Chemistry

Degrees Offered

• Master of Science
• Doctor of Philosophy

Nature of the Program

The Department of Chemistry offers graduate studies leading to the degrees of master of science and doctor of philosophy with research concentration in the areas of analytical, inorganic, organic, and physical chemistry. The master of science and doctor of philosophy degrees require completion of a research project which represents the principal component of the graduate program. The M.S. program is limited in scope and involves advanced coursework and a study of a problem in chemical research culminating in the preparation and oral defense of a M.S. thesis.

The Ph.D. program has a much wider scope than the M.S. program. Ph.D. students are expected to take a broad range of advanced coursework, both within and outside of the major area of interest. The major emphasis of the Ph.D. program is on research. A typical research problem may take several years to complete and involves many advanced techniques and concepts at the frontiers of chemical knowledge. The Ph.D. program culminates in the preparation and defense of the Ph.D. dissertation.

The program for the degree of doctor of philosophy reflects a flexible, research-oriented approach geared to develop the interests, capability, and potential of students. A program of courses is recommended to suit individual needs based on background and ability. These courses are classified as basic graduate courses, which present the essentials of a given discipline on an advanced level, and specialized graduate courses, which take one to the frontiers in a specific area of research. The course offerings are designed to provide guidelines from which students can launch their independent studies in preparation for candidacy examinations. Students are required to enroll in the departmental seminar program and attend special lectures and seminars offered by visiting scientists. Graduate students in the Ph.D. program are required to satisfactorily complete a minimum of three courses (three credits each) at the 500 to 700-level offered by the Department of Chemistry and distributed in at least two areas outside their major area of research. In addition, each major area in chemistry requires students in that area to enroll in basic graduate courses presenting the essentials of that discipline on an advanced level.

FACULTY

CHAIR

• Gregory Dudley - Ph.D. (Massachusetts Institute of Technology)
  Eberly Family Distinguished Professor, Chemical Synthesis, Organic Reaction Methodology, Medicinal Chemistry

PROFESSORS

• Terry Gullion - Ph.D. (William and Mary)
  Physical Chemistry, Solid State NMR, Biological Materials, Polymers
• Lisa Holland - Ph.D. (University of North Carolina-Chapel Hill)
  Micro-separations, High Throughput Drug Screening
• Fred L. King - Ph.D. (University of Virginia)
  Analytical Chemistry, Mass Spectrometry, Trace Elements, Gas-phase Chemistry
• Michelle Richards-Babb - Ph.D. (Lehigh University)
  Chemical Education
• Kenneth Showalter - Ph.D. (University of Colorado)
  Bennett Distinguished Professor, Physical Chemistry, Chemical Kinetics, Multistability and Oscillating Systems
• Bjorn C. Soderberg - Ph.D. (Royal Institute of Technology, Sweden)
  Organic Synthesis Using Transition Metals
• Kung K. Wang - Ph.D. (Purdue University)
  Eberly Distinguished Professor of Chemistry, Organic Chemistry, Stereoselective Synthesis, Natural Products

ASSOCIATE PROFESSOR

• Fabien Goulay - Ph.D. (University of Rennes, France)
  Physical Chemistry, Laser Spectroscopy
• Jessica Hoover - Ph.D. (University of Washington)
  Organometallic Chemistry, Catalysis
• Justin Legleiter - Ph.D. (Carnegie Mellon University)
  Biophysical Chemistry, Scanning Probe Microscopy
Admissions

Applicants for graduate studies in chemistry must have a bachelor’s degree with an overall GPA of 3.0 as a minimum requirement. Applicants must have a major or concentration in chemistry and an appropriate background in physics and mathematics. The Chemistry program admits students directly to the doctoral degree. Admitted students may transition to the MS in Chemistry during their studies. Scores of the GRE general test should be submitted, as should three letters of recommendation and a personal statement. The department requires a TOEFL score of 80 or an IELTS score of 6.5 for international students.

All entering graduate students in chemistry are required to take departmental guidance examinations in the major areas of chemistry. These examinations, at the undergraduate level, are administered before registration and serve to guide the faculty in recommending a course program for the beginning graduate student. Deficiencies revealed by the departmental guidance examinations need to be corrected in a manner prescribed by the faculty.

Master of Science

Degree Requirements

• **Credit Hours:** A total of 30 credit hours are required. Students may apply up to 6 hours of research credit and 3 hours of seminars toward the 30-hour requirement. Students are required to complete a minimum of 21 graduate credit hours in Chemistry courses at the 500, 600, and 700 level.

• **Grade Point Average:** Students must earn a minimum GPA of 3.00 in coursework applied to their graduate program.

• **Area of Emphasis:** Students may declare an area of emphasis in analytical, inorganic, physical, or organic chemistry. Each area of emphasis is defined by the research project undertaken by the student and requires participation in the appropriate Graduate Seminar (CHEM 796A-C) each semester.

• **Graduation Requirement:** Students are required to submit a research thesis

• **Benchmarks:** By the end of the second semester in residence, students are required to pass 3 out of 4 guidance exams. The guidance exams are in the areas of analytical, inorganic, organic, and physical chemistry. Students have 3 total attempts to pass each exam. The initial attempts occurs prior to the student's first semester in the form of written exams. Subsequent attempts can be either re-taking the written exam or earning a grade of B or better in a designated graduate course.
  • **Master’s Thesis:** Graduate students in the M.S. program in chemistry are required to submit a research thesis. A research project is chosen in the area of the student's interest and in consultation with the faculty. The thesis defense shows the ability of the student to defend scientific conclusions based on their research project. A final oral examination is administered after completion and submission of the thesis.
  • **Credit Hour Requirement:** Students may apply up to 6 hours of research credit and 3 hours of seminars toward the 30-hour requirement. The remaining 21 hours of credit must be earned in the basic graduate courses which reflect a diversified exposure to chemistry, and no more than 10 hours may be elected outside the department. Students are required to enroll in the departmental seminar program and are required to attend special lectures and seminars offered by visiting scientists.

• **Additional Requirements:** [Please list, if applicable]

Curriculum Requirement

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<tr>
<th>Minimum GPA of 3.0 is required in coursework applied to their graduate program</th>
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<tr>
<td><strong>Chemistry Coursework (500, 600, 700-level)</strong></td>
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<td><strong>Research Requirements</strong></td>
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<td>CHEM 797</td>
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<td><strong>Seminars Requirements</strong></td>
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<td>CHEM 796</td>
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CHEM 789 | Research Seminar (Repeated)

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<th>Thesis</th>
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<td>Thesis Defense</td>
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| Total Hours | 30 |

* Courses from outside the chemistry department may be applied toward this requirement with approval from the departmental graduate studies committee.

**Doctor of Philosophy**

Students are required to enroll in the departmental seminar program and attend special lectures and seminars offered by visiting scientists. In addition, each major area in chemistry requires students in that area to enroll in basic graduate courses presenting the essentials of that discipline on an advanced level.

**MAJOR REQUIREMENTS**

Minimum GPA of 3.0 is required.

| Chemistry Coursework (500, 600, 700-level) | 18 |
| Graduate Research | 24 |
| CHEM 797 | Research (Repeated) |
| Research Seminar | 4 |
| CHEM 789 | Research Seminar (Repeated) |
| Graduate Seminar | 4 |
| CHEM 796 | Graduate Seminar (Repeated) |
| Comprehensive Examination |
| Dissertation |
| Dissertation Defense |

| Total Hours | 50 |

**Research**

Research, which is the major theme of graduate studies, may be initiated as early as the student and faculty feel appropriate for the individual. Normally, a student will begin laboratory work no later than the beginning of the second semester. Upon successful completion of an original piece of research, the candidate will present results in a Ph.D. dissertation and, at the appropriate time, defend the work in a final oral examination.

**Candidacy**

Candidacy examinations contain written and oral portions. The written portion is a research progress report that will contain a comprehensive review of the pertinent literature and applicable scientific concepts, a discussion of current results, a description of studies needed to finish the project, a discussion of expected results and alternative approaches, and a timeline for completing the work. After notification of successful completion of the written portion, the student will present and defend an oral progress report. This oral report must demonstrate fundamental chemical knowledge and independence on the part of the student. Both the written and oral portions of the candidacy examination will be evaluated by the student’s research committee and any other interested faculty members.

**Degree Progress**

**MASTER’S BENCHMARKS**

By the end of the second semester in residence, students are required to pass 3 out of 4 guidance exams. The guidance exams are in the areas of analytical, inorganic, organic, and physical chemistry. Students have 3 total attempts to pass each exam. The initial attempts occur prior to the student's first semester in the form of written exams. Subsequent attempts can be either re-taking the written exam or earning a grade of B or better in a designated graduate course.

- **Master’s Thesis:** Graduate students in the M.S. program in chemistry are required to submit a research thesis. A research project is chosen in the area of the student's interest and in consultation with the faculty. The thesis defense shows the ability of the student to defend scientific conclusions based on their research project. A final oral examination is administered after completion and submission of the thesis.

- **Credit Hour Requirement:** Students may apply up to 6 hours of research credit and 3 hours of seminars toward the 30-hour requirement. The remaining 21 hours of credit must be earned in the basic graduate courses which reflect a diversified exposure to chemistry, and no more than 10 hours may be elected outside the department. Students are required to enroll in the departmental seminar program and are required to attend special lectures and seminars offered by visiting scientists.
DOCTORAL BENCHMARKS

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Major Learning Outcomes

CHEMISTRY
The graduate programs in the C. Eugene Bennett Department of Chemistry provide rigorous training in chemistry. The central mission of the Graduate Program is to train the next generation of Chemists for productive careers in the global economy.

Students earning a M.S. or Ph.D. in Chemistry will be able to:

- Explain chemical principles as they pertain to their specific field of research.
- Demonstrate the ability to understand and critically evaluate the existing literature published within their field.
- Independently design and execute new chemical experiments that can address important scientific questions.
- Understand and apply good laboratory practices (chemical hygiene, personal protective wear, etc.) and the proper handling of chemical waste streams.
- Generate quality data using a variety of experimental and/or computational techniques.
- Interpret the meaning and implication of their data.
- Effectively communicate their research in oral and written formats, including the ability to author manuscripts suitable for publication in peer reviewed scientific journals.
- Understand the ethical impact of personal and professional behavior.