in research and development in Theoretical and Physical Chemistry and related fields.

PLO6: Demonstrate creativity in enriching and advancing professional knowledge in Theoretical and Physical Chemistry.

PLO7: Analyze scientific problems and propose creative and original approaches for research and applications in Theoretical and Physical Chemistry and related areas.

PLO8: Organize, manage, and lead professional activities in research and development; communicate, discuss, analyze, critically evaluate, and disseminate research results in Theoretical and Physical Chemistry and related fields.

3.3. Autonomy and Responsibility

PLO9: Demonstrate a strong passion for research and the creation of new knowledge.

PLO10: Show creativity and the ability to adapt to changing environments, as well as the capacity for self-direction and leadership in research and development.

PLO11: Demonstrate research management capabilities and the ability to make timely and well-reasoned expert decisions in research activities within Theoretical and Physical Chemistry.

PLO12: Uphold professional ethics and academic integrity; demonstrate responsibility toward oneself, research teams, and the community; and maintain professional conduct and cultural awareness.

4. ENTRY REQUIREMENTS

- Applicants must hold a Master's degree or have completed a specialized training program at Level 7 in a relevant field, or possess an excellent Bachelor's degree (or an

equivalent or higher qualification) in a relevant discipline, and demonstrate research capability and experience.

- Applicants must have foreign language proficiency at Level 4 of the Vietnamese 6-Level Foreign Language Proficiency Framework (or an equivalent or higher level).

Applicants holding a Master's degree or an excellent Bachelor degree in a relevant field:

Doctoral Program	Relevant Master or Excellent Bachelor Degree	Bridging Credits Required
Theoretical and Physical Chemistry	Master degree: - Theoretical and Physical Chemistry - Inorganic Chemistry - Organic Chemistry - Analytical Chemistry - Chemistry	0
	Bachelor degree (Excellent): - Chemistry - Chemistry Education	30

Applicants holding a Master degree or an excellent Bachelor degree in a related field (bridging courses required):

Doctoral Program	Related Degree Requiring Bridging Courses	Required Bridging Credits	Notes
Theoretical and Physical Chemistry	Master's degree: - Theory and Methods of Teaching Chemistry - Pharmaceutical Chemistry - Fields within the Physical Sciences group (Code: 84401xx) - Fields within Chemical Engineering, Materials, Metallurgy and Environmental Engineering (Code: 85203xx)	3	
	Bachelor's degree (Excellent): - Chemical Engineering Technology - Chemical Engineering - Pharmaceutical Chemistry	33	
	Other related fields in Natural Sciences, Life Sciences, Environmental Sciences, Engineering and Technology, Manufacturing and Processing	Determined by the training institution during the admission review for each	

		specific case	
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5. ELIGIBLE APPLICANTS

In accordance with the current regulations on doctoral admission and training issued by the Ministry of Education and Training of Vietnam and Quy Nhon University.

6. PROGRAM DURATION AND TOTAL ACADEMIC WORKLOAD

6.1. Program Duration: From **03 years (36 months)** to **04 years (48 months)**.

6.2. Total Credits:

- **Category 1:** PhD candidates holding a Master degree in a relevant field.
- **Category 2:** PhD candidates holding a Master degree in a related field.
- **Category 3:** PhD candidates holding an excellent Bachelor degree in a relevant field.
- **Category 4:** PhD candidates holding an excellent Bachelor degree in a related field.

Program Structure	Number of credits	Category			
		1	2	3	4
I. Bridging Courses		0	3	30	33
Theoretical Foundations of Chemistry	3				3
Advanced Theoretical and Physical Chemistry	3		3		
Advanced Inorganic Chemistry	3			3	3
Advanced Organic Chemistry	3			3	3
Data Processing and Experimental Design	3			3	3
Research Methodology in the Discipline	3			3	3
Advanced Computational Chemistry	3			3	3
Multiscale Simulation in Chemistry	3			3	3
Spectroscopic Methods in Chemistry	3			3	3
Advanced Thermodynamics	3			3	3
Advanced Chemical Kinetics	3			3	3
Advanced Electrochemistry	3			3	3
II. Doctoral-level Courses (Compulsory and Elective)		15	15	15	15
II.1 Compulsory Courses		6	6	6	6
Advanced Electronic Structure Theory	3	3	3	3	3
Selected Topics in Physical Chemistry	3	3	3	3	3
II.2 Elective Courses		9	9	9	9
Advanced Group Theory and Applications in Chemistry	3	3	3	3	3

Simulation and Calculation of Weak Interactions in Chemistry	3	3	3	3	3
Materials Modeling and Simulation	3	3	3	3	3
Advanced Materials for Energy Conversion and Storage	3	3	3	3	3
Advanced Materials for Environmental and Biomedical Applications	3	3	3	3	3
Synthesis and Characterization of Advanced Materials	3	3	3	3	3
III. Scientific Research and Dissertation		75	75	75	75
<i>III.1 Scientific Research</i>		<i>15</i>	<i>15</i>	<i>25</i>	<i>15</i>
Seminar at the Department					
Participation in national and international scientific conferences					
Scientific publications					
Other activities related to scientific research					
<i>III.2 Dissertation</i>		<i>60</i>	<i>60</i>	<i>60</i>	<i>60</i>
Total		90	93	120	123

7. TRAINING METHOD, GRADUATION REQUIREMENTS

7.1. Training Method

The training program is implemented under the credit-based system and complies with the current regulations and policies issued by the Ministry of Education and Training of Vietnam and Quy Nhon University.

7.2. Recognition of Qualification and Award of the Doctoral Degree

PhD candidates shall be considered for recognition of qualification and the award of the Doctoral degree when they satisfy the following requirements: a) The candidate's dissertation has been approved by the University-level Dissertation Evaluation Council;

b) The candidate has submitted to the University (both printed and electronic versions) the finalized dissertation bearing the candidate's signature, the supervisor's confirmation, and the certification of the Chair of the Dissertation Evaluation Council after all required revisions and amendments (if any) have been completed;

c) The candidate has submitted to the National Library of Vietnam (both printed and electronic versions) the dissertation abstract and the final complete dissertation, bearing the candidate's signature, the supervisor's signature, and the confirmation of the University.

8. ASSESSMENT

8.1. Grading Scale

A 10-point grading scale is used for all forms of assessment.

8.2. Assessment Methods, Evaluation Criteria, and Weighting

These are implemented in accordance with the current regulations on doctoral admission and training issued by the Ministry of Education and Training of Vietnam and Quy Nhon University. Specific criteria are described in detail in the syllabus of each course.

8.3. Assessment Methods

Assessment methods are implemented in accordance with the current regulations on doctoral admission and training issued by the Ministry of Education and Training of Vietnam and Quy Nhon University. Specific criteria are detailed in the syllabus of each course.

9. PROGRAM FRAMEWORK

No.	Course code		Course name	Year	Credits				Prequisite course code	Department in charge	Applicable Category
	Alphabetical	Numerical			Total	Theory	Assignment	Discussion			
I. Bridging courses					0						Candidate 1
					3						Candidate 2
					30						Candidate 3
					33						Candidate 4
1	TSHL	01	Theoretical Foundations of Chemistry	1	3	1.5	0.5	1.0		DNS	4
2	TSHL	02	Advanced Theoretical and Physical Chemistry	1	3	1.5	0.5	1.0		DNS	2
3	TSHL	03	Advanced Inorganic Chemistry	1	3	1.5	0.5	1.0		DNS	3, 4
4	TSHL	04	Advanced Organic Chemistry	1	3	1.5	0.5	1.0		DNS	3, 4
5	TSHL	05	Data Processing and Experimental Design	1	3	1.5	0.5	1.0		DNS	3, 4
6	TSHL	06	Research Methodology in Chemistry	1	3	1.5		1.5		DNS	3, 4
7	TSHL	07	Advanced Computational Chemistry	1	3	1.5	0.5	1.0		DNS	3, 4
8	TSHL	08	Multiscale Simulation in Chemistry	1	3	1.5	0.5	1.0		DNS	3, 4
9	TSHL	09	Spectroscopic Methods in Chemistry	1	3	1.5	1.5			DNS	3, 4
10	TSHL	10	Advanced Thermodynamics	1	3	1.5	0.5	1.0		DNS	3, 4
11	TSHL	11	Advanced Chemical Kinetics	1	3	1.5	0.5	1.0		DNS	3, 4
12	TSHL	12	Advanced	1	3	1.5	0.5	1.0		DNS	3, 4

No.	Course code		Course name	Year	Credits				Prequisite course code	Department in charge	Applicable Category
	Alphabetical	Numerical			Total	Theory	Assignment	Discussion			
			Electrochemistry								
II. Doctoral-level Courses					15						1, 2, 3, 4
II.1. Compulsory Courses					6						1, 2, 3, 4
13	TSHL	13	Advanced Electronic Structure Theory	1	3	1.5	0.5	1.0		DNS	1, 2
				2							3, 4
14	TSHL	14	Selected Topics in Physical Chemistry	1	3	1.5	0.5	1.0		DNS	1, 2
				2							3, 4
II. 2. Elective Courses (Select 3/6 courses)					9						1, 2, 3, 4
15	TSHL	15	Advanced Group Theory and Applications in Chemistry	1	3	1.5	0.5	1.0		DNS	1, 2
				2							3, 4
16	TSHL	16	Simulation and Calculation of Weak Interactions in Chemistry	1	3	1.5	0.5	1.0		DNS	1, 2
				2							3, 4
17	TSHL	17	Materials Modeling and Simulation	1	3	1.5	0.5	1.0		DNS	1, 2
				2							3, 4
18	TSHL	18	Advanced Materials for Energy Conversion and Storage	1	3	1.5		1.5		DNS	1, 2
				2							3, 4
19	TSHL	19	Advanced Materials for Environmental and Biomedical Applications	1	3	1.5		1.5		DNS	1, 2
				2							3, 4
20	TSHL	20	Synthesis and Characterization of Advanced Materials	1	3	1.5	0.5	1.0		DNS	1, 2
				2							3, 4
III. Scientific Research and Dissertation					75						1, 2, 3, 4
21	TSHL	21	Scientific Research	1-3	15					DNS	1, 2
				2-4							3, 4
22	TSHL	22	Dissertation	1-3	60					DNS	1, 2
				2-4							3, 4
Total					90						Category 1
					93						Category 2
					120						Category 3
					123						Category 4

(*DNS: Department of Natural Sciences)

Courses and mapping to program learning outcomes:

No.	Course	PLO
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		1	2	3	4	5	6	7	8	9	10	11	12
1	Theoretical Foundations of Chemistry	x	x			x				x	x		
2	Advanced Theoretical and Physical Chemistry	x	x			x	x		x	x	x		
3	Advanced Inorganic Chemistry		x				x		x	x	x		
4	Advanced Organic Chemistry		x				x		x	x	x		
5	Data Processing and Experimental Design		x		x			x	x			x	x
6	Research Methodology in Chemistry				x			x	x			x	x
7	Applied Computational Chemistry	x	x			x	x			x	x		
8	Multiscale Simulation in Chemistry		x	x			x	x			x	x	
9	Spectroscopic Methods in Chemistry		x		x			x	x			x	x
10	Advanced Thermodynamics	x	x			x			x			x	x
11	Advanced Chemical Kinetics	x	x			x			x			x	x
12	Advanced Electrochemistry	x	x			x			x			x	x
13	Advanced Electronic Structure Theory	x	x			x			x	x	x		
14	Selected Topics in Physical Chemistry	x	x			x			x			x	x
15	Advanced Group Theory and Applications in Chemistry	x	x				x	x			x	x	
16	Simulation and Calculation of Weak Interactions in Chemistry		x	x			x	x			x	x	
17	Materials Modeling and Simulation		x	x			x	x			x	x	
18	Advanced Materials for Energy Conversion and Storage		x	x			x	x			x		x
19	Advanced Materials for Environmental and Biomedical Applications		x	x			x	x			x		x
20	Synthesis and Characterization of Advanced Materials		x	x			x	x			x		x
21	Scientific Research	x	x	x	x	x	x	x	x	x	x	x	x
22	Doctoral Dissertation	x	x	x	x	x	x	x	x	x	x	x	x

10. TRAINING PLAN

No.	Course code	Course	Number of credits	Plan $(year)$				Suggested Lecturers	Faculty/Department in charge	Applicable category
				1	2	3	4			
I. I. Bridging Courses										2, 3, 4
1	TSHL01	Theoretical	3	3				Dr. Truong Thi	DNS	4

No.	Course code	Course	Number of credits	Plan(year)				Suggested Lecturers	Faculty/Department in charge	Applicable category
				1	2	3	4			
		Foundations of Chemistry						Cam Mai PGS.TS. Nguyen Phi Hung		
2	TSHL02	Advanced Theoretical and Physical Chemistry	3	3				Assoc.Prof. Dr.. Nguyen Tien Trung Assoc.Prof. Dr. Nguyen Phi Hung		2
3	TSHL03	Advanced Inorganic Chemistry	3	3				Assoc.Prof. Dr. Nguyen Van Kim TS. Truong Thi Cam Mai	DNS	3, 4
4	TSHL04	Advanced Organic Chemistry	3	3				Assoc.Prof. Dr. Nguyen Thi Viet Nga Dr. Nguyen Le Tuan	DNS	3, 4
5	TSHL05	Data Processing and Experimental Design	3	3				Dr. Nguyen Le Tuan Assoc.Prof. Dr. Cao Văn Hoàng	DNS	3, 4
6	TSHL06	Research Methodology in Chemistry	3	3				Prof. Dr. Vo Vien Assoc.Prof. Dr. Nguyen Tien Trung	DNS	3, 4
7	TSHL07	Applied Computational Chemistry	3	3				Assoc.Prof. Dr. Nguyen Tien Trung Assoc.Prof. Dr. Vu Thi Ngan	DNS	3, 4
8	TSHL08	Multiscale Simulation in Chemistry	3	3				Assoc.Prof. Dr. Nguyen Tien Trung Assoc.Prof. Dr. Vu Thi Ngan		3, 4
9	TSHL09	Spectroscopic Methods in Chemistry	3	3				Dr. Nguyen Le Tuan Dr. Lê Cảnh Định		3, 4
10	TSHL10	Advanced Thermodynamics	3	3				Assoc.Prof. Dr. Nguyen Phi Hung Assoc.Prof. Dr. Nguyen Thi Vuong Hoan		3, 4
11	TSHL11	Advanced Chemical Kinetics	3	3				Prof. Dr. Vo Vien Assoc.Prof. Dr. Nguyen Phi Hung Nguyen Phi Hung		3, 4
12	TSHL12	Advanced	3	3				Assoc.Prof. Dr.		3, 4

No.	Course code	Course	Number of credits	Plan ^(year)				Suggested Lecturers	Faculty/Department in charge	Applicable category
				1	2	3	4			
		Electrochemistry						Huynh Thi Mien Trung Prof. Dr. Vo Vien		
II. Doctoral-Level Courses			15							1, 2, 3, 4
II.1. Compulsory Courses			6							1, 2, 3, 4
13	TSHL13	Advanced Electronic Structure Theory	3	3				Assoc.Prof. Dr. Vu Thi Ngan Assoc.Prof. Dr. Nguyen Tien Trung	DNS	1, 2
					3					3, 4
14	TSHL14	Selected Topics in Physical Chemistry	3	3				Prof. Dr. Vo Vien Assoc.Prof. Dr. Nguyen Phi Hung	DNS	1, 2
					3					3, 4
II.2. Elective Courses (Select 3/6 courses)			9							1, 2, 3, 4
15	TSHL15	Advanced Group Theory and Applications in Chemistry	3	3				Assoc.Prof. Dr. Vu Thi Ngan Dr. Nguyen Van Thang	DNS	1, 2
					3					3, 4
16	TSHL16	Simulation and Calculation of Weak Interactions in Chemistry	3	3				Assoc.Prof. Dr. Nguyen Tien Trung Assoc.Prof. Dr. Vu Thi Ngan	DNS	1, 2
					3					3, 4
17	TSHL17	Materials Modeling and Simulation	3	3				Assoc.Prof. Dr. Nguyen Tien Trung Assoc.Prof. Dr. Vu Thi Ngan	DNS	1, 2
					3					3, 4
18	TSHL18	Materials for Energy Conversion and Storage Applications	3	3				Prof. Dr. Vo Vien Assoc.Prof. Dr. Huynh Thi Mien Trung	DNS	1, 2
				3	3					3, 4
19	TSHL19	Materials for Environmental and Biomedical Applications	3	3				Assoc.Prof. Dr. Nguyen Thi Vuong Hoan, Assoc.Prof. Dr. Nguyễn Thị Diệu Cẩm	DNS	1, 2
					3					3, 4
20	TSHL20	Synthesis and Characterization of Advanced Materials	3	3				Dr. Tran Thi Thu Phuong Dr. Nguyen Van Thang	DNS	1, 2
					3					3, 4

No.	Course code	Course	Number of credits	Plan(year)				Suggested Lecturers	Faculty/Department in charge	Applicable category
				1	2	3	4			
III. Scientific Research and Dissertation										1, 2, 3, 4
21	TSHL21	Scientific Research	15					Faculty members of DNS		1, 2, 3, 4
22	TSHL22	Dissertation	60					Faculty members of DNS		1, 2, 3, 4
Total			90							1
			93							2
			120							3
			123							4
Notes: - Scientific Research and Dissertation activities are conducted from Year 1 for candidates in Categories 1 and 2, and from Year 2 for candidates in Categories 3 and 4. - The minimum number of credits per academic year is 30 credits.										

11. GUIDELINES FOR TRAINING PROGRAM IMPLEMENTATION

This training program has been implemented since the 2023 admission cycle.

- The training process is developed based on the designed curriculum, training objectives, target learners, human resource requirements, and specific requirements for doctoral education. For elective courses, depending on practical conditions, development trends, and societal needs, the managing faculty will advise doctoral candidates in selecting appropriate courses.
- The Dean of the managing faculty is responsible for organizing and guiding the principles for developing detailed course syllabi to ensure that the objectives, contents, and requirements are fully met, while also satisfying the needs of learners and society.
- The training program is periodically reviewed and updated in accordance with current regulations to ensure alignment with the development of Theoretical and Physical Chemistry and to meet the demands of socio-economic development.

12. SYLLABI OF COURSES

See Appendix.

Binh Dinh, July 31, 2023

RECTOR

Assoc.Prof. Dr. Do Ngoc My