CHEMISTRY, DOCTOR OF PHILOSOPHY (PH.D.) WITH A CONCENTRATION IN CHEMICAL PHYSICS

Program goal

The Department of Chemistry is committed to the dual mission of teaching and research at the bachelor's, master's and doctoral level. In teaching, the purpose is to provide high quality education in chemistry to students in preparation for professional careers at all levels. In research, the goals are to advance the science of chemistry, to keep faculty on the forefront of the field and to maintain an educational program consistent with the latest technology and development of the discipline. Service to the chemical profession is also an important aspect of the department's activities.

Student learning outcomes

1. Demonstrate expertise (breadth and depth) in chemistry
2. Demonstrate appropriate ability to design and conduct experimental research
3. Demonstrate ability to analyze data critically and to design experiments independently
4. Develop competency in the responsible conduct of research
5. Develop effective oral and written communication skills

VCU Graduate Bulletin, VCU Graduate School and general academic policies and regulations for all graduate students in all graduate programs

The VCU Graduate Bulletin website documents the official admission and academic rules and regulations that govern graduate education for all graduate programs at the university. These policies are established by the graduate faculty of the university through their elected representatives to the University Graduate Council.

It is the responsibility of all graduate students, both on- and off-campus, to be familiar with the VCU Graduate Bulletin as well as the Graduate School website (http://www.graduate.vcu.edu) and academic regulations in individual school and department publications and on program websites. However, in all cases, the official policies and procedures of the University Graduate Council, as published on the VCU Graduate Bulletin and Graduate School websites, take precedence over individual program policies and guidelines.

Visit the academic regulations section for additional information on academic regulations for graduate students. (http://bulletin.vcu.edu/academic-regs)

Degree candidacy requirements

A graduate student admitted to a program or concentration requiring a final research project, work of art, thesis or dissertation, must qualify for continuing master's or doctoral status according to the degree candidacy requirements of the student's graduate program. Admission to degree candidacy, if applicable, is a formal statement by the graduate student's faculty regarding the student's academic achievements and the student's readiness to proceed to the final research phase of the degree program.

Graduate students and program directors should refer to the following degree candidacy policy as published in the VCU Graduate Bulletin for complete information and instructions.

Visit the academic regulations section for additional information on degree candidacy requirements. (http://bulletin.vcu.edu/academic-regs/grad/candidacy)

Graduation requirements

As graduate students approach the end of their academic programs and the final semester of matriculation, they must make formal application to graduate. No degrees will be conferred until the application to graduate has been finalized.

Graduate students and program directors should refer to the following graduation requirements as published in the Graduate Bulletin for a complete list of instructions and a graduation checklist.

Visit the academic regulations section for additional information on graduation requirements. (http://bulletin.vcu.edu/academic-regs/grad/graduation-info)

Other information

The Department of Chemistry graduate handbook is available online (http://chemistry.vcu.edu/graduate-programs/graduate-handbook).

Apply online at graduate.admissions.vcu.edu (http://www.graduate.admissions.vcu.edu)**.**

Admission requirements

Degree:	Semester(s) of entry:	Deadline dates:	Test requirements:
Ph.D.	Fall	Mar 15	GRE-General
	Spring	Nov 15	

In addition to the general admission requirements of the VCU Graduate School (http://bulletin.vcu.edu/graduate/study/admission-graduate-study/admission-requirements), the following requirements represent the minimum acceptable standards for admission:

1. Have a bachelor's degree from an accredited college or university with 30 credit hours in chemistry or in physics.
2. Admission on a provisional basis is possible for a student temporarily lacking this expected chemistry background or in physics.

Degree requirements

In addition to general VCU Graduate School graduation requirements (http://bulletin.vcu.edu/academic-regs/grad/graduation-info), students are required to complete course work in core and elective courses and to conduct significant research.

1. Credit hour requirements: Students in the Ph.D. in Chemistry program are required to earn a minimum of 60 graduate-level credit hours beyond the baccalaureate. At least one-half of the credit hours presented for graduation must be at the 600 level or higher.
2. Proficiency exams: Students entering the chemical physics concentration must pass proficiency examinations in two areas of chemistry and two areas of physics (mechanics, electricity

and magnetism). Students entering with a bachelor's or master's degree in chemistry who have not taken the courses previously may satisfy the physics requirement with an A or B in PHYS 301 Classical Mechanics I and PHYS 302 Classical Mechanics II and PHYS 376 Electromagnetism I. Students entering with a bachelor's or master's degree in physics who have not taken the chemistry courses previously may satisfy the chemistry requirement with an A or B in two of the four courses, CHEM 301 Organic Chemistry-CHEM 302 Organic Chemistry; the two-course sequence counts as one course only), CHEM 406 Inorganic Chemistry II, CHEM 409 Instrumental Analysis or CHEM 510 Atomic and Molecular Structure.

3. Doctoral candidacy: The student is required to complete written and oral examinations in his/her major field to become a doctoral candidate. The written examinations consist of a series of cumulative exams based on the chemistry literature. The oral examination includes the presentation and defense of the proposed dissertation research.
4. Dissertation: The student must conduct a substantial original investigation under the supervision of his/her adviser and must prepare a dissertation reporting the results of the research and analyzing its significance in relation to existing scientific knowledge. An oral defense of the dissertation will be held. Full-time students should complete the degree requirements in four to five years.

Curriculum requirements

Course	Title	Hours
Required didactic courses [1]		
CHEM 510	Atomic and Molecular Structure	3
or PHYS 580	Quantum Mechanics	
CHEM 511	Chemical Thermodynamics and Kinetics	3
CHEM 612	Modern Statistical Mechanics: Fundamentals and Applications	3
PHYS 576	Electromagnetic Theory	3
PHYS 641	Solid State Physics	3
Recommended electives		
Select nine credit hours of the following, in consultation with adviser		9
CHEM 512	Applied Molecular Modeling	
CHEM 550	Introduction to Polymer Chemistry	
CHEM 591	Topics in Chemistry	
CHEM 610	Applied Quantum Chemistry	
CHEM 611	Molecular Spectroscopy	
CHEM 615	Chemical Thermodynamics	
CHEM 616	Chemical Kinetics	
CHEM 620	Advanced Inorganic Chemistry I	
CHEM 634	Surface Science	
CHEM 635	Spectrochemical Analysis	
CHEM 691	Topics in Chemistry	
NANO 650	Experimental Techniques in Nanoscience I	
NANO 651	Experimental Techniques in Nanoscience II	
PHYS 550	Techniques in Material Research	
PHYS 571	Theoretical Mechanics	
PHYS 573	Analytical Methods in Physics	
PHYS 661	Surface and Materials Physics	
PHYS 691	Special Topics	
Other required courses		
CHEM 690	Research Seminar in Chemistry [3]	1-8
or PHYS 690	Research Seminar	
CHEM 692	Chemistry Seminar Presentation [3]	2
CHEM 693	Chemistry Perspectives and Ethics [4]	1
CHEM 697	Directed Research [5]	30
or PHYS 697	Directed Research	

[1] Students must earn a minimum of 24 credit hours in didactic graduate courses, not including credit for CHEM 690, CHEM 692, CHEM 693 or CHEM 697.

[2] At least 12 credit hours of the 24 required didactic course credit hours must be CHEM graduate courses. Therefore, depending on the choice of CHEM 510 or PHYS 580 above, at least 3 to 6 credit hours chosen from the list of recommended electives must be CHEM graduate courses, respectively.

[3] Students are expected to participate in the chemistry and/or physics department seminar program by enrolling in CHEM 690, CHEM 692 or PHYS 690 every spring and fall semester. At least two formal talks are to be presented in the seminar program by enrolling twice in CHEM 692 (one credit hour).

[4] Students are expected to enroll in CHEM 693 within their first year of enrollment.

[5] Students are expected to enroll in CHEM 697 or PHYS 697 (one credit hour minimum) every spring and fall semester. Up to 15 credit hours of PHYS 697 can be used to satisfy the minimum requirement of 30 credit hours of directed research. If the required 60 credit hours for the degree is not fulfilled after completion of all other course requirements, then additional credit hours of CHEM 697 can satisfy the remaining credit hours for the degree.

The minimum total of graduate credit hours required for this degree is 60.

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Program website:chemistry.vcu.edu (http://chemistry.vcu.edu)