CHEMISTRY, MASTER OF SCIENCE (M.S.)

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-reg/) and academic regulations for graduate students.

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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-reg/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

<table>
<thead>
<tr>
<th>Degree</th>
<th>Semester(s) of entry</th>
<th>Deadline dates</th>
<th>Test requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.S.</td>
<td>Fall</td>
<td>Mar 15</td>
<td>GRE-General</td>
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<tr>
<td></td>
<td>Spring</td>
<td>Nov 15</td>
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</tbody>
</table>

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-reg/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 M.S. in Chemistry program are required to earn a minimum of 30 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 demonstrate competency in analytical, inorganic, organic and physical chemistry by satisfactory performance on the proficiency exams or with a minimum grade of B in the appropriate course. These examinations are at the level of sound undergraduate courses and are offered preceding the start of the school’s fall and spring semesters. These tests are used to
Chemistry, Master of Science (M.S.)

evaluate the student's strengths and weaknesses, and the student's program is planned accordingly.

3. Other requirements: Students are to conduct a research study under the guidance of a thesis adviser. After their first year, students are required to present their research at a poster presentation every fall semester. Once students have completed all required course work (with a 3.0 GPA) and the literature seminar, they must submit the application to candidacy form to the chemistry graduate director. After candidacy, an acceptable research thesis and a final oral examination on the thesis are required. Full-time students should complete these degree requirements in two to three years.

**Curriculum requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Required didactic courses 1</td>
<td>Select three core courses of the following four areas: analytical, inorganic, organic and physical 2</td>
<td>9</td>
</tr>
<tr>
<td>CHEM 504</td>
<td>Advanced Organic Chemistry I</td>
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<tr>
<td>CHEM 510</td>
<td>Atomic and Molecular Structure 4</td>
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<tr>
<td>CHEM 620</td>
<td>Advanced Inorganic Chemistry I</td>
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<tr>
<td>CHEM 63x or ENGR 691 (course in analytical area) 3</td>
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<tr>
<td>Course completed twice</td>
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<td>1</td>
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<tr>
<td>CHEM 698</td>
<td>Investigations in Current Chemistry Literature (0.5 credit hour)</td>
<td>6</td>
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<tr>
<td>Select five credit hours of recommended electives from the following, in consultation with adviser</td>
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<tr>
<td>BIOC 500-level (except BIOC 505, BIOC 506 and BIOC 507)</td>
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<tr>
<td>BIOC 530</td>
<td>Biochemistry, Cell and Molecular Biology Module 1: Protein Structure and Function</td>
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<td>BIOC 531</td>
<td>Biochemistry, Cell and Molecular Biology Module 2: Basic Metabolism</td>
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<tr>
<td>BIOC 532</td>
<td>Biochemistry, Cell and Molecular Biology Module 3: Central Dogma of Molecular Biology</td>
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<tr>
<td>BIOC 533</td>
<td>Biochemistry, Cell and Molecular Biology Module 4: Lipids/Membranes and Bioenergetics</td>
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<tr>
<td>BIOC 602</td>
<td>Physical Properties of Macromolecules</td>
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<tr>
<td>BIOC 543</td>
<td>Graduates Research Methods I</td>
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<tr>
<td>BIOS 543</td>
<td>Graduates Research Methods II</td>
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<tr>
<td>BIOS 544</td>
<td>Graduates Research Methods I</td>
<td></td>
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<tr>
<td>CHEB 601</td>
<td>Chemical Biology I</td>
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<tr>
<td>CHEB 602</td>
<td>Chemical Biology II</td>
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<tr>
<td>CHEM 500-level</td>
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<tr>
<td>CHEM 604</td>
<td>Advanced Organic Chemistry II</td>
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<tr>
<td>CHEM 605</td>
<td>Physical Organic Chemistry</td>
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<tr>
<td>CHEM 606</td>
<td>Advanced Spectroscopic Methods in Organic Chemistry</td>
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<td>CHEM 610</td>
<td>Applied Quantum Chemistry</td>
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<td>CHEM 611</td>
<td>Molecular Spectroscopy</td>
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<td>CHEM 612</td>
<td>Modern Statistical Mechanics: Fundamentals and Applications</td>
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<td>CHEM 615</td>
<td>Chemical Thermodynamics</td>
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<td>CHEM 616</td>
<td>Chemical Kinetics</td>
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<tr>
<td>CHEM 620</td>
<td>Advanced Inorganic Chemistry I</td>
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<tr>
<td>CHEM 621</td>
<td>Advanced Inorganic Chemistry II</td>
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<tr>
<td>CHEM 630</td>
<td>Electroanalytical Chemistry</td>
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<tr>
<td>CHEM 631</td>
<td>Separation Science</td>
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<td>CHEM 632</td>
<td>Chemometrics</td>
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<tr>
<td>CHEM 633</td>
<td>Mass Spectrometry</td>
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<tr>
<td>CHEM 634</td>
<td>Surface Science</td>
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<tr>
<td>CHEM 635</td>
<td>Spectrochemical Analysis</td>
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<tr>
<td>CHEM 691</td>
<td>Topics in Chemistry</td>
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<tr>
<td>CHEM 698</td>
<td>Investigations in Current Chemistry Literature 5</td>
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<tr>
<td>ENGR 591</td>
<td>Special Topics in Engineering</td>
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<tr>
<td>ENGR 691</td>
<td>Special Topics in Engineering</td>
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<tr>
<td>MEDC 541</td>
<td>Survey of Molecular Modeling Methods</td>
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<tr>
<td>MEDC 670</td>
<td>Advanced Molecular Modeling Theory and Practice</td>
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<tr>
<td>NANO 570</td>
<td>Nanoscale Physics</td>
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<tr>
<td>NANO 571</td>
<td>Nanoscale Chemistry</td>
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<tr>
<td>NANO 650</td>
<td>Experimental Techniques in Nanoscience I</td>
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<tr>
<td>NANO 651</td>
<td>Experimental Techniques in Nanoscience II</td>
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<tr>
<td>NANO 660</td>
<td>Theoretical Studies of Nanostructures</td>
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<tr>
<td>NANO 661</td>
<td>Computational Nanoscience</td>
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<tr>
<td>PHYS 550</td>
<td>Techniques in Material Research</td>
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<td>PHYS 573</td>
<td>Analytical Methods in Physics</td>
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<td>PHYS 576</td>
<td>Electromagnetic Theory</td>
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<td>PHYS 580</td>
<td>Quantum Mechanics</td>
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<tr>
<td>PHYS 591</td>
<td>Topics in Physics</td>
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<tr>
<td>PHYS 661</td>
<td>Surface and Materials Physics</td>
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<tr>
<td>PHYS 691</td>
<td>Special Topics</td>
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</tbody>
</table>

Total Hours 30

1 Students must earn a minimum of 15 credit hours in six didactic graduate courses, not including credit hours for CHEM 690, CHEM 692, CHEM 693 or CHEM 697.

2 One of these courses may be waived upon satisfactory proficiency exam scores. The required number of credit hours for the degree does not change.

3 The ENGR 691 topics course must be materials characterization.
In some cases, students may be required to enroll in both CHEM 510 and CHEM 511 because of proficiency exam scores.

Students are expected to enroll in CHEM 698 (0.5 credit hour) twice during their graduate studies, including the semester preceding their literature seminar presentation (CHEM 692). Note: A maximum of two credit hours of CHEM 698 may be presented toward the didactic course graduation requirements to count as one course.

Students are expected to participate in the department's seminar program by enrolling in CHEM 690 or CHEM 692 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).

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

Students are expected to enroll in CHEM 697 (one credit hour minimum) every spring and fall semester.

The minimum total of graduate credit hours required for this degree is 30.

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