

<p><b>Chemistry and Biochemistry (MA,MS,PhD)</b></p> <p>Telephone: (302) 831-1247  <a href="http://www.chem.udel.edu">http://www.chem.udel.edu</a>  Faculty Listing: <a href="http://www.chem.udel.edu/faculty">http://www.chem.udel.edu/faculty</a></p> <p><b>Program Overview</b></p> <p>The Department of Chemistry and Biochemistry offers programs leading to the PhD, MS, and MA degrees. Financial support for PhD students is available in the form of teaching assistantships, research assistantships, and fellowships. The thesis for the Master of Science degree or the doctoral dissertation may be in analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, or physical chemistry. Certain courses offered in other departments may be taken for credit for advanced degrees in chemistry if these fit logically into the proposed course of study and have the approval of the candidate's advisor.</p> <p>Four major state-of-the-art facilities support the research of faculty and students. These laboratories are operated by PhD-level scientists who provide analytical service and training courses. The Blue Hen NMR Complex houses six state-of-the-art NMR spectrometers with operating frequencies ranging from 400 MHz to 850 MHz and one FT-ESR spectrometer. Graduate students routinely use these instruments in their research. The departmental mass spectrometry laboratory encompasses instruments that provide service in electrospray ionization (ESI), matrix-assisted laser desorption ionization (MALDI), fast-atom bombardment (FAB), chemical ionization (CI), and electron ionization (EI) mass spectrometry. GC/MS, LC/MS, and MALDI instruments are available for routine student use. The X-ray laboratory includes two CCD X-ray diffractometers for small molecule crystallography. Our department also houses the university-wide Surface Analysis Facility, which provides analytical capabilities in scanning probe microscopy (SPM), including scanning tunneling microscopy (STM) and atomic force microscopy (AFM), Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS or ESCA) and time-of-flight secondary ion mass spectrometry (TOF-SIMS).</p> <p>A research facility to perform macromolecular crystallography is also housed in the department. A wide variety of equipment is available in individual research laboratories. The department maintains electronics, machine, and glass-blowing</p>	<p><b>Chemistry and Biochemistry (MA,MS,PhD)</b></p> <p>Telephone: (302) 831-1247  <a href="http://www.chem.udel.edu">http://www.chem.udel.edu</a>  Faculty Listing: <a href="http://www.chem.udel.edu/faculty">http://www.chem.udel.edu/faculty</a></p> <p><b>Program Overview</b></p> <p>The Department of Chemistry and Biochemistry offers programs leading to the PhD, MS, and MA degrees. Financial support for PhD students is available in the form of teaching assistantships, research assistantships, and fellowships. The thesis for the Master of Science degree or the doctoral dissertation may be in analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, or physical chemistry. Certain courses offered in other departments may be taken for credit for advanced degrees in chemistry if these fit logically into the proposed course of study and have the approval of the candidate's advisor.</p> <p>Four major state-of-the-art facilities support the research of faculty and students. These laboratories are operated by PhD-level scientists who provide analytical service and training courses. The Blue Hen NMR Complex houses six state-of-the-art NMR spectrometers with operating frequencies ranging from 400 MHz to 850 MHz and one FT-ESR spectrometer. Graduate students routinely use these instruments in their research. The departmental mass spectrometry laboratory encompasses instruments that provide service in electrospray ionization (ESI), matrix-assisted laser desorption ionization (MALDI), fast-atom bombardment (FAB), chemical ionization (CI), and electron ionization (EI) mass spectrometry. GC/MS, LC/MS, and MALDI instruments are available for routine student use. The X-ray laboratory includes two CCD X-ray diffractometers for small molecule crystallography. Our department also houses the university-wide Surface Analysis Facility, which provides analytical capabilities in scanning probe microscopy (SPM), including scanning tunneling microscopy (STM) and atomic force microscopy (AFM), Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS or ESCA) and time-of-flight secondary ion mass spectrometry (TOF-SIMS).</p> <p>A research facility to perform macromolecular crystallography is also housed in the department. A wide variety of equipment is available in individual research laboratories. The department maintains electronics, machine, and glass-blowing</p>
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shops as well as a chemistry reference library. Further information regarding research areas and resources can be found at the departmental web site <http://www.chem.udel.edu>

### **Requirements for Admission**

Admission to the graduate program in the Chemistry and Biochemistry Department is evaluated on the basis of the applicant's GRE scores and undergraduate records including the transcript and letters of recommendation. TSE and TOEFL scores are required for foreign applicants for whom English is not the first language. Admission is selective and competitive based on the number of well-qualified applicants and the limits of available faculty and facilities. Those who meet stated minimum academic requirements are not guaranteed admission, nor are those who fail to meet those requirements necessarily precluded from admission if they offer other appropriate strengths.

### **Requirements for the Degrees**

#### **MA in the Department of Chemistry and Biochemistry**

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). A minimum of 18 credit hours must be course work at the 600 level or above (excluding pre-candidacy study, research, thesis or dissertation credits) as specified in the PhD requirements listed below. A maximum of 12 credit hours, 500 level or greater, may be taken in other departments toward the 30 credit hour requirement. No thesis is required. The MA degree requires successful completion of a series of cumulative examinations.

#### **MS in the Department of Chemistry and Biochemistry**

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). A minimum of 18 credit hours must be course work at the 600 level or above (excluding pre-candidacy study, research, thesis or dissertation credits) as specified in the PhD requirements listed below. A maximum of 12 credit hours, 500 level or greater, may be taken in other departments toward the 30 credit hour requirement.

First year-graduate students are required to take a

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### **Requirements for Admission**

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non-credit one-hour special seminar, [CHEM 865-010](#) (new student seminar). Graduate students must also register for one of the topical seminar series ([CHEM 865-XXX](#) - Biochemistry Seminar, Organic/Inorganic Seminar, Physical/Analytical Seminar), as well as Colloquia ([CHEM 865-XXX](#)). A thesis is required. Thesis must not represent more than six credit hours. Thesis and/or research must represent a minimum of 6 and a maximum of twelve credit hours toward the 30 credit hour requirement.

### **PhD in the Department of Chemistry and Biochemistry**

A minimum of 30 credit hours of graduate-level courses is required with an overall B average (3.00). The department course requirements are a minimum of eighteen credit hours in graduate level courses (600-level or higher) excluding research and dissertation ([CHEM 868](#) and [CHEM 969](#)). At least nine of these must be taken outside the student's division. Specific course requirements for each division are listed below. Scientific courses offered by other Departments may be counted as courses outside the student's division, if approved by the faculty in the student's division. The student must achieve at least a cumulative grade point average of 3.00 in the courses that fulfill this requirement. The course requirements, including the division's requirements, should be satisfied within four semesters of entering the program with a bachelor's degree.

First year-graduate students are required to take a non-credit one-hour special seminar, [CHEM 865-010](#) (new student seminar). Graduate students must also register for one of the topical seminar series ([CHEM 865-XXX](#) - Biochemistry Seminar, Organic/Inorganic Seminar, Physical/Analytical Seminar), as well as Colloquia ([CHEM 865-XXX](#)). The PhD degree requires successful completion of a series of cumulative examinations. The PhD degree requires a thesis based on original research and a final public oral defense of the dissertation.

**Specific course requirements by division are outlined below. If a student wished to take courses other than those specified, then each of these courses must be approved in writing: (a) at the Fall and Spring advisements for first-year graduate students by the representative from the respective Division on the Graduate Curriculum**

other departments toward the 30 credit hour requirement.

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Committee, and (b) at other times by the research advisor.

The remaining courses satisfying the departmental course requirement of 18 credits in graduate level coursework can be selected from offerings in the Department of Chemistry and Biochemistry, or appropriate graduate level courses in other Departments.

All students pursuing a degree program in Chemistry and Biochemistry need to secure the written permission from both their research advisor and the Director of Graduate Studies prior to enrolling in any course not bearing a CHEM-6XX or CHEM-8XX designation.

**Analytical Chemistry:** Six credit hours of graduate analytical courses from the list below plus six additional credit hours of graduate coursework approved by the research advisor.

<a href="#">CHEM 620</a>	Analytical Spectroscopy
<a href="#">CHEM 621</a>	Chemical Separations
<a href="#">CHEM 622</a>	Electroanalytical Chemistry
<a href="#">CHEM 623</a>	Chemometrics
<a href="#">CHEM 624</a>	Principles of Mass Spectrometry
<a href="#">CHEM 625</a>	Heterogeneous Atmospheric Chemistry
<a href="#">CHEM 628</a>	Chemical Sensors
<a href="#">CHEM 629</a>	Surface Chemistry and Analysis
<a href="#">CHEM 820</a>	Special topics in analytical chemistry (may be repeated for credit when topics vary)

**Biochemistry:** At least 9 credits in graduate-level biochemistry courses. CHEM 641 must be taken as one of these courses unless this requirement is waived by the Biochemistry Division. The

graduate students by the representative from the respective Division on the Graduate Curriculum Committee, and (b) at other times by the research advisor.

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<a href="#">CHEM 624</a>	Principles of Mass Spectrometry
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<a href="#">CHEM 820</a>	Special topics in analytical chemistry (may be repeated for credit when topics vary)

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<a href="#">CHEM 641</a>	Biochemistry
<a href="#">CHEM 642</a>	Biochemistry
<a href="#">CHEM 643</a>	Intermediary Metabolism
<a href="#">CHEM 644</a>	Mechanisms of Enzyme Catalysis
<a href="#">CHEM 645</a>	Protein Structure and Function
<a href="#">CHEM 646</a>	DNA-Protein Interactions
<a href="#">CHEM 684</a>	Biochemistry of Nucleic Acids
<a href="#">CHEM 686</a>	Biophysical Chemistry

**Inorganic Chemistry:** Nine credit hours from the following courses:

<a href="#">CHEM 651</a>	Advanced Inorganic Chemistry I
<a href="#">CHEM 652</a>	Organometallic Chemistry
<a href="#">CHEM 653</a>	Bioinorganic Chemistry
<a href="#">CHEM 654</a>	Advanced Inorganic Chemistry II

**Organic Chemistry:**

<a href="#">CHEM 633</a>	Advanced Organic Chemistry: Physical
<a href="#">CHEM 634</a>	Advanced Organic Chemistry: Synthesis and Reactivity

Two additional courses (6 credit hrs) with a CHEM-63X or CHEM-83X designation (one of these courses may be audited)

It is strongly recommended that the courses taken outside of Organic Chemistry should be chosen from the following list:

<a href="#">CHEM 641</a>	Biochemistry
<a href="#">CHEM 642</a>	Biochemistry

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<p><b>Physical Chemistry:</b> A minimum of three courses from among the following:</p> <p><a href="#">CHEM 671</a> Quantum Chemistry</p> <p><a href="#">CHEM 672</a> Advanced Quantum Chemistry</p> <p><a href="#">CHEM 674</a> Chemical Dynamics</p> <p><a href="#">CHEM 678</a> Structure and properties of surfaces</p> <p>One may substitute for one of these three courses from related three-credit courses upon the approval of the research advisor.</p>	<p><b>Physical Chemistry:</b> A minimum of three courses from among the following:</p> <p><a href="#">CHEM 671</a> Quantum Chemistry</p> <p><a href="#">CHEM 672</a> Advanced Quantum Chemistry</p> <p><a href="#">CHEM 674</a> Chemical Dynamics</p> <p><a href="#">CHEM 678</a> Structure and properties of surfaces</p> <p>One may substitute for one of these three courses from related three-credit courses upon the approval of the research advisor.</p>
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