

Department of Chemistry

Department Head: Zuraw

Professors: Blanton, Mabrouk

Associate Professors: McAfee, Zuraw

Assistant Professors: Bevsek, Dorko

The course of study for students majoring in chemistry is designed to prepare them to enroll as graduate students in full standing at leading universities; to provide the foundation for pursuing careers in medicine, dentistry, and other professions; and to fill positions as chemists in industrial laboratories. The curricula embody training in the five fundamental subdivisions of the science: biochemistry, inorganic, organic, analytical, and physical chemistry.

The department occupies Byrd Hall, which was completed in 1968. Within its 52,000 square feet, this facility houses a lecture theater, laboratories, a centrally located library, and conveniently located stock, preparation, and balance rooms.

The B.S. in Chemistry and the B.S. in Chemistry - Biochemistry Specialization curricula are intended for those students who plan to enter graduate, medical, dental, veterinary, or other professional schools; military service; positions in industry; and teaching. Such a variety of career options is possible due to the number of general electives that are available as a part of these degree plans. A specific curriculum will be developed in consultation with the student's academic advisor to fit the student's career goals. Students who plan to go to graduate school in chemistry, biochemistry, chemical engineering, or medical research or to fill positions in industrial laboratories may elect to take additional courses to qualify for the American Chemical Society approved curricula for both the B.S. in Chemistry and B.S. in Chemistry-Biochemistry degrees.

The curriculum for the B.A. in Chemistry provides great flexibility in choosing electives, and this permits the design of a program to fit the student's individual aspirations. This degree is intended for those who wish to combine a technical background with a more liberal arts education.

ACS Approved Program

Students who wish to pursue research related careers (medical, chemical, industrial) should consider taking the courses to complete the ACS approved

programs. Students receiving these additional requirements are awarded a certificate by the American Chemical Society documenting their status as professional chemists and are frequently given preferential treatment as candidates for professional positions. In order to qualify for this distinction, students must take CHEM 315, CHEM 460, MATH 131 (instead of MATH 106), MATH 132 (instead of MATH 107), and MATH 234 (as an elective course). A chapter of Student Affiliates of the ACS is active at The Citadel.

Premedical Program

Students who plan to enter medical school or allied professional schools such as dental or veterinary school should consider either of the two B.S. in Chemistry - Biochemistry Specialization programs. The non-ACS curriculum will provide a solid foundation for medical, dental or veterinary school. However, students who are pursuing a career in medical research should consider taking the ACS approved curriculum. Students who plan to enter medical school upon completion of their baccalaureate degrees should acquaint themselves with requirements of the medical schools of their choice and plan their programs accordingly. An extremely worthwhile reference to the entrance requirements for all medical schools in the United States and Canada is *Medical School Admission Requirements*, published each year by the Association of American Medical Colleges, One DuPont Circle N.W., Washington, D.C. 20036.

Minor in Chemistry

Objectives: The minor in chemistry will provide students with a stronger background in chemistry than they would obtain from the requirements in the core curriculum. It is designed to acquaint students with the more advanced theories and techniques that are illustrated in the major subfields of chemistry.

Knowledge and/or Skills to be Achieved: In general, the student completing the minor will have a more in-depth foundation in chemical bonding, physical properties and synthesis of compounds, chemical thermodynamics and kinetics, chemical and instrumental analyses, properties of biomolecules, and the design of polymers. More specifically, by the choice of advanced courses, the student may gain greater insight with regards to one or more of these general areas to meet specific career goals. Additionally, because the department places considerable emphasis on oral and written presentations, the student will gain considerable experience in interpreting and presenting chemical data in a professional manner.

This minor is not approved for students majoring in Chemistry.

Structure of the minor:

1. Required Courses: (8 Credit Hours)

CHEM 151	General Chemistry I*
CHEM 161	General Chemistry Laboratory I*
CHEM 152	General Chemistry II*
CHEM 162	General Chemistry Laboratory II*
CHEM 207	Organic Chemistry I
CHEM 217	Organic Chemistry Laboratory I
CHEM 208	Organic Chemistry II
CHEM 218	Organic Chemistry Laboratory II

*These four courses meet the requirements for the core curriculum, and their hours are **not** counted toward the total for the Minor in Chemistry. Also note that CHEM 103/113 and CHEM 104/114 do **not** meet the requirements for the Minor in Chemistry.

2. Electives: (10 Credit Hours)**

- A. One of the three sequential upper-level offerings (300 or above)
 - CHEM 305/306 Physical Chemistry I & II
 - CHEM 300/302 Quantitative Analysis/Instrumental Analysis
 - CHEM 401/402 Inorganic Chemistry I & II
- B. Any combination of additional upper-level chemistry courses which bring the total number of hours to at least 18 including at least one upper-level laboratory course. Again, this total is exclusive of the eight hours of General Chemistry required for the core curriculum.

**Biology majors will be required to take 12 credit hours of upper level offerings. The additional courses must be approved in advance by the Head of the Department of Chemistry.

Total Credit Hours required—18

Minor in Molecular Biology and Biochemistry

The Departments of Biology and Chemistry offer a joint minor in Molecular Biology and Biochemistry. This minor will be beneficial to students interested in careers in medicine, dentistry, and other health science fields as well as those who wish to pursue careers in the chemical and biochemical industry. Active learning exercises, use of scientific literature, computer modeling, inquiry-based laboratories, and research are important components of the courses in the sequence. Requirements for the minor vary slightly depending on the student's major. The following courses are prerequisites for the minor: BIOL 130/131 and 140/141; CHEM 151/161, 152/162, 207/217, and 208/218.

Requirements for Students Majoring in Biology

BIOL 424	Molecular Genetics
BIOL or CHEM 429	Literature Seminar

CHEM 409	Biochemistry I
CHEM 410	Biochemistry II
CHEM 460	Biochemistry Laboratory
and one of the following	
BIOL 310	Microbiology
CHEM 300	Quantitative Analysis

Requirements for Students Majoring in B.A. Chemistry

BIOL 308	Genetics
BIOL 424	Molecular Genetics
BIOL or CHEM 429	Literature Seminar
CHEM 409	Biochemistry I
CHEM 410	Biochemistry II
CHEM 460	Biochemistry Laboratory

Requirements for All Other Majors

BIOL 308	Genetics
BIOL 424	Molecular Genetics
BIOL 429	Literature Seminar
CHEM 409	Biochemistry I
CHEM 410	Biochemistry II
CHEM 460	Biochemistry Laboratory

Requirements for Non-Science Students

Unless the students' degree plans stipulate they take CHEM 151/161 and CHEM 152/162, it is highly recommended they take CHEM 103/113 and CHEM 104/114. A student may not use both CHEM 103 and CHEM 151 or CHEM 104 and CHEM 152 to meet degree requirements.

Chemistry Course Descriptions

CHEM 103	<i>Introduction to Chemistry I</i>	Three Credit Hours
Corequisite or prerequisite: CHEM 113		
For non-science majors only.		

The first semester of a course designed for students who are not science and engineering majors. The course will cover the fundamentals of chemistry including electronic structure of the atoms, bonding, basic chemical calculations, gases, and various types of reactions. Mathematical emphasis will be less rigorous than in CHEM 151. Chemical processes of products used in everyday life will be stressed.

Lecture: three hours.

CHEM 104 *Introduction to Chemistry II* Three Credit Hours

Prerequisites: CHEM 103 and CHEM 113 or CHEM 151 and CHEM 161

Corequisite or prerequisite: CHEM 114

For non-science majors only.

The concluding semester of a course designed for students who are not science and engineering majors. Among the topics to be covered will be the relationship of chemistry to ecology, to the human body, to energy productions, and to product manufacturing. Emphasis will be placed on making students more informed consumers as they choose and use everyday products.

Lecture: three hours.

CHEM 113 *Introduction to Chemistry Laboratory I* One Credit Hour

Prerequisite or corequisite: CHEM 103

Required of all students selecting CHEM 103.

Student-conducted laboratory procedures and experiments designed to parallel as closely as possible and to enhance the material covered in CHEM 103. Emphasis will be placed on basic laboratory techniques. Demonstrations will be used to illustrate important chemical concepts.

Laboratory: two hours.

CHEM 114 *Introduction to Chemistry Laboratory II* One Credit Hour

Prerequisites: CHEM 103 and CHEM 113

Corequisite or Prerequisite: CHEM 104

Required of all students selecting CHEM 104.

A continuation of CHEM 113. Experiments and demonstrations will parallel, as closely as possible, and enhance the material covered in CHEM 104. Preparation and analysis of some interesting common products will be conducted.

Laboratory: two hours.

CHEM 151 *General Chemistry I* Three Credit Hours

Corequisite or prerequisite: CHEM 161; Chemistry majors must have a grade of C or higher.

Required of all freshmen majoring in the sciences and engineering; the chemistry option for B.S. in Mathematics or Computer Science; elective to others.

Problem-solving techniques and essential concepts, including structure and properties, reactions, stoichiometry, states of matter, thermochemistry, and bonding. Calculators with logarithmic capability are required.

Lecture: three hours.

CHEM 152 *General Chemistry II* Three Credit Hours
Prerequisites: CHEM 151 and CHEM 161; Chemistry majors must have a grade of C or higher.

Corequisite or prerequisite: CHEM 162

Required of all students majoring in the sciences and engineering; the chemistry option for B.S. in Mathematics or Computer Science; elective to others.

Continuation of CHEM 151. Emphasis includes solutions, kinetics, equilibrium, acids and bases, solubility, redox, and an introduction to organic chemistry.

Lecture: three hours.

CHEM 161 *General Chemistry Laboratory I* One Credit Hour
Prerequisite or corequisite: CHEM 151

Required of all students selecting CHEM 151.

Introduction to laboratory techniques and experiments designed to accompany the topics covered in CHEM 151.

Laboratory: two hours. (Note: Chemistry majors register for a special section of this course which meets three hours a week.)

CHEM 162 *General Chemistry Laboratory II* One Credit Hour
Prerequisites: CHEM 151 and CHEM 161

Corequisite or prerequisite: CHEM 152

Required of all students selecting CHEM 152.

A continuation of CHEM 161; experiments include an introduction to qualitative analysis, quantitative techniques, and selected instrumental methods.

Laboratory: two hours. (Note: Chemistry majors register for a special section of this course which meets three hours a week.)

CHEM 207 *Organic Chemistry I* Three Credit Hours
Prerequisites: CHEM 152 and CHEM 162; Chemistry majors must have a grade of C or higher.

Required of all sophomores majoring in chemistry.

A study of the aliphatic hydrocarbons, their preparations and reactions, with emphasis on reaction mechanisms and transformations.

Lecture: three hours.

CHEM 208 *Organic Chemistry II* Three Credit Hours
Prerequisites: CHEM 207 and CHEM 217

Corequisite or prerequisite: CHEM 218

A study of aromatic compounds and the various functional classes of compounds. Emphasis will be placed on reactions, reaction mechanisms, and transformations. Important biomolecules will be covered briefly.

Lecture: three hours.

CHEM 217 *Organic Chemistry Laboratory I* One Credit Hour

Corequisite or prerequisite: CHEM 207

A course which emphasizes the development of skill in the use of basic laboratory techniques through the completion of a series of experiments involving various types of reactions such as substitution, elimination, and addition reactions with an introduction to modern instrumentation such as the IR spectrophotometer, gas chromatograph, and NMR spectrometer.

Laboratory: three hours.

CHEM 218 *Organic Chemistry Laboratory II* One Credit Hour

Prerequisites: CHEM 207 and CHEM 217

Corequisite or prerequisite: CHEM 208

A continuation of CHEM 217 with the emphasis on the synthesis, reactions, and identification of the various classes of organic compounds.

Laboratory: three hours.

CHEM 300 *Quantitative Analysis* Four Credit Hours

Prerequisites: CHEM 152 and CHEM 162 and MATH 107 or the equivalent or permission of the department head.

Required of all juniors majoring in chemistry; elective to others.

This course has as a primary focus the chemical principles involved with classical gravimetric and volumetric analysis; however, modern methods of analysis including colorimetry and potentiometry are introduced.

Lecture and discussion: three hours; laboratory: three hours.

CHEM 302 *Instrumental Methods* Four Credit Hours

Prerequisites: CHEM 300 and CHEM 305 or permission of the instructor.

Corequisite: CHEM 306

Required of all juniors majoring in chemistry; elective to others.

Modern instrumental methods of analysis are discussed, with emphasis on the physical or chemical principles involved in the method, design or analytical instruments, and treatment of analytical data. Laboratory work provides practice in the three major areas of instrument analysis—chromatography, electrochemistry, and spectroscopy.

Lecture: two hours; laboratory: four hours.

CHEM 305 and *Physical Chemistry I and II* Three Credit Hours
 CHEM 306 Each Semester

Prerequisites: MATH 132 or MATH 107; and PHYS 204/254 or PHYS 221/271; CHEM 152, CHEM 162 or permission of department head.

Corequisite for CHEM 305: CHEM 300

Prerequisite for CHEM 306: CHEM 305

Corequisite for CHEM 306: CHEM 302 and CHEM 316

Required of all juniors majoring in chemistry; elective to others.

CHEM 305 provides a detailed study of the laws of thermodynamics, Gibbs Energy calculations, and chemical equilibrium. CHEM 306 covers phase equilibria in both ideal and non-ideal solutions, surface thermodynamics, kinetic theory of gases, kinetics and mechanisms of reactions, viscosity, and electrical conductance of electrolyte solutions.

Lecture: three hours.

CHEM 308 *Introduction to Chemical Research* Two Credit Hours

Required of all chemistry majors; elective to others.

This course is an introduction to the literature of chemistry and the basics of developing a research project. Students will be introduced to both computer and print-based literature searches and will apply these skills as they research their thesis topics under the direction of a faculty research advisor.

Lecture and discussion: two hours.

Prerequisite: CHEM 208

CHEM 309 *Current Topics in Chemistry* Three Credit Hours

Prerequisites: A two-semester sequence of Introduction to Chemistry, CHEM 103/104 or General Chemistry, CHEM 151/152.

General elective only.

Interesting current topics will be presented at a level appropriate for students with a general chemistry background. The topics will be determined by student interest and faculty availability.

Lecture: three hours.

CHEM 310 *Survey of Nuclear Science* Three Credit Hours

Prerequisites: CHEM 300; MATH 106 and MATH 107 or equivalents; PHYS 204/254 or equivalent; or permission of the instructor.

Elective course; not open to physics majors.

A survey of the field of nuclear science particularly as applied to chemistry.

Lecture: three hours.

CHEM 315 and *Physical Chemistry Laboratory I & II* One Credit Hour
CHEM 316 Each Semester

Prerequisite: MATH 107 or MATH 132

Corequisites or prerequisites: CHEM 305 and CHEM 306

Required of all chemistry majors; elective to others.

The first semester course will be devoted to attaining skills in the evaluation, analysis, and presentation of experimental data. Topics covered will include graphing techniques, error analysis, extraction of useful quantities from raw data, use of computers in handling data, and the use of spreadsheets. Experiments will be performed on topics covered in CHEM 305. The second semester work will be a hands-on study of experimental physical chemistry on topics covered in CHEM 306, emphasizing the acquisition of data that can be analyzed using the skills learned in the first semester.

CHEM 319 *Applied Current Topics in Chemistry* Three Credit Hours

Prerequisites: A two-semester sequence of Introduction to Chemistry, CHEM 103/104 or General Chemistry, CHEM 151/152.

General elective for all majors.

Interesting topics will be presented at a level appropriate for students with a general chemistry background. This course will utilize a laboratory component.

CHEM 320 *Polymer Chemistry* Three Credit Hours

Prerequisites: CHEM 208 and CHEM 305 or approval of instructor

A general overview of polymer chemistry which includes mechanisms of polymerization, reactions of monomers, molecular weight distributions and limitations, polymer morphology and rheology, structure elucidation, applications, and industrial processing.

Lecture: three hours.

CHEM 401 *Inorganic Chemistry I* Three Credit Hours

Prerequisites: CHEM 208 and CHEM 305 or approval of instructor

Required of all chemistry majors.

An introduction to the systematic chemistry of the elements and the structures and reactions of their compounds. Topics covered include atomic and bonding theories, acid-base theories, symmetry and spectroscopy, and chemistry of the main group elements.

Lectures: three hours.

CHEM 402 *Inorganic Chemistry II* Three Credit Hours

Prerequisites: CHEM 401

Required of all B.S. chemistry majors; elective to others.

The chemistry of the transition metals, including bonding theories, coordination compounds, organometallic chemistry, catalysis and bioinorganic chemistry.

Lecture: three hours.

CHEM 403 *Special Topics in Biochemistry* Three Credit Hours

Prerequisites: CHEM 208

Required of B.S. Chemistry majors; elective to others.

An in-depth study of a selected topic in chemistry that requires a thorough understanding of organic chemistry. Topics vary depending on student interest and instructor availability.

Lecture: three hours.

CHEM 404 *Advanced Topics in Chemistry* Three Credit Hours

Prerequisites: CHEM 300, CHEM 305, and CHEM 315

Elective course.

A detailed study of a selected contemporary topic will be presented at a level that requires comprehension of the subject matter covered in the physical chemistry and quantitative analysis courses.

Lecture: three hours.

CHEM 409 *Biochemistry I* Three Credit Hours

Prerequisites: CHEM 207, CHEM 208, CHEM 217, and CHEM 218

Elective course.

A coverage of the chemistry of amino acids, peptides and proteins; enzymes; biochemical energetics; Krebs's cycle; electron transport system and oxidative phosphorylation; and amino acid metabolism.

Lecture: three hours.

CHEM 410 *Biochemistry II* Three Credit Hours

Prerequisite: CHEM 409 or permission of department head.

A continuation of the topics covered in Biochemistry I. Topics include lipids with emphasis on fatty acid oxidation, synthesis and lipid biosynthesis, and carbohydrates and their metabolism, and nucleic acid biochemistry.

Lecture: three hours.

CHEM 419 *Senior Research I* Three Credit Hours

Required of all B.S. Chemistry majors; elective to others with permission of the instructor.

This course provides an introduction to a research topic of the student's choosing and under the direction of a faculty advisor. After the topic has been approved by the faculty advisor, the student will be allowed to initiate the project. Using this topic, the student will be required to develop a research proposal which will be presented in the form of a seminar to the Chemistry Department Faculty and the chemistry majors.

CHEM 420 *Senior Research II* Three Credit Hours

Prerequisite: CHEM 419

A continuation of CHEM 419 in which the research project is completed and the data and results are compiled into a senior thesis. To finalize the project, the student will present a seminar to the Chemistry Department Faculty and chemistry majors and defend the thesis before a committee of faculty members from the Chemistry Department.

CHEM 425 *Senior Thesis I* Two Credit Hours

Required of all B.A. Chemistry majors.

This course requires an exhaustive literature search and the presentation of a seminar to the Chemistry Department Faculty and chemistry majors.

CHEM 426 *Senior Thesis II* Two Credit Hours

Prerequisites: CHEM 425

A continuation of CHEM 425 in which the literature review is continued and expanded into a senior thesis. To finalize the project, the student will present a seminar to the Chemistry Department Faculty and chemistry majors and defend the thesis before a committee of faculty members from the Chemistry Department.

CHEM 429 *Literature Seminar* One Credit Hour

Prerequisites: CHEM 151/161; 152/162; 207/217; 208/218.

A current topics course that involves discussions of relevant journal articles and related materials.

CHEM 460 *Biochemistry Laboratory* One Credit Hour

Corequisites: CHEM 409 OR CHEM 410

Covers experimental techniques commonly used in biochemistry including protein isolation and characterization, enzyme kinetics, isolation and manipulation of DNA, reactions and characterization of lipids and carbohydrates.

Laboratory: three hours.