CHEMISTRY, BACHELOR OF SCIENCE (B.S.) WITH A CONCENTRATION IN PROFESSIONAL CHEMIST WITH HONORS

The curriculum in chemistry prepares students for graduate study in chemistry and related fields and for admission to schools of medicine, dentistry, pharmacy and veterinary medicine. It prepares students to teach in secondary schools or to work in chemical and industrial laboratories and in related fields of business and industry. The department also offers required and elective courses in chemistry to students in other programs of study.

The Department of Chemistry offers five areas of concentration for completing the Bachelor of Science in Chemistry: chemical science, professional chemist, professional chemist with honors, biochemistry and chemical modeling. With proper selection of electives, the degree satisfies admission requirements to most schools of medicine, dentistry, pharmacy and veterinary medicine.

Student learning outcomes

Upon completing this program, students will know how to do the following:

Chemistry core outcomes
- Demonstrate proficiency in the major concepts and theoretical principles of chemistry, critical thinking and problem-solving skills
- Demonstrate proficiency in laboratory skills, including wet chemistry and instrumental methods, and laboratory safety practices
- Demonstrate communication skills, both written and oral, needed to explain chemical phenomenon
- Demonstrate proficiency in scientific literacy skills including searching and reading scientific publications
- Demonstrate an understanding of the need for ethical practices in chemistry

Professional chemist with honors concentration-specific outcome
- Demonstrate experience with novel research, including critical review of literature and oral and written presentation of scientific work

Special requirements

The professional chemist with honors concentration is an intensive, research-based option for students interested in developing a research focus. This option requires a 3.0 GPA in chemistry to be maintained after completing eight credits of chemistry courses. As part of the requirement for completing this concentration, an honors thesis is written and the work is presented as a seminar in the Department of Chemistry. With the proper combination of courses, this degree can be certified as meeting the requirements of the American Chemical Society.

CHEM 403 and CHEM 406 and CHEZ 406 and CHEM 409 and CHEZ 409 are required to satisfy the requirements for the American Chemical Society certification of the professional chemist concentration. MATH 307 also is required for the American Chemical Society certification.

Students must complete 46-47 credits in chemistry and 36 credits of ancillary requirements in addition to general education requirements. A minimum grade of C is required in each prerequisite course except for CHEM 100, which requires a minimum of B.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 100</td>
<td>Introductory Chemistry (if required through placement qualifiers)</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 101</td>
<td>General Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 102</td>
<td>General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 301</td>
<td>Organic Chemistry</td>
<td>3</td>
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<tr>
<td>CHEM 302</td>
<td>Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 309</td>
<td>Quantitative Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 313 or CHEM 314</td>
<td>Physical Chemistry I with Math Modules</td>
<td>3</td>
</tr>
<tr>
<td>CHEZ 101</td>
<td>General Chemistry Laboratory I</td>
<td>1</td>
</tr>
<tr>
<td>CHEZ 102</td>
<td>General Chemistry Laboratory II</td>
<td>1</td>
</tr>
<tr>
<td>CHEZ 301</td>
<td>Organic Chemistry Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>CHEZ 302</td>
<td>Organic Chemistry Laboratory II</td>
<td>2</td>
</tr>
<tr>
<td>CHEZ 309</td>
<td>Quantitative Analysis Laboratory</td>
<td>2</td>
</tr>
</tbody>
</table>

VCU students in other programs who wish to declare chemistry as their major must complete CHEM 101, CHEZ 101, CHEM 102 and CHEZ 102, each with a minimum grade of C and have a minimum GPA in their chemistry courses of 2.0.

Degree requirements for Chemistry, Bachelor of Science (B.S.) with a concentration in professional chemist with honors

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td>Select 30 credits of general education courses in consultation with an adviser.</td>
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<tr>
<td></td>
<td><strong>Major requirements</strong></td>
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<tr>
<td></td>
<td>• Major core requirements</td>
<td></td>
</tr>
<tr>
<td>CHEM 102 &amp; CHEZ 102</td>
<td>General Chemistry II and General Chemistry Laboratory II</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 301 &amp; CHEZ 301</td>
<td>Organic Chemistry and Organic Chemistry Laboratory I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 302 &amp; CHEZ 302</td>
<td>Organic Chemistry and Organic Chemistry Laboratory II</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 309 &amp; CHEZ 309</td>
<td>Quantitative Analysis and Quantitative Analysis Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 313 or CHEM 314</td>
<td>Physical Chemistry I with Math Modules</td>
<td>3-4</td>
</tr>
<tr>
<td>CHEM 315</td>
<td>Physical Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEZ 313</td>
<td>Physical Chemistry Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 320</td>
<td>Inorganic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 398</td>
<td>Professional Practices and Perspectives Seminar</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 499</td>
<td>Chemistry Capstone Experience¹</td>
<td>0</td>
</tr>
</tbody>
</table>

• Concentration requirements
CHEM 492  Independent Study (repeated for 6 credits)  6
CHEM 498  Honors Thesis  1
CHEZ 413  Advanced Physical Chemistry Laboratory  2

• Major electives
Select from the lists below.  6

Ancillary requirements
CHEM 101 & CHEZ 101  General Chemistry I and General Chemistry Laboratory I (both satisfy general education BOK for natural sciences and AOI for scientific and logical reasoning)  4
HUMS 202  Choices in a Consumer Society  1
MATH 200  Calculus with Analytic Geometry I (satisfies general education quantitative foundations)  4
MATH 201  Calculus with Analytic Geometry II  4
MATH 307  Multivariate Calculus  4
PHYS 207 & PHYS 208  University Physics I and University Physics II (PHYS 207 satisfies general education BOK for natural sciences and AOI for scientific and logical reasoning)  10

Experiential fine arts  1-3
Foreign language through the 102 level (by course or placement)  0-6

Open electives
Select any course.  19-28

Total Hours  120

Students in this concentration meet the capstone requirement by taking other courses within the program.

Course offered by the School of the Arts
The minimum number of credit hours required for this degree is 120.

Junior chemistry electives
Course  Title  Hours
CHEM 306  Industrial Applications of Inorganic Chemistry  3
CHEM 310  Medicinal Chemistry and Drug Design  3
CHEM 350  Guided Inquiry in Chemistry  1.5
CHEM 351  Chemistry Preceptorship  1.5
CHEM 403  Biochemistry I  3
CHEM 404  Biochemistry II  3
CHEZ 404  Biochemistry Laboratory  2
CHEZ 413  Advanced Physical Chemistry Laboratory  2
CHEZ 400  Exploring the Frontiers of Chemistry: Research Methods  2
CHEZ 404  Biochemistry Laboratory  2

Senior chemistry electives
Course  Title  Hours
CHEM 403  Biochemistry I (if not taken as junior)  3
CHEM 404  Biochemistry II (if not taken as junior)  3
CHEM 406 & CHEZ 406  Inorganic Chemistry II and Inorganic Chemistry Laboratory  5
CHEM 409 & CHEZ 409  Instrumental Analysis and Instrumental Analysis Laboratory  5
CHEM 491  Topics in Chemistry  1-4
CHEM 492  Independent Study  1-4
CHEM 493  Chemistry Internship  1-3
CHEM 504  Advanced Organic Chemistry I  3
CHEM 510  Atomic and Molecular Structure  3
CHEM 512  Applied Molecular Modeling  3
CHEM 520  Advanced Inorganic Chemistry  3

These five courses are required to satisfy the requirements for the American Chemical Society certification of the professional chemist concentration. MATH 307 also is required for the American Chemical Society certification.

What follows is a sample plan that meets the prescribed requirements within a four-year course of study at VCU. Please contact your adviser before beginning course work toward a degree.

Freshman year
Fall semester  Hours
CHEM 101 & CHEZ 101  General Chemistry I and General Chemistry Laboratory I (both satisfy general education BOK for natural sciences and AOI for scientific and logical reasoning)  4
HUMS 202  Choices in a Consumer Society  1
MATH 200  Calculus with Analytic Geometry I (satisfies general education quantitative foundations)  4
UNIV 111  Play course video for Focused Inquiry I (satisfies general education UNIV foundations)  3

Term Hours:  15

Spring semester
CHEM 102 & CHEZ 102  General Chemistry II and General Chemistry Laboratory II  4
MATH 201  Calculus with Analytic Geometry II  4
PHYS 207  University Physics I (satisfies general education AOI for scientific and logical reasoning)  5
UNIV 112  Play course video for Focused Inquiry II (satisfies general education UNIV foundations)  3

Term Hours:  16
Sophomore year
Fall semester
CHEM 301 Organic Chemistry 5
& CHEZ 301 and Organic Chemistry Laboratory I
CHEM 309 Quantitative Analysis 5
& CHEZ 309 and Quantitative Analysis Laboratory
MATH 307 Multivariate Calculus 4
UNIV 200 Advanced Focused Inquiry: Literacies, Research and Communication (satisfies general education UNIV foundations) 3
Term Hours: 17

Spring semester
CHEM 302 Organic Chemistry 5
& CHEZ 302 and Organic Chemistry Laboratory II
CHEM 320 Inorganic Chemistry I 3
CHEM 398 Professional Practices and Perspectives Seminar 1
PHYS 208 University Physics II 5
Term Hours: 14

Junior year
Fall semester
CHEM 313 Physical Chemistry I 3-4
CHEM 314 or Physical Chemistry I with Math Modules
CHEZ 313 Physical Chemistry Laboratory I 2
Foreign language 101 3
General education course 1 3
Major elective 3
Term Hours: 14-15

Spring semester
CHEM 315 Physical Chemistry II 3
CHEM 492 Independent Study 3
Foreign language 102 3
General education course 1 3
Major elective 3
Term Hours: 15

Senior year
Fall semester
CHEM 492 Independent Study 3
CHEM 499 Chemistry Capstone Experience 2 0
Experiential fine arts 1-3
Open electives 9
Term Hours: 13-15

Spring semester
CHEM 498 Honors Thesis 1
CHEZ 413 Advanced Physical Chemistry Laboratory 2
Open electives 13
Term Hours: 16

Total Hours: 120-123

1 At least three additional general education courses (nine credits) are required. Three credits come from each of the following areas of inquiry:

2 Students in this concentration meet the capstone requirement by taking other courses within the program.

The minimum number of credit hours required for this degree is 120.

diversities in the human experience; creativity, innovation and aesthetic inquiry; and global perspectives. The latter two areas of inquiry courses should also fulfill the breadth of knowledge requirement from the areas of humanities/fine arts and social/behavioral sciences.