American Chemical Society Certification
Students desiring American Chemical Society certification must
- Complete the required courses for the (ACS) Bachelor of
  Science degree in chemistry or biochemistry 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, for chemistry, 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, 211*, 231, 232, 241, 242, 311, 312, 411, 412, 431,
441, BCHM421
* CHEM211 is required every semester for students of freshman
and sophomore class standing.

General Education Requirements—Chemistry with
Secondary Certification
See professional program requirements, p. 51, and note the following specific requirements:
- Religion: 12*—RELT100, 225, RELH400 and a 3-credit
  elective chosen in consultation with your SED advisor
- Language/Communication: ENGL115, 215, COMM450
- Foreign Language (BA only)—Intermediate Language (4)
- History: HIST117, 118
- Fine Arts/Humanities: Choose one course from:
  ARTH220, PHOTO210, Studio Art (3), ENGL255, PHIL224,
  MUHL214, Ensemble Music (3)
- Life/Physical Sciences: professional degree requirements
- Mathematics: professional degree requirements
- Computer Literacy: INFS120
- Service: EDTE165
- Social Sciences: GDPC302 & EDTE228
- Fitness Education: HLED120 plus two Fitness Education
  courses

BS: Chemistry
Major Requirements: Core courses 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; MATH191(or 195), 192;
PHYS241, 242, 271, 272.

BS: Chemistry
(American Chemical Society approved)
Major Requirements: Core courses 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 or 498.
Cognate Courses: MATH191(or 195), 192, 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 (American Chemical Society approved)

Major Requirements: Core courses plus BCHM422, 430, CHEM415, 440, 441, 442, 444, 447, 448, 449.

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 or 498.

Cognate Courses: BIOL165, 166; MATH191(or 195), 192, 286; CPTR125 or CPTR151; PHYS241, 242, 271, 272 and one course selected from BIOL371, 418. Courses in economics and marketing are strongly recommended.

BS: Biochemistry

Major Requirements: Core courses plus BCHM422, 430.

Cognate Courses: BIOL165, 166; MATH191(or 195), 192; 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 pursuing the ACS Bachelor of Science degree in biochemistry, but the Bachelor of Science degree in biochemistry can be strengthened by the addition of CHEM415, 440, and 495.

Minor in Chemistry

CHEM131, 132, 231, 232, 241, 242, plus 4 credits of CHEM/BCHM courses that apply to a major in chemistry or biochemistry.

Graduate Program

The Department of Chemistry & Biochemistry collaborates in offering the MS: Mathematics and Science with the departments of Mathematics, Biology, and Physics. See the program description under Mathematics and Science, p. 174.

Courses

See inside front cover for symbol code.

BCHM120 Introduction to Biological Chemistry

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, 1 recitation, and a 3-hour lab. Not applicable towards a major or minor in chemistry or biochemistry. Prerequisite: CHEM110. Spring

BCHM422 Biochemistry II

Continuation of BCHM421 including selected topics of hormone and regulatory biochemistry, the study of the four primary neurotransmitter systems and an overview of selected human pathologies emphasizing cancer biochemistry and biology. Weekly: 3 lectures. Prerequisite: BCHM421. Spring

BCHM430 Biochemistry Lab

Introduction to quantitative and qualitative methods for the isolation, purification and identification of biological materials and applications of enzyme kinetics. Weekly: 4 hours of lab. Prerequisite: BCHM421 and registration in BCHM422. Spring

CHEM100 Consumer Chemistry

A one-semester course primarily for non-science majors presenting an introduction to fundamental concepts of chemistry to convey an appreciative understanding of the nature of chemistry and how it is applied to our daily lives. Topics of consumer chemistry to be studied will be selected from fuels, energy, polymers, fertilizers, pesticides, food and food additives, household cleaners, cosmetics and personal care chemicals, pharmaceuticals, and air and water pollution. Meets the physical science general education requirement. Three lectures per week and one 3-hour laboratory. Not applicable toward a major or minor in chemistry or biochemistry. Spring

CHEM110 Introduction to Inorganic and Organic Chemistry

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 General Chemistry I

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: MPE-P3 or passing grade in MATH166/168 or above or MATH191/195; High school chemistry or physics strongly recommended. Fall

CHEM132 General Chemistry II

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. Prerequisite: a grade of C- or better in CHEM131. Spring

CHEM195 Independent Research I

An opportunity for students to gain research experience by joining with a faculty member in study of an area of special interest. This course is for students who are beginning to establish their knowledge of chemistry and biochemistry. May be repeated for credit. Required: permission of faculty member. Arranged. Fall, Spring, Summer
CHEM200  $ (4)
Quantitative Analysis
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. Prerequisite: CHEM132. Fall

CHEM211  $ (0)
Current Chemistry Topics
Attendance at departmental seminar series devoted to topics in current chemical research as presented by students, faculty, and guest speakers. Repeatable and required each semester of all freshman and sophomore chemistry and biochemistry majors. Grading is on an S/U basis. Weekly: 1 seminar. Fall, Spring

CHEM231  $ (3)
Organic Chemistry I
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. Prerequisite: CHEM132. Fall

CHEM232  $ (3)
Organic Chemistry II
This course is a continuation of CHEM231. Weekly: 3 lectures and 2 recitations. Prerequisite: a grade of C- or better in CHEM231. Spring

CHEM241  $ (1)
Organic Chemistry Laboratory I
Experiments related to the course content of CHEM231. Weekly: one 4-hour laboratory. Prerequisite: CHEM231 or concurrent enrollment in CHEM231. Fall

CHEM242  $ (1)
Organic Chemistry Laboratory II
Experiments related to the course content of CHEM232. Weekly one 4-hour laboratory. Prerequisite: CHEM232 or concurrent enrollment in CHEM232. Spring

CHEM295  $ (1–3)
Independent Research II
An opportunity for students to gain research experience by joining with a faculty member in study of an area of special interest. This course is for students who are establishing their knowledge of chemistry and biochemistry at the college level. May be repeated for credit. Required: permission of faculty member and a passing grade in CHEM312. Arranged. Fall, Spring, Summer

CHEM300  Alt $ (2)
Laboratory Glassblowing
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 (even years or as needed)

CHEM311  $ (5)
Seminar in Chemistry
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  $ (5)
Seminar in Chemistry
Continuation of CHEM311. This course is required of, and open only to, junior chemistry and biochemistry majors; freshmen and sophomores are encouraged to attend. Grading is on S/U basis. Weekly: 1 seminar. Prerequisite: CHEM311. Spring

CHEM340  $ (4)
Environmental Chemistry
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. Spring (odd years or as needed)

CHEM410  ♠ $ (2)
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  $ (5)
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  $ (5)
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  ♠ (4)
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, MATH192, 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 micro-computers. 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, MATH192. **Fall**

CHEM441

*Physical Chemistry Laboratory I*
Experiments related to the course content of CHEM431. Weekly: one 4-hour laboratory. Prerequisite: concurrent enrollment in CHEM431. **Fall**

CHEM442

*Physical Chemistry Laboratory II*
Experiments related to the course content of CHEM432. Weekly: one 4-hour laboratory. Prerequisite: concurrent enrollment in CHEM432. **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 CHEM445. **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

*Advanced Topics in Physical Chemistry*
Advanced study of molecular spectroscopy, statistical thermodynamics, chemical dynamics, or the application of quantum mechanics. Prerequisites: CHEM432 or CHEM431 and permission of the instructor. **Fall**

CHEM495

*Advanced Independent Research*
An opportunity for students to gain research experience by joining with a faculty member in study of an area of special interest. This course is for students who have a reasonably established knowledge of chemistry and biochemistry at the college level. May be repeated for credit. Required: permission of faculty member and a passing grade in CHEM232/242 or (CHEM200 and CHEM231/241). Arranged. **Fall, Spring, Summer**

**Graduate**

CHEM530

*Topics in Teaching Chemistry*
Each time the course is offered, it treats one of the following areas:
- Concepts in Chemistry
- Demonstrations
- Problem-Solving Strategies
  - Simple experiments which illustrate chemical principles
  - 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. **(2-4)**

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. Prerequisite: CHEM431. Repeatable to 6 credits. **(2-4)**