

## Chemistry

*Faculty:* Bradley, Chair; Allison, Arvanitis, Billmers, Bradley, Dixon, Dumas, Falcone, Hirsh, Huang, Keller

Chemistry is the science concerning the control, properties, reactivity, and detection of atoms and molecules in the world around us. Just as chemistry contributes to our existence, culture, and our quality of life, the discipline of chemistry is a central science with new frontiers continually being explored, and new benefits resulting from them. As home of a central science, the department serves the entire student population in addition to chemistry majors, in a new state-of-the-art facility that is part of the TCNJ Science Complex. Consistent with the goals of TCNJ, the chemistry faculty members have substantial contact with each student. Faculty advisers meet regularly with students to assist in defining educational paths that will best allow the pursuit of career goals. Assistance is also available through a strong seminar program, which includes discussions of the roles and responsibilities of chemists in today's society.

Many TCNJ chemistry majors pursue advanced degrees in analytical, organic, inorganic, physical chemistry, or biochemistry graduate programs throughout the country. Graduates are also well-suited for entrance into dental, medical, and other professional schools. The program prepares students for pursuing careers in the rapidly changing chemical industry, teaching careers, and careers in state and national government laboratories. Students interested in pursuing a career in pharmaceutical sales and marketing can combine a major in chemistry (CHMA) with a minor in marketing. A forensic chemistry concentration is available as well, to further broaden the career options for graduates.

The department has a strong sense of community. It has a strong Student Chemist's Association (ACS Student Affiliates) and a chapter of the National Chemistry Honor Society, Gamma Sigma Epsilon. The chemistry department's degree program is accredited by the American Chemical Society. Students completing the chemistry major will receive a Bachelor of Science degree.

Transfer students are required to take a minimum of four course units of chemistry (courses numbered CHE 300 or above) for graduation as chemistry majors from The College of New Jersey.

Those students wishing an honors designation in chemistry may earn it by successfully completing a series of ACS examinations and a research project.

### Program Entrance, Retention, and Exit Standards

Every major program at the College has set standards for allowing students to remain in that program, to transfer within the College from one program to another, and to graduate from a program. The following are the standards for chemistry programs. Minimum grades are noted in parentheses:

- Retention in the program is based on the following performance standards in these "critical content courses": CHE 201 and 202/General Chemistry I and II (C); CHE 331/Organic Chemistry I (C).
- Transfer into the program from another program within the College is based upon the following performance standards in these "foundation courses": CHE 201/General Chemistry (C); MAT 127/Calculus A (C).
- Graduation requires a GPA of 2.0 in courses for the program.

## **The Forensic Chemistry Concentration (CFOR)—Program Description**

The forensic chemistry concentration builds on a complete BS degree in chemistry and currently is open only to majors in this department. Completion of the concentration leads to BS chemists who can still pursue a wide range of careers or graduate education, and who also have insights into chemical aspects of the field of forensic science.

To complete the forensic chemistry concentration, students must complete the following program in addition to all requirements for the BS in chemistry program: 1) two criminology and justice studies courses (200 and 415, or 201 and 415); 2) a research experience or internship in a related area; and 3) two forensic chemistry courses, one of which must be CHE 360, the other may be either Forensic Applications of Mass Spectrometry or Forensic Methods and Applications for Biomolecule Analysis. All three courses will have a laboratory component. In addition, students completing the concentration are strongly encouraged to attend a meeting in a related area such as the American Academy of Forensic Sciences Annual Meeting.

To enroll in the program, students should identify chemistry (CHMA) as their major and the forensic chemistry concentration (CFOR) as their second major/concentration.

## **Chemistry Teaching (CHMT)**

An overview of the entire secondary-level teacher preparation sequence for students can be found in the section of this bulletin for the Department of Education Administration and Secondary Education.

The CHMT student will earn ACS accreditation as well as a teaching degree. Students planning to teach middle or high school chemistry should consult with their advisor in planning their academic program. These plans should take into account requirements for: the major, liberal learning, professional courses, and state certification. To be retained in the program, a student must earn at least a 2.5 cumulative grade point average (CGPA) before enrolling in the junior year education sequence. The student must also establish a minimum 2.75 CGPA before he/she is allowed to student teach (CHE 490). A student wishing to obtain Physical Science Certification must replace one of the CHE Advanced Electives with an Advanced Physics course, and take a second Advanced Physics course.

Candidates for a teacher-education certificate must have a 2.75 or higher cumulative grade point average to successfully complete their teacher education program. They also must meet the state hygiene/physiology requirement, and pass the appropriate Praxis examination before the New Jersey State Department of Education will issue the appropriate certificate. Teacher-education candidates will receive a “certificate of eligibility with advanced standing” which requires a candidate to be provisionally certified for his or her first year of teaching. After one year of successful teaching, the candidate is eligible for a permanent certificate. The teacher-education candidate also will have to pay a fee during his or her first year of teaching.

## **Pre-Health Profession Option for Chemistry Majors**

Students interested in health-related careers such as medicine, dentistry, pharmacy, etc. may study for admission to these professional schools through the chemistry major CHMA. Careful selection of courses within this major and within free electives will prepare the student to meet health professional school admission requirements. (See also Medical Career Advisory Committee.)

## **Elementary Education M/S/T (ELST) or Early Childhood Education M/S/T (ECST) or Deaf and Hard of Hearing M/S/T (DHST) with a Chemistry Specialization**

This interdisciplinary major integrates formal study in mathematics, science, and technology and consists of a common “core” with a “specialization” in one of the M/S/T disciplines. Students electing a Chemistry Specialization will complete 10 units of common core requirements including MAT 127, 128/Calculus A, B, CHE 201/General Chemistry I, CHE 202/General Chemistry II, one approved non-chemistry science course, TST 171/Fundamentals of Technology, TST 181/Principles of Structures and Mechanisms, TED 460/Integrated M/S/T for the Child/Adolescent Learner, and two M/S/T approved electives. The Chemistry Specialization consists of a minimum of three additional units including CHE 321/Organic Chemistry I, CHE 322/Organic Chemistry II and a chemistry elective at the 300 level or above. See the M/S/T academic program coordinator for general advisement.

### **Chemistry Minor**

A minor in chemistry is comprised of five full courses in CHE courses including CHE 202 (or Honors CHE 202) and four other CHE courses numbered 300 or higher, but not including CHE 316, 317, 318, 340, 393, 399, 489, 490.

### **Chemistry Major (CHMA)**

CHE 201, 202/General Chemistry I, II	2 course units
CHE 310/Analytical Chemistry	1 course unit
CHE 331, 332/Organic Chemistry I, II	2 course units
CHE 371/Quantum Chemistry	1 course unit
CHE 372/Chemical Thermodynamics	1 course unit
CHE 410/Instrumental Analysis	1 course unit
CHE 430/Biochemistry	1 course unit
CHE 451/Inorganic Chemistry—Structure and Bonding	1 course unit
CHE 452/Inorganic Chemistry—Reactions and Mechanisms	1 course unit
Two chemistry option courses (by advisement)	2 course units
CHE 099, 316, 317, 318/Chemistry Seminars	0 course unit
<b>Total major courses</b>	<b>13 course units</b>

MAT 127, 128/Calculus A, B	2 course units
PHY 201, 202/Physics I, II	2 course units
<b>Total required correlate courses</b>	<b>4 course units</b>

### **First-Year Suggested Sequence**

#### **Fall Semester**

FSP First Seminar  
CHE 099/Orientation to Chemistry  
CHE 201/General Chemistry I  
PHY 201/General Physics I  
MAT 127/Calculus A

#### **Spring Semester**

CHE 202/General Chemistry II  
PHY 202/General Physics II

WRI 102/Academic Writing (if not exempted)\*  
MAT 128/Calculus B

*\*It is recommended that students exempted from this course take another liberal learning course.*

### **Chemistry Major-Teaching (CHMT)**

CHE 201, 202/General Chemistry I, II	2 course units
CHE 310/Analytical Chemistry	1 course unit
CHE 331, 332/Organic Chemistry I, II	2 course units
CHE 371/Quantum Chemistry	1 course unit
CHE 372/Chemical Thermodynamics	1 course unit
CHE 410/Instrumental Analysis	1 course unit
CHE 430/Biochemistry	1 course unit
CHE 451/Inorganic Chemistry—Structure and Bonding	1 course unit
CHE 452/Inorganic Chemistry—Reactions and Mechanisms	1 course unit
*Two CHE Advanced Electives (by advisement)	2 course units
CHE 099, 316, 317, 318/Chemistry Seminars	0 course unit
<b>Total major courses</b>	<b>13 course units</b>

*\*Students who wish to obtain Physical Science Certification must replace one of the CHE Advanced Electives with an Advanced Physics course, and take a second Advanced Physics course*

MAT 127, 128/Calculus A, B	2 course units
PHY 201, 202/Physics I, II	2 course units
<b>Total required correlate courses</b>	<b>4 course units</b>

### **Professional Education Sequence**

SED 224/Adolescent Learning and Development	1 course unit
EFN 298/School and Communities	1 course unit
SED 399/Pedagogy in Secondary Schools	1 course unit
PHY 390/Methods of Teaching Science	1 course unit
SPE 323/Secondary Content Literacy in Inclusive Classrooms	1 course unit
EFN 398/Historical and Political Context of Schools	1 course unit
BIO 490/Student Teaching	2 course units
SED 498/Collaborative Capstone for Professional Inquiry	1 course unit

**Total required professional education courses 9 course units**

**First-Year Suggested Sequence—same as for the Chemistry Major (CHMA) above**

### **Courses**

**CHE 099/Orientation to Chemistry 0 course unit**  
(annually)

Required of all entering chemistry majors, this course provides an orientation to The College of New Jersey community; to chemistry faculty; and to the chemistry liberal arts and chemistry education programs offered by the Department of Chemistry including, among other topics, advisement opportunities, curriculum and scheduling, laboratory safety procedures, facilities, introduction to the library, professional societies and student affiliates, career options, and the

American Chemical Society Code of Ethics. The academic component, involving common readings and assignments, is part of the course requirements. Grade is P/U and course is required for graduation.

**CHE 201, 202/General Chemistry I, II** **2 course units**  
(with laboratory)  
(every semester)

*Prerequisite:* Completion of College Basic Skills requirements

Laws and theories of matter in its various states: atomic and molecular structure from quantum and orbital interpretations; kinetics and equilibrium; periodicity and properties. Quantitative experiments coordinated with lectures. A working knowledge of elementary algebra is required. Successful completion of a high school chemistry course is strongly recommended.

**CHE 310/Analytical Chemistry** **1 course unit**  
(with laboratory)  
(annually)

*Prerequisite:* CHE 202

A study of quantitative analysis including analytical data treatment, equilibrium calculations, volumetric determinations, and electrochemical analysis.

**CHE 316/Sophomore Chemistry Seminar** **0 course unit**  
(annually)

*Prerequisite:* CHE 099

A seminar course designed for sophomore chemistry majors. Included in this course are an introduction to scientific word processing, molecular-modeling programs, and other software computer programs needed by the chemist. Other topics include use of the chemical literature such as *Chemical Abstracts* and the library computer search program *SciFinder Scholar*. Professionalism and ethics, resumes, cover letters, and internship opportunities will also be discussed. Grade is P/U and course is required for graduation.

**CHE 317/Junior Chemistry Seminar** **0 course unit**  
(annually)

*Prerequisite:* CHE 316

Designed to explore career options within the field of chemistry. Topics include graduate school applications and opportunities, internships, departmental research, and career presentations. A final oral and written research project is also required. Grade is P/U and course is required for graduation.

**CHE 318/Senior Chemistry Seminar** **0 course unit**  
(annually)

*Prerequisite:* CHE 317

A course designed for senior chemistry majors. Oral and written papers will be presented on current chemical literature and each student will be required to develop, present, and defend an original research proposal to the class. Grade is P/U and course is required for graduation.

**CHE 321, 322/Organic Chemistry for Non-Majors I, II** **2 course units**  
(with laboratory)  
(annually)

*Restriction:* Not open to chemistry majors

*Prerequisite:* CHE 202

Coverage in lectures is similar to that in CHE 331, 332 but laboratory meetings are designed in

accordance with the needs of students majoring in biology.

**CHE 331, 332/Organic Chemistry I, II**

**2 course units**

(with laboratory)

(annually)

*Restriction:* Required for chemistry majors, open to others on space available basis

*Prerequisite:* CHE 202

The chemistry of organic compounds with emphasis on reaction mechanisms is presented. Topics include theory and descriptive material on aliphatic, alicyclic, aromatic, and heterocyclic compounds.

**CHE 340/History of Chemistry and Physics**

**1 course unit**

(annually)

*Prerequisite:* One year of a college science (admission without prerequisite by permission of instructor only)

The principles of chemistry and physics and the interaction of chemistry, physics, and society from earliest times through modern times and into the future are studied. The work of selected chemists, physicists, the evolution of energy, mechanics, atomic structure, and other modern theories, the development of various chemical industries, the importance of environmental concerns, and other currently important subjects are examined.

**CHE 350/Essentials of Biochemistry**

**1 course unit**

(annually)

*Restriction:* Not open to chemistry majors

*Prerequisites:* BIO 211, CHE 332, 322

A one-semester lecture course covering amino acids and proteins, intermediary metabolism, lipids, carbohydrates, and the biochemistry of nucleotides, DNA, and RNA. Designed for science majors with no background in physical chemistry.

**CHE 360/Forensic Chemistry**

**1 course unit**

(with laboratory)

(annually)

*Prerequisite:* CHE 371 or permission of the instructor

This course approaches the challenges, methods, and analyses of forensic science from a fundamental, chemical perspective. Topics include drug analysis, arson investigation, questioned document analysis, and the analysis of paint and gunshot residue samples.

**CHE 371/Quantum Chemistry**

**1 course unit**

(annually)

*Prerequisites:* CHE 331 or HON 321, MAT 128, PHY 202

A study of quantum mechanics as it applies to atoms and molecules, chemical bonding and spectroscopy.

**CHE 372/Chemical Thermodynamics**

**1 course unit**

(annually)

*Prerequisites:* CHE 331 or HON 321, MAT 128, PHY 202

A study of thermodynamics, kinetics, statistical mechanics, and other areas fundamental to an understanding of the physical behavior of matter.

**CHE 393/Independent Research I** **1 course unit**  
(every semester)

*Prerequisites:* CHE 332 or 322, CHE 371, and permission of the instructor

This course is designed as a first semester research experience for students who are majoring in chemistry, and focuses on mentored undergraduate research under close supervision of a faculty member.

**CHE 399/Internship in Chemistry** **variable course units**  
(every semester)

*Prerequisite:* Permission of department chair

This arrangement provides an opportunity for practical field experience. See department chairperson for further information.

**CHE 410/Instrumental Analysis** **1 course unit**  
(with laboratory)

(annually)

*Prerequisites:* CHE 310, 371

A study of principles, applications, and operations of chemical instrumentation.

**CHE 430/Biochemistry** **1 course unit**  
(with laboratory)

(annually)

*Prerequisites:* CHE 332 or 322, CHE 372

The fundamental principles of chemistry as they apply to biological and physiological processes. Designed for chemistry majors.

**CHE 451/Inorganic Chemistry—Structure and Bonding** **1 course unit**  
(annually)

*Prerequisites:* CHE 372 or CHE 371 and permission of the instructor.

A study of inorganic chemistry exploring modern concepts of structure and bonding with considerable emphasis placed on computer-aided molecular modeling, crystallography and spectroscopy (UV and IR).

**CHE 452/Inorganic Chemistry—Reactions and Mechanisms** **1 course unit**  
(annually)

*Prerequisites:* CHE 451

A study of inorganic chemistry exploring modern concepts of synthesis and reactivity with focus placed on reaction mechanism and the role of inorganic complexes in chemical catalysis. Analysis of mechanism by spectroscopic techniques is incorporated.

**CHE 457/Organometallic Chemistry Laboratory** **1 course unit**  
(with laboratory)

(alternate years)

*Prerequisites:* CHE 371, 372, 450

A study of modern concepts of structure and bonding in organotransition metal chemistry emphasizing synthetic methods, catalysis, and reaction mechanisms.

**CHE 493/Independent Research II** **1 course unit**  
(every semester)

*Prerequisites:* CHE 393 and permission of instructor

This course is for students who plan to continue undergraduate research under close supervision of a faculty member. CHE 493 may be repeated for credit for those students who desire to do more than two semesters of mentored undergraduate research.