

# DEPARTMENT OF CHEMISTRY & BIOCHEMISTRY

The chemistry and biochemistry programs provide the opportunity for students to appreciate chemical science as an intrinsic part of their liberal arts education. An understanding of the beauty, order, and harmony of the subject contributes much to a deeper understanding of the world in which we live. The implications of chemistry extend also to the realistic and practical fact that much public decision making rests upon the scientific sophistication of the citizenry. For these reasons, the department encourages training in chemistry for all students.

The natural sciences program is a general, interdisciplinary program that includes study of biology, chemistry, earth sciences, and physics.

Students may elect to pursue a Bachelor of Science (B.S.) or a Bachelor of Arts (B.A.) in Chemistry degree program, a Bachelor of Science in Biochemistry degree program, or a Bachelor of Science in Natural Sciences degree program.

Students earning a bachelor's degree in chemistry or biochemistry may confidently enter

- graduate work in any branch of chemistry, medicine, or dentistry,
- a career as a teacher in elementary or secondary school, or
- a career in government, science writing, business, medical technology, pharmaceuticals, or a wide variety of other positions in the occupational spectrum.

For information about special partnerships in medicine, pharmacy, and physical therapy, see Partnerships & Preparation for Careers in Engineering, Law, & Health Related Fields (<http://catalog.georgian.edu/undergraduate/academic-programs/preparation-careers-engineering-law-medicine-pharmacy-physical-therapy/>).

## Accelerated B.S. Chemistry + Seton Hall University M.S. Chemistry Program

Students pursuing the B.S. in Chemistry degree may complete their bachelor's degree in seven semesters and enroll in Seton Hall University's M.S. in Chemistry program in their eighth semester, thus accelerating their education and saving one semester of GCU tuition. Students can indicate their interest in the program when they first enroll at GCU, or at a subsequent time. To be eligible to enroll in Seton Hall University (SHU), students need to have an overall GPA of at least 3.0 and will formally apply to SHU's M.S. program at the beginning of the first semester of their fourth year.

## Honors Program

The honors research program in chemistry is an opportunity for distinction, offered by the department, to those majors demonstrating exceptional ability and commitment to the discipline. The program is by invitation only. Students will be informed of their eligibility at the beginning of the spring semester of the junior year. Upon accepting the invitation, the students participate in an independent research project with a professor (CH350 Research in Chemistry/Biochemistry I, CH449 Research in Chemistry/Biochemistry II or CH450 Research in Chemistry/Biochemistry III), for two semesters.

Students majoring in chemistry or biochemistry who are in the University Honors Program may choose independent research work with a professor

(CH350 Research in Chemistry/Biochemistry I, CH449 Research in Chemistry/Biochemistry II, or CH450 Research in Chemistry/Biochemistry III) to meet their Honors Program requirements by contract.

## New Jersey Teaching Credentials

The New Jersey certifications below are available for students earning the B.A. in Chemistry or B.S. in Chemistry:

- Early Childhood Education (P–3) with Teacher of Students with Disabilities Endorsement, & with option for ESL endorsement
- Elementary Education (K–6) with Teacher of Students with Disabilities Endorsement, & with option for Middle School Science Endorsement and/or ESL endorsement
- Teacher of Chemistry (K–12) with Teacher of Students with Disabilities Endorsement, & with option for ESL endorsement

The New Jersey certifications below are available for students earning the B.S. in Natural Sciences:

- Early Childhood Education (P–3) with Teacher of Students with Disabilities Endorsement, & with option for ESL endorsement
- Elementary Education (K–6) with Teacher of Students with Disabilities Endorsement, & with option for Middle School Science Endorsement and/or ESL endorsement

For required professional courses in education and other education requirements, please refer to the Education (<http://catalog.georgian.edu/undergraduate/school-education/>) section of the catalog.

## Programs Majors

- Biochemistry, B.S. (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/chemistry-biochemistry/biochemistry-bs/>)
- Chemistry, B.A. (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/chemistry-biochemistry/chemistry-ba/>)
- Chemistry, B.S. (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/chemistry-biochemistry/chemistry-bs/>)
- Natural Sciences, B.S. (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/chemistry-biochemistry/natural-sciences-bs/>)

## Minors

- Chemistry, Minor (<http://catalog.georgian.edu/undergraduate/school-arts-sciences/chemistry-biochemistry/chemistry-minor/>)

## Courses Chemistry (CH)

### CH108 Environmental Chemistry (4.0 Credits)

An introductory course that fulfills the general education science requirements. The extraordinary role played by chemistry is illustrated by studying environmental topics. Topics include pollution, ozone hole, global warming, energy crisis, water purification, acid rain, and nuclear energy. Basic concepts in the field of chemistry will also be discussed. 3 hours lecture, 3 hours laboratory.

**CH111 The World of Chemistry (4.0 Credits)**

An introductory course for non-science majors and natural science majors that emphasizes the principles of chemistry, specifically the comprehensive laws that help explain how matter behaves through inquiry based learning. The major theme explores the way in which molecules interact and how that explains the nature of substances. 3 hours lecture, 3 hours laboratory.

**CH112 Chemistry in Your Life (4.0 Credits)**

Second part of a two semester sequence. An introductory course for non-science majors and natural science majors that emphasizes the principles of chemistry, specifically the comprehensive laws that help explain how matter behaves through inquiry based learning. The major theme explores the relations between molecular structure within the body and their physiological functions. 3 hours lecture, 3 hours laboratory. Offered in the spring semester.

Prerequisite(s): CH111.

**CH113 General Chemistry I (4.0 Credits)**

The first course of the two semester sequence (CH113,CH114), provides introduction to the systematic study of the fundamental principles and concepts of chemistry. Topics include matter and measurement, atomic theory, molecular structure and bonding models, stoichiometric calculations, aqueous reaction chemistry, states of matter, intermolecular interactions and thermo chemistry. Laboratory work is designed to develop an understanding of the experimental methods used to develop the theoretical basis of the science. 3 hours lecture, 3 hours laboratory, 1 hour recitation. Offered in the fall semester.

Prerequisite(s): MA109 or eligibility to take MA110 or MA115 on the college mathematics placement test.

**CH114 General Chemistry II (4.0 Credits)**

Building on the fundamental principles and concepts of chemistry (CH113), this course introduces the study of various branches of chemistry—inorganic, organic, physical and nuclear chemistry including chemical equilibrium, acid-base equilibrium, kinetics, electrochemistry and chemical thermodynamics. Laboratory presents a series of exercises that demonstrate the chemical principles presented in lecture. 3 hours lecture, 3 hours laboratory, 1 hour recitation. Offered in the spring semester.

Prerequisite(s): CH113.

**CH151 Chemistry for the Health Sciences (4.0 Credits)**

Basic concepts of the three states of matter (solid, liquid and gas), composition of matter at the atomic and molecular level, nature of chemical changes involving matter, properties of carbon compounds and their applications in a biological system—biochemistry of proteins, carbohydrates, nucleic acids and lipids. The laboratory work will include hands-on experience in identifying a chemical change, separating mixtures and reactions of biological chemicals. 3 hours lecture, 3 hours laboratory.

**CH211 Chemistry of the Elements (3.0 Credits)**

An in-depth study of the Periodic Table of Elements and the atomic, ionic and molecular nature of materials. Emphasis will be placed on understanding the relationship between composition/structure of matter and its physical and chemical properties. The lecture introduces the most widely accepted theories on the origins and natural states of matter, and the bonding models used to explain and anticipate material properties. Descriptive chemistry will address the many numerous, important commercial chemicals and industrial processes. The course is recommended for those planning to teach in the physical sciences, but may be taken by non-science majors as well. 3 hours lecture.

Prerequisite(s): CH113.

**CH223 Organic Chemistry I (4.0 Credits)**

The first of a two-semester sequence (CH223, CH224), this course provides an introduction to the chemistry of carbon compounds—bonding, geometry, functional group classification and isomerism, common reaction mechanisms and structure elucidation methods, and reactions and synthesis of hydrocarbons and halogenated hydrocarbons. Laboratory work will include simple organic synthetic reactions, purification and identification of organic compounds with emphasis on the use of instrumentation. 3 hours lecture, 3 hours laboratory. Offered each fall.

Prerequisite(s): CH114.

**CH224 Organic Chemistry II (4.0 Credits)**

Building on the introduction to the chemistry of carbon compounds (CH223), this course focuses on the spectroscopic structure elucidation methods (mass spectrometry, UV-VIS, IR, and NMR spectroscopy) and reactions and synthesis of aromatic compounds, oxygenated and nitrogenous compounds and natural product chemistry. Laboratory work will include organic synthesis and isolation of a natural product, with emphasis on the use of instrumentation (GC-MS, UV-VIS, and IR). 3 hours lecture, 3 hours laboratory. Offered each spring.

Prerequisite(s): CH223.

**CH241 Quant. Analysis (4.0 Credits)**

Applications of the principles of chemical equilibrium to the theory and techniques of titrimetric, gravimetric and electrogravimetric procedures. Discussion of sample preparation, method validation and emphasis on statistical treatment of data with the application of spreadsheets for data manipulation and presentation. 3 hours lecture, 4 hours laboratory.

Prerequisite(s): CH114.

**CH304 Chemical Literature (2.0 Credits)**

Introduction to the sources of retrospective and current chemical information (i.e., primary peer reviewed literature, handbooks, abstracts, reviews, monographs, and compendiums), with emphasis on the techniques of retrieval and evaluation of this information using on-line databases (SciFinder, Science Direct), and the Internet. Preparation of scientific papers, literature reviews and literary techniques. 2 hours lecture. Usually offered online.

Prerequisite(s): CH224.

**CH311 Biochemistry I (4.0 Credits)**

The first course of a two semester sequence (CH311, CH312), this course provides an introduction to the chemistry of macromolecules in biological systems including the structure and function of proteins, carbohydrates, lipids, and nucleic acids; catalytic and regulatory strategies of enzymes, membrane structure, and signal transduction. 3 hours lecture, 3 hours laboratory. Offered each fall. This course is cross-listed with BI437.

Prerequisite(s): CH224.

**CH312 Biochemistry II (4.0 Credits)**

Building on the introduction to the chemistry of biological macromolecules (CH311), this course focuses on the metabolism of carbohydrates (including glycolysis, gluconeogenesis, pentose phosphate pathway, glycogen synthesis and degradation, the citric acid cycle, and oxidative phosphorylation), lipids, amino acids and nucleic acids, and Gene replication and expression: DNA structure, replication and repair; RNA synthesis and splicing; control of gene expression in prokaryotes and eukaryotes. 3 hours lecture, 3 hours laboratory. Offered each spring. This course is cross-listed with BI438.

Prerequisite(s): CH311.

**CH331 Quantum Chemistry (4.0 Credits)**

Principles of quantum chemistry including the following topics: quantum approaches to atomic and molecular structure, symmetry adopted linear combinations of molecular orbitals, semi-empirical *ab initio* methods, rotational, vibrational, and electronic and magnetic resonance spectroscopies and photochemistry. 3 hours lecture, 3 hours laboratory, 1 hour recitation.

Prerequisite(s): CH224, PH122, and MA116.

**CH332 Reaction Dynamics (4.0 Credits)**

Principles of physical chemistry including thermodynamics and chemical equilibrium and reaction kinetics and electrochemistry. 3 hours lecture, 3 hours laboratory, 1 hour recitation.

Prerequisite(s): CH224, CH241, and MA116.

Pre/corequisite(s): PH122.

**CH334 Inorganic Chemistry (4.0 Credits)**

In depth study of atomic theory and the periodic table, main group and transition elements, molecular structure and bonding models, states of matter, solution chemistry, acids and bases, equilibrium, kinetics, coordination and organometallic chemistry, Group Theory and spectroscopy. Laboratory experience includes synthesis and characterization of inorganic compounds. 3 hours lecture, 4 hours laboratory.

Pre/corequisite(s): CH223.

**CH345 Externship Program (1.0 Credits)**

Provides the students with an industrial or advanced academic research experience. Students present research findings at an industrial or academic seminar on-site and give a written report to the department. 1–4 credits depending on the duration of the experience.

Prerequisite(s): Junior or senior status.

**CH350 Research in Chemistry/Biochemistry I (2.0 Credits)**

Provides the students an opportunity to participate in an independent research project under the guidance of a professor (5 hours a week; hours to be arranged with the professor). A technical paper covering the existing literature on the topic of research and results of the investigation has to be submitted. Assessment for this course is pass/fail. This course is open to junior and senior chemistry and biochemistry majors. Students majoring in chemistry or biochemistry who are in the University Honors Program may choose independent research work with a professor (Honors Program coursework by contract, CH350H, 8 hours/week) and will receive a letter grade for the course. The course contract must be prepared with the professor and approved by the Honors Program director prior to starting the research work.

**CH402 Instrumental Analysis (4.0 Credits)**

Theoretical principles and practical aspects of spectral, electrochemical, chromatographic, colligative and nuclear instrumentation. Discusses physical and chemical properties of matter that make measurement possible. Laboratory experiences designed to familiarize the student with the modern instruments and techniques used in chemistry today. 3 hours lecture, 4 hours laboratory.

Prerequisite(s): CH241.

Pre/corequisite(s): CH332.

**CH416 Topics in Chemistry/Biochemistry (3.0 Credits)**

Topics will vary according to the area of specialization of the professor teaching the course and the interest of the students. A student may earn no more than 6 credits of CH416.

Prerequisite(s): CH312 or CH332 or permission of the chairperson.

**CH420 Chemistry/Biochemistry Seminar (1.0 Credits)**

This course is a capstone experience for majors in chemistry or biochemistry that requires the students to unify the knowledge and skills learned in all other courses. The course instruction focuses on planning, obtaining and organizing technical information from primary and secondary journals to develop a review article on a chosen topic. Skills needed to be an effective speaker will also be discussed. The students will prepare a technical review article on a current topic and present a seminar on this topic to the faculty and students of the department. 1 hour lecture.

Pre/corequisite(s): CH332.

**CH449 Research in Chemistry/Biochemistry II (2.0 Credits)**

Provides the students an opportunity to participate in an independent research project under the guidance of a professor (5 hours a week; hours to be arranged with the professor). A technical paper covering the existing literature on the topic of research and results of the investigation has to be submitted. Assessment for this course is pass/fail. This course is open to junior and senior chemistry and biochemistry majors. Students majoring in chemistry or biochemistry who are in the University Honors Program may choose independent research work with a professor (Honors Program coursework by contract, CH449H, 8 hours/week) and will receive a letter grade for the course. The course contract must be prepared with the professor and approved by the Honors Program director prior to starting the research work.

Prerequisite(s): CH350.

**CH450 Research in Chemistry/Biochemistry III (2.0 Credits)**

Provides the students an opportunity to participate in an independent research project under the guidance of a professor (5 hours a week; hours to be arranged with the professor). A technical paper covering the existing literature on the topic of research and results of the investigation has to be submitted. Assessment for this course is pass/fail. This course is open to junior and senior chemistry and biochemistry majors. Students majoring in chemistry or biochemistry who are in the University Honors Program may choose independent research work with a professor (Honors Program coursework by contract, CH450H, 8 hours/week) and will receive a letter grade for the course. The course contract must be prepared with the professor and approved by the Honors Program director prior to starting the research work.

Prerequisite(s): CH449.

## Faculty

**Prasad S. Lakkaraju, Professor of Chemistry; Chair, Department of Chemistry and Biochemistry**

Ph.D., Indian Institute of Technology

B.Sc., Andhra University

**Eduard Bitto, Associate Professor of Biochemistry**

Ph.D., University of Illinois at Chicago

M.S., Charles University, Czech Republic

**Andrew J. Weber, Assistant Professor of Chemistry**

Ph.D., M.S., Seton Hall University

B.A., William Paterson College