

## Chemistry-1

### Chemistry

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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, well-equipped, 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 advisors 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. Additionally, students have the opportunity to participate in research programs with faculty members in each sub-discipline of chemistry.

Many TCNJ chemistry majors pursue advanced degrees in analytical, organic, inorganic, physical chemistry, or biochemistry at leading 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 chemistry 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 to earn an honors designation in chemistry may do so 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.

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### **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 the 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 being eligible for teaching certification. 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.

Teacher education candidates 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.

### **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.)

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### **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**

The M/S/T interdisciplinary major integrates formal study in mathematics, science, and technology to gain a better understanding of the human-designed world in which we all live. The major consists of nine units of courses drawn from a common “core”, one approved M/S/T elective, and a four-unit “specialization” in one of the M/S/T disciplines. Students in the major receive careful course selection advisement so that they qualify for a middle school endorsement in one of the M/S/T disciplines. **All majors must see the M/S/T academic program coordinator for general advisement.**

Students electing a Chemistry Specialization within the MST major will complete MAT 127/128 Calculus A/B, CHE 201/202 General Chemistry I/II, one approved non-chemistry science course, ETE 261/Multimedia Design, ETE 271/Structures and Mechanics, MAT 105/Mathematical Structures and Algorithms for Educators I, TED 460/Integrated M/S/T for the Child/Adolescent Learner, and one M/S/T approved elective. The Chemistry Specialization consists of CHE 331/332 Organic Chemistry I/II, a chemistry elective at the 300 level or above, and an approved elective supporting middle school endorsement.

### **M/S/T Suggested First Year Course Sequence**

FSP	First Seminar	1 course unit
MAT	127/Calculus A	1 course unit
TST	161/Creative Design	1 course unit
ETE	261/Multimedia Design	1 course unit
	Science Option #1 (by advisement)	1 course unit
	Math or Science Option (by advisement)	1 course unit
MAT	105/Mathematical Structures and Algorithms for Education I	1 course unit
WRI	102/Academic Writing (if not exempt)*	1 course unit

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

**Total for year** **8 course units**

### **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, 393, 399, 490.

Minimum grade point average for retention and completion for the minor is the same as for the major.

### **Study Abroad**

Students pursuing a degree in Chemistry have the option to study abroad for a semester. Any student interested in studying abroad should meet with his/her faculty advisor before the sophomore year in order to plan a curriculum so that the student may complete his/her studies in four years. An appointment with the college's [Office of International and Off-Campus Programs](#) is also required. The student must receive approval from the chair of chemistry in order for courses taken abroad to count toward requirements for the major.

### **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

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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 units

*\*two semesters of CHE 493 can replace one chemistry option course.*

**Total major courses 13 course units**

MAT 127, 128/Calculus A, B	2 course units
PHY 201, 202/Physics I, II	2 course units

**Total required correlate courses 4 course units**

## 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 units

**Total major courses 13 course units**

*\*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

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**Total required correlate courses**

**4 course units**

### Professional Education Sequence

SED	224/Adolescent Learning and Development	1 course unit
EFN	299/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
CHE	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 units**

(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)

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.

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### **CHE 316/Sophomore Chemistry Seminar**

**0 course units**

(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 units**

(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 units**

(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 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 350/Essentials of Biochemistry**

**1 course unit**

(annually)

*Restriction:* Not open to chemistry majors

*Prerequisites:* BIO 211, CHE 332

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.

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**CHE 370 Selected Topics in Chemistry** **1 course unit**

(3 class hours, or 3 class hours and 3 lab hours, or 2 class hours and 4 lab hours)  
(occasionally)

*Prerequisite:* Approval of department chair

Selected topics of current relevance and interest in chemistry will be presented by faculty and guest lecturers with special areas of competency. Topics will be announced in advance.

**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, 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, 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

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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 470/Selected Topics in Chemistry** **1 course unit**

(3 class hours, or 3 class hours and 3 lab hours, or 2 class hours and 4 lab hours)

(occasionally)

*Prerequisite:* Approval of department chair

Selected topics of current relevance and interest in chemistry will be presented by faculty and guest lecturers with special areas of competency. Topics will be announced in advance.

**CHE 471/Forensic Applications of Mass Spectrometry** **1 course unit**

(3 class hours and 3 lab hours)

(alternate years)

*Prerequisite:* CHE 372

This course discusses mass spectrometry instrumentation, and the interpretation of mass spectra obtained using GC/MS, using forensic applications and examples such as arson investigations and drug analyses.

**CHE 472/Forensic Chemistry II** **1 course unit**

(3 class hours and 3 lab hours)

(alternate years)

*Prerequisite:* CHE 372

This course investigates the chemical basis for forensic presumptive tests, and challenges students to create new chemical tests for the forensic community. It also discusses forensic applications of DNA analysis.

**CHE 490/Student Teaching Chemistry** **two course units**

(every semester)

*Prerequisite:* Meeting all criteria for admission to student teaching

Student teaching during the senior year. Teaching is conducted in approved public schools, and supervised and observed by college and public school teachers. Students learn through observation and participation in the classroom, and through responsible teaching.



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### **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. One semester of CHE 493 may be used to satisfy a writing intensive requirement; CHE 493 may be repeated for credit for those students who desire to do more than two semesters of mentored undergraduate research.