CHEMISTRY AND BIOCHEMISTRY

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chemistry@andrews.edu
http://www.andrews.edu/CHEM/

Faculty
G. William Mutch, Chair
David E. Alonso
Desmond H. Murray
D. David Nowack
Steven E. Warren
Peter A. Wong

Students who plan to major in chemistry or biochemistry are expected to have entrance credit in the preparatory subjects of chemistry and mathematics (including algebra and trigonometry); a background in physics is desirable. Those who do not have entrance credit or equivalent training in these subjects, particularly mathematics, may not fulfill the department graduation requirements in four years.

Students are encouraged to plan early for an on-campus or off-campus research experience required of all students in the Bachelor of Science degree programs in chemistry and strongly recommended for those in the Bachelor of Science degree program in biochemistry. This experience may take the form of a cooperative educational-research experience or research in an academic, industrial, or governmental laboratory setting. Interested students should consult the department chair.

AMERICAN CHEMICAL SOCIETY CERTIFICATION

Students desiring American Chemical Society certification must
• Complete the required courses for the (ACS) Bachelor of Science degree in chemistry as spelled out in this bulletin
• Achieve a minimum GPA of 3.00 in all chemistry courses taken at Andrews University
• Satisfactorily complete a research or cooperative educational experience in chemistry
• Pass at least one advanced course selected from the following: CHEM470, 474 or 475.

A complete statement of certification requirements is available from the department chair.

Undergraduate Programs

Core Courses—30
CHEM131, 132, 200, 231, 232, 241, 242, 311, 312, 411, 412, 431, 441, BCHM421

BS: Chemistry—38

Major Requirements: Core plus CHEM415, 440.
Research/Cooperative Experience: An on-campus or off-campus research or cooperative educational experience. The student may satisfy this requirement by matriculating in CHEM495, HONS497, 498 or IDSC380.
Cognate Courses: CPTR125 or CPTR151; MATH141, 142; PHYS241, 242, 271, 272.

BS: Chemistry—44
(American Chemical Society approved)

Major Requirements: Core plus CHEM440, 415, 432, 442; and one course selected from the following: CHEM470, 474, or 475.
Research/Cooperative Experience: An on-campus or off-campus research or cooperative educational experience. The student may satisfy this requirement by matriculating in CHEM495, HONS497, 498 or IDSC380.
Cognate Courses: MATH141, 142, 286; CPTR125 or CPTR151; PHYS241, 242, 271, 272.

Courses in economics and marketing are strongly recommended. A reading knowledge of German or French, although not required for professional undergraduate education in chemistry, is strongly recommended for students planning advanced study.

BS: Biochemistry—34

Major Requirements: Core plus BCHM422, 430.
Cognate Courses: BIOL165, 166; MATH141, 142; PHYS141, 142 (or PHYS241, 242, 271, 272); and two courses selected from BIOL371, 372; FDNT485; ZOOL315, 464, 465.

Students desiring a career in biochemistry might be better served by adding the biochemistry courses to the Bachelor of Science degree in chemistry, but the Bachelor of Science degree in biochemistry can be strengthened by the addition of CHEM415, 440, and 495.

Minor in Chemistry—20
CHEM131, 132, 231, 232, plus 4 credits of majors level chemistry or biochemistry.

Graduate Program

The Department of Chemistry and Biochemistry collaborates in offering the Master of Science: Interdisciplinary Studies (Mathematics and Physical Sciences). See the Interdisciplinary Studies section, p. 128.
### Courses (Credits)

See inside front cover for symbol code.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BCHM120</td>
<td>Introduction to Biological Chemistry</td>
<td>$ (4)</td>
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<tr>
<td>BCHM421</td>
<td>Biochemistry I</td>
<td>$ (4)</td>
</tr>
<tr>
<td>CHEM110</td>
<td>Introduction to Inorganic and Organic Chemistry</td>
<td>$ (4)</td>
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<tr>
<td>CHEM131</td>
<td>General Chemistry I</td>
<td>$ (4)</td>
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<tr>
<td>CHEM132</td>
<td>General Chemistry II</td>
<td>$ (4)</td>
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<tr>
<td>CHEM200</td>
<td>Quantitative Analysis</td>
<td>$ (4)</td>
</tr>
<tr>
<td>CHEM231</td>
<td>Organic Chemistry I</td>
<td>$ (3)</td>
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<tr>
<td>CHEM232</td>
<td>Organic Chemistry II</td>
<td>$ (3)</td>
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<tr>
<td>CHEM300</td>
<td>Laboratory Glassblowing</td>
<td>Alt $ (2)</td>
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<tr>
<td>CHEM311</td>
<td>Seminar in Chemistry</td>
<td>(5)</td>
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<tr>
<td>CHEM312</td>
<td>Seminar in Chemistry</td>
<td>(5)</td>
</tr>
<tr>
<td>CHEM340</td>
<td>Environmental Chemistry</td>
<td>$ (4)</td>
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</tbody>
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- **BCHM120**
  - A survey of major concepts in biochemistry such as structures of biological molecules, their functions, energy metabolism, regulation of biochemical pathways; for nursing, dietetics, and allied health students. Weekly: 3 lectures, and a 3-hour lab. Not applicable towards a major or minor in chemistry or biochemistry. Prerequisite: CHEM110. *Spring*

- **BCHM421**
  - Study of the fundamental principles of enzyme kinetics and mechanisms based on the structure and chemistry of biomolecules including amino acids, carbohydrates, lipids, proteins, nucleotides, nucleic acids, and biological membranes. Weekly: 4 lectures. Prerequisite: BCHM421. *Fall*

- **CHEM110**
  - An introduction to the principles and applications of inorganic and organic chemistry; for nursing, dietetics, and allied health students. Meets the natural/physical science general education restricted choice requirement. Weekly: 3 lectures, 1 recitation, and a 3-hour lab. *Fall*

- **CHEM131**
  - This first course in chemistry is for students planning to major in science and engineering. Topics include stoichiometry, atomic and molecular structure, bonding, states of matter, solutions, chemical kinetics, and chemical equilibrium. Weekly: 3 lectures, 2 recitations, and a 3-hour lab. Prerequisite: MPE2-P3 or MATH166 or MATH141; High school chemistry or physics strongly recommended. *Fall*

- **CHEM132**
  - A continuation of CHEM131 with topics including thermodynamics, acid and base chemistry, descriptive and nuclear chemistry. Weekly: 3 lectures, 2 recitations, and a 3-hour lab. Prerequisites: a grade of C- or better in CHEM131. *Spring*

- **CHEM200**
  - Lecture topics include statistics, chemical equilibrium, titrimetric procedures, gravimetric procedures, and electrochemistry. Laboratory experiments include gravimetric procedures and titrimetric procedures of acid and base systems and redox systems, electrochemistry, and an introduction to instrumental methods. Weekly: 2 lectures and two 4-hour labs. Prerequisites: CHEM132. *Spring*

- **CHEM231**
  - The chemistry of carbon-containing compounds with emphasis on nomenclature, molecular structure, spectra-structure relationships, and a mechanistic approach to organic reactions. Weekly: 3 lectures and 2 recitations. Prerequisites: CHEM131. *Fall*

- **CHEM232**
  - Continuation of CHEM231 including selected topics of hormone and regulatory biochemistry, and the study of the four primary neurotransmitter systems—acetylcholine, catecholamines, serotonin, and gamma-aminobutyric acid. Weekly: 3 lectures. Prerequisite: BCHM421. *Spring*

- **CHEM300**
  - Practice of fundamental glassblowing skills common to both scientific and creative glass blowing. Two projects are required. The student may choose between scientific and creative projects. Weekly: 1 lecture demonstration and 4 hours of lab. Not applicable towards a major or minor in chemistry or toward the General Education requirement in natural science. Offered Fall 2002-2003 but not in 2003-2004.

- **CHEM311**
  - Departmental seminar series devoted to topics in current chemical research by students, faculty, and guest speakers. This course is required of and open only to junior chemistry and biochemistry majors, and attendance for both semesters is required for one credit; freshmen and sophomores are encouraged to attend. Grading is on an S/U basis. A deferred grade (DG) is assigned Fall Semester and is removed upon successful completion of CHEM312. Weekly: 1 seminar. Prerequisite: CHEM232. *Fall*

- **CHEM312**
  - Continuation of CHEM311. This course is required of and open only to junior chemistry and biochemistry majors; freshmen and sophomore are encouraged to attend. Grading is on S/U basis. Weekly: 1 seminar. Prerequisite: CHEM311. *Spring*

- **CHEM340**
  - A survey of environmental and energy-related problems. Topics include air, soil, and water pollution, energy and other resources, solid wastes and recycling, and toxic chemicals. Weekly: 3 lectures and one 4-hour lab. Not applicable towards a major in chemistry or biochemistry. Prerequisites: CHEM132; CHEM232 or CHEM200 strongly recommended. Offered *Fall* (odd years or as needed)
CHEM410
Forensic Chemistry
Principles of chemistry as applied to the methods of analysis and identification of drugs. Rules of evidence as they apply to testimony in court. Observation of drug-related court procedures. Weekly: 1 lecture and two 3-hour labs. Participation must be arranged with the instructor at least 2 months prior to beginning of course. Prerequisites: CHEM200, 232. Spring

CHEM411
Seminar in Chemistry
First half of semester consists of two meetings per week: one is an introduction to chemical literature and computer searching of Chemical Abstracts and chemical databases, the other meeting is the regular seminar series presented by students, faculty, and invited speakers. During the semester, each student prepares and presents a seminar. This course is required of and open only to senior chemistry and biochemistry majors, and attendance for both semesters is required for one credit. A deferred grade (DG) is assigned Fall Semester and is removed upon successful completion of CHEM412. Weekly: Two meetings during first half of semester, one meeting remainder of semester. Prerequisite: CHEM312. Fall

CHEM412
Seminar in Chemistry
Continuation of CHEM411. During the semester, each student prepares and presents a seminar. This course is required of and open only to seniors. Prerequisite: CHEM411. Spring

CHEM415
Advanced Inorganic Chemistry
Atomic and molecular structure, symmetry, group theory, solid state, acids and bases; structure, bonding, spectra, and reaction mechanisms of d-metal complexes, systematic chemistry of non-metals; organometallic chemistry and catalysis. Weekly: 4 lectures. Prerequisites: CHEM232, 431. Spring

CHEM431
Physical Chemistry I
Fundamental concepts in chemical thermodynamics, free energy, chemical equilibria, phase changes, solutions, molecular transport, chemical dynamics, and electrochemistry. Weekly: 3 lectures. Prerequisites: CHEM200, MATH142, PHYS142 (or 242, 272). Fall

CHEM432
Physical Chemistry II
Wave mechanics, atomic and molecular structure, chemical bonding, atomic and molecular spectroscopies, and applications to chemical dynamics and statistical thermodynamics. Weekly: 3 lectures. Prerequisites: CHEM431, MATH286; MATH240 strongly recommended. Spring

CHEM440
Instrumental Analysis
Theory and practice of analytical separations and chemical analyses by chromatographic, optical and electrochemical methods. Introduction to interface of instruments with microcomputers. Instruments used include emission and absorption spectrometers, lasers, mass spectrometer, chromatographs, microcomputers, analog and digital devices. Weekly: 2 lectures and two 4-hour labs. Prerequisites: CHEM200, MATH142. Fall

CHEM441
Physical Chemistry Laboratory I
Experiments related to the course content of CHEM431. Weekly:

CHEM442
Physical Chemistry Laboratory II
Experiments related to the course content of CHEM432. Weekly one 4-hour laboratory. Prerequisite: concurrent enrollment in CHEM 432. Spring

CHEM470
Modern Synthetic Techniques
An advanced laboratory course designed to incorporate a wide variety of modern synthetic techniques of organic, organometallic, and inorganic chemistry. Weekly: two 4-hour labs. Prerequisites: CHEM474,415 or concurrent enrollment in CHEM415. Spring

CHEM474
Advanced Topics in Organic Chemistry
Study of the principles of modern synthetic organic chemistry with applications from one or more of the following areas: natural product, medicinal, or polymer chemistry. Weekly: 2 lectures. Prerequisite: CHEM232. Fall

CHEM475
Independent Research
An opportunity for chemistry and biochemistry majors to gain research experience by joining with a faculty member in study of an area of special interest.

GRADUATE

CHEM530
Topics in Teaching Chemistry
Each time the course is offered, it treats one of the following areas:
- Concepts in Chemistry
- Fundamental ideas of chemistry
- Demonstrations
- Simple experiments which illustrate chemical principles
- Problem-Solving Strategies
- Exploration into the mental processes and logic behind problem solving.

None of the above areas are to occur twice in one student’s program. Prerequisite: CHEM232. Repeatable to 6 credits.

CHEM540
Topics in Chemistry
Independent readings to be chosen in consultation with the instructor. A written report and an oral presentation covering the materials read are required. A minimum of 60 hours of work is required for each credit. Prerequisites: CHEM431. Repeatable to 6 credits.