BIOL655
Program Continuation
Students may register for this non-credit continuation course to maintain active status. For additional information on active status, please refer to p. 47 in the bulletin. Registration does not indicate full-time status.

BIOL660
Thesis Continuation
Student may register for this title while clearing deferred grade (DG) and/or incomplete (I) courses with advisor approval only. Registration for this title indicates full-time status.

BIOL670
Comprehensive Exam

BIOL681, 682
Research Methods and Biology Seminar
An introduction to graduate studies in biology, the nature and methods of science, and principles of research ethics. During second semester reports are made by each student to the group on topics from current literature and on specific problems in biology. Participation once per week for 2 semesters is required. BIOL681: Fall; BIOL682: Spring

BIOL690
Independent Study
Independent study in biology under the direction of the instructor. Consent of instructor required. Fall, Spring, Summer

BIOL697
Research in Biology
Repeatable to 4 credits. Arranged

BIOL699
Master's Thesis
Repeatable to 6 credits. Arranged

CHEMISTRY & BIOCHEMISTRY

Halenz Hall, Room 225
269-471-3247 or 471-3248
chemistry@andrews.edu
www.andrews.edu/chem/

Faculty
D. David Nowack, Chair
David E. Alonso
Ryan Hayes
Getahun Merga
Desmond H. Murray
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Academic Programs | Credits
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BS: Chemistry | 38
BS: Chemistry (Approved by the American Chemical Society (ACS) Committee on Professional Training) | 44
BS: Biochemistry (Approved by the American Chemical Society (ACS) Committee on Professional Training) | 45
BS: Biochemistry | 34
Minor in Chemistry | 20

Mission
The mission of the Department of Chemistry & Biochemistry within the context of a Seventh-day Adventist Christian worldview is to assist all students to excel in developing their analytical and critical reasoning skills, using fundamental chemical principles and computational methods; prepare our chemistry and biochemistry majors to enter graduate school, professional school, the chemical industry, or the teaching profession, in a diverse world; develop in our students an understanding of responsible, environmentally sensitive use of global resources; engage students and faculty in the process of discovery and creativity in the research lab and the classroom to model a life of personal and professional integrity.

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 biochemistry (ACS) 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 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, 231, 232, 241, 242, 311, 312, 411, 412, 431, 441,
BCHM421

BS: Chemistry
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; MATH191, 192; PHYS261,
242, 271, 272.

(38)

BS: Chemistry
(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 or 498.
Cognate Courses: MATH191, 192, 286; CPTR125 or CPTR151;
PHYS261, 242, 271, 272.

(44)

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 plus CHEM415, 422, 430, 432, 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 or 498.
Cognate Courses: BIOL165, 166; MATH191, 192, 286; CPTR125
or CPTR151; PHYS261, 242, 271, 272 and one course selected from
BIOL371, 418.

(45)

Courses in economics and marketing are strongly recommended.

BS: Biochemistry
Major Requirements: Core plus CHEM422, 430.
Cognate Courses: BIOL165, 166; MATH191, 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 majors level
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

BCHM421
Biochemistry I
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: 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 $ (4)

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 $ (4)

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: a grade of C- or better in CHEM131. Fall

CHEM132 General Chemistry II $ (4)

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. Fall

CHEM200 Quantitative Analysis $ (4)

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

CHEM231 Organic Chemistry I (3)

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: CHEM232. Fall

CHEM232 Organic Chemistry II (3)

This course is a continuation of CHEM231. Weekly: 3 lectures and 2 recitations. Prerequisite: a grade of C- or better in CHEM231. Spring

CHEM241 Organic Chemistry Laboratory I $ (1)

Experiments related to the course content of CHEM231. Weekly: one 4-hour laboratory. Prerequisite: CHEM232 or concurrent enrollment in CHEM231. Fall

CHEM242 Organic Chemistry Laboratory II $ (1)

Experiments related to the course content of CHEM232. Weekly one 4-hour laboratory. Prerequisite: CHEM232 or concurrent enrollment in CHEM232. Spring

CHEM300 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 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 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 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 Environmental Chemistry $ (4)

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 Forensic Chemistry $ (2)

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, 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 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, 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 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
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.

CHEM495
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. Prerequisite: CHEM431. Repeatable to 6 credits.