

# CHEMISTRY, DOCTOR OF PHILOSOPHY (PH.D.)

## 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 effective oral and written communication skills
3. Demonstrate ability to analyze data critically
4. Demonstrate ability to conduct independent research correctly while abiding to ethical and safety standards

## 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 (<https://chemistry.vcu.edu/graduates/graduate-handbook/>).

Apply online today. (<https://www.vcu.edu/admissions/apply/graduate/>)

## 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.
2. Admission on a provisional basis is possible for a student temporarily lacking this expected chemistry background.

## 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 core and elective courses and to conduct original research under the supervision of an adviser.

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 must take proficiency exams in analytical, inorganic, organic and physical chemistry during orientation week. These examinations are standardized tests to determine weaknesses at the undergraduate level that should be corrected by selecting the appropriate electives.
3. Doctoral candidacy: To apply for doctoral candidacy, besides having a minimum GPA of 3.0, students must complete written cumulative tests and an oral candidacy exam. The former are written examinations completed during the second semester about chemical topics selected by faculty. The oral candidacy exam must be completed no later than the end of the fourth semester, and it

entails the oral presentation and defense of a proposed dissertation project described in a written document submitted to the student's thesis committee.

4. Dissertation: Students must conduct original research in their dissertation project guided by an adviser. A written dissertation reporting the results and their significance in relation to existing scientific knowledge must be submitted for oral presentation and defense to the thesis committee during the semester of graduation. Students who wish to have a chemical education focus in their Ph.D., must present a research project on chemical education along with a research project in any of the other areas of chemistry.

|          |                                 |     |
|----------|---------------------------------|-----|
| CHEM 631 | Separation Science              | 1.5 |
| CHEM 633 | Mass Spectrometry               | 1.5 |
| CHEM 635 | Spectrochemical Analysis        | 1.5 |
| CHEM 636 | Chemical Sensors and Biosensors | 1.5 |
| CHEM 637 | Electrochemistry Applications   | 1.5 |
| CHEM 691 | Topics in Chemistry             | 1-6 |

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**Program website:** [chemistry.vcu.edu](http://chemistry.vcu.edu) (<http://chemistry.vcu.edu/>)

## Curriculum requirements

| Course                                | Title   | Hours     |
|---------------------------------------|---|-----------|
| <b>Core courses</b>                   |   |           |
| CHEM 690                              | Research Seminar in Chemistry (taken three times)     | 3         |
| CHEM 692                              | Chemistry Seminar Presentation                        | 1         |
| CHEM 693                              | Chemistry Perspectives and Ethics                     | 1         |
| CHEM 698                              | Investigations in Current Chemistry Literature        | 1         |
| CHEM 699                              | Scientific Writing in Chemistry                       | 3         |
| <b>Directed research</b> <sup>1</sup> |   |           |
| CHEM 697<br>or HUMS 701               | Directed Research<br>Post-candidacy Doctoral Research | 33        |
| <b>Electives</b>                      |   |           |
| Choose from list below                |   | 18        |
| <b>Total Hours</b>                    |   | <b>60</b> |

<sup>1</sup>

A minimum of 33 research credits are required for the degree in the form of **CHEM 697** or in combination with **HUMS 701**. CHEM 697 can be registered for as needed during pre- and post-candidacy, but HUMS 701 is a nine-credit course exclusive for doctoral candidates.

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

## Approved electives

| Course   | Title  | Hours |
|----------|--|-------|
| CHEB 601 | Chemical Biology I   | 3     |
| CHEB 602 | Chemical Biology II  | 3     |
| CHEM 504 | Advanced Organic Chemistry I                               | 3     |
| CHEM 506 | Introduction to Spectroscopic Methods in Organic Chemistry | 1.5   |
| CHEM 510 | Atomic and Molecular Structure                             | 3     |
| CHEM 511 | Chemical Thermodynamics and Kinetics                       | 3     |
| CHEM 512 | Applied Molecular Modeling                                 | 3     |
| CHEM 520 | Advanced Inorganic Chemistry                               | 3     |
| CHEM 591 | Topics in Chemistry  | 1-6   |
| CHEM 604 | Advanced Organic Chemistry II                              | 3     |
| CHEM 606 | Advanced Spectroscopic Methods in Organic Chemistry        | 1.5   |
| CHEM 622 | Solid State and Materials Chemistry                        | 1.5   |
| CHEM 630 | Electroanalytical Chemistry                                | 1.5   |