Programs of the Department

The Department of Chemistry offers the following curricular options:

- Major in Chemistry
- Major in Chemistry - Professional Track
- American Chemical Society accredited major in Chemistry
- Major in Forensic Chemistry (General Track, Trace Evidence/Drug Analysis Track, or DNA track)
- Chemistry Secondary Education Concentration for students planning to teach chemistry at the secondary level
- Minor in Chemistry
- Biochemistry Concentration through Molecular Biology, Biochemistry and Bioinformatics Program
- Environmental Chemistry Track in Environmental Science and Studies Program
- Master of Science in Forensic Science

The Chemistry major provides a strong background in all major areas of chemistry: physical chemistry, inorganic chemistry, organic chemistry, biochemistry, analytical chemistry, and instrumental analysis. Students may concentrate in one or more of the above areas by taking advanced courses in areas of specific interest. Students are required to learn to use instruments commonly encountered in chemistry laboratories. Small classes are prevalent in all chemistry courses and students are taught by faculty in both lecture and laboratory. Special topics courses are offered periodically to provide students the opportunity to broaden their background in chemistry.

Chemistry majors are prepared to pursue many different careers after graduation, including graduate study in chemistry and related areas, employment in government or industry, professional school (e.g., medicine, dentistry, pharmacy, law, library science), or secondary school teaching. Other employment opportunities are available to Chemistry majors, including those in water pollution, forensic chemistry, environmental chemistry, molecular biology, research and development, quality assurance and genetic engineering.

Departmental Honors Option

The Department of Chemistry, under the direction of the Towson University Honors College, offers a Departmental Honors option for students who demonstrate exemplary abilities in their discipline. Students in this option will work closely with faculty mentors in an individual program of research, directed readings, independent study and seminar. Departmental honors will be posted to the transcript shortly after the bachelor’s degree is conferred.

Criteria for Admission into the Departmental Honors Option

1. Major in Chemistry or Forensic Chemistry.
2. Completion of at least 60 units of courses.
3. Overall cumulative GPA of 3.25 or above and a 3.50 or above cumulative average in major course requirements. Students below this threshold may appeal to the Departmental Honors Committee.

Interested students should contact the Department Honors Coordinator (Dr. John Sivey, jsivey@towson.edu) to find out the procedure for applying to this program.

ACS Certification

Certification of a student’s chemistry degree from the American Chemical Society (ACS) is widely recognized throughout industry, government and education as a standard of excellence. Students with a good academic record are encouraged to pursue this option. Students electing the Professional Track may obtain ACS certification of their degrees provided they submit a comprehensive written report on their research (CHEM 491). Students who have taken PHYS 211-PHYS 212 may count these courses for ACS certification provided that an additional advanced physics lecture course is taken, subject to prior approval by the Department of Chemistry.

Environmental Chemistry Track in Environmental Science and Studies Program

Students may pursue the Environmental Chemistry Track of the Environmental Science and Studies Program that is described in a later section in the College of Science and Mathematics.

Transfer Credit Policy

Students who transfer to TU from a regionally accredited two-year college with an A.A. degree should have completed two terms of general chemistry with lab, two terms of organic chemistry with lab, one term of calculus, and two terms of general physics. Students who transfer from a two-year college without an A.A. degree should complete as many of the above-mentioned chemistry, physics, and mathematics courses as possible. Transfer students should consult the Department of Chemistry concerning the transferability of chemistry courses and this catalog for TU transfer policies.

Advanced Placement and Credit for Prior Learning

The Department of Chemistry awards credit for General Chemistry through the Advanced Placement Examinations given by the Educational Testing Service.

Students may also receive credit for General Chemistry by taking the Credit for Prior Learning Examination, which is administered through the Registrar’s Office. Students may also receive credit for other chemistry courses by passing the appropriate examinations. Further information may be obtained from the department.

Advanced Composition Course

The Department of Chemistry offers CHEM 301 Professional Ethics for Scientists, which is a course that deals with professional ethics in the physical sciences and fulfills the requirements for the advanced writing course.
Core Curriculum Courses

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<td>CHEM 131L</td>
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<td>CHEM 132L</td>
<td>GENERAL CHEMISTRY II LABORATORY</td>
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1 These two-term lecture-laboratory sequences meet the Core 8 requirement.

Departmental Activities and Awards

Many Chemistry majors actively participate in the Student Affiliates of the American Chemical Society (ACS), a student group supported by the department under the auspices of the ACS. This organization permits students to join the national organization and to obtain certain chemistry publications and services at reduced rates.

Student awards are given annually for outstanding work in chemistry courses. These include:

- CRC Press Freshman Chemistry Achievement Award
- Achievement Award in Organic Chemistry
- ACS Achievement in Organic Chemistry Award (joint Polymer-Education Committee)
- Analytical Division (ACS) Award in Analytical Chemistry
- Floyd A. Blankenship Award in Physical Chemistry
- American Institute of Chemists Outstanding Senior Award
- ACS Outstanding Student Award
- Dr. Frank R. Milio Book Endowment
- Linda Sweeting Endowment for Undergraduate Research in Science
- Alan and Eileen Wingrove Endowment for Chemistry Scholars
- Raspet Summer Research Fellowship.

- Major in Chemistry
- Major in Chemistry - Professional Track
- Major in Chemistry - Secondary Education Concentration
- Major in Forensic Chemistry
- Minor in Chemistry

Faculty

Professors: Ryan Casey (Chairperson), Ellen Hondrogiannis, Clare Muhoro, David Owlbry

Associate Professors: Mary Devadas, Kelly Elkins, Kathryn Kautzman, Shuhua Ma, Sonali Raje, Keith Reber, John Sivey (Graduate Program Director), Ana-Maria Soto, Shannon Stitzel (Assistant Chair), Cynthia Zeller

Assistant Professors: Stephen Hancock, Sarah Stokes, Anthony Tierno, Khanh-Hoa Tran-Ba

Lecturers: Katharine Bowdy, Joseph Bushey, Nicole Carbonaro, Dimitra Douskas, Daniel Macks, Henderika van Huizen

Clinical Assistant Professor: Courtney Thomas

Graduate Programs

The Master of Science in Forensic Science program is a molecular biochemistry based program focusing on forensic DNA analysis rich with laboratory experience, capped with a research program, internship in a forensic laboratory or thesis. The program is intended for students who are interested in working as forensic scientists in the discipline of forensic body fluid analysis. Detailed information regarding the program is given in the Graduate Catalog.
CHEM 103 FOUNDATIONS OF CHEMISTRY (3)
Development of reasoning and quantitative skills for problem solving. Introduction to atomic structure, chemical reactions, chemical nomenclature, formulas, symbols and equations, basic skills of laboratory work. Three lecture hours. Not for credit toward Chemistry major or minor. Does not satisfy University Core requirement. S/U grading.

CHEM 104 INTRODUCTION TO ENVIRONMENTAL CHEMISTRY (4)
Principles of chemistry that are relevant to environmental issues, including water quality, nutrient pollution, air pollution, and specific classes of environmental contaminants. Three lecture hours and three laboratory hours. Prerequisite: three years of high school mathematics. Core: Biological & Physical Sciences. Lab/Class fee will be assessed.

CHEM 111 HONORS CHEMISTRY FOR ALLIED HEALTH PROFESSIONS I (4)
An introduction to the concepts of general chemistry, including states of matter, atomic structure and periodic table, molecular structure, chemical reactions, intermolecular forces, solutions, buffers and pH and radio activity. Laboratory includes data handling and chemical and instrumental techniques. May not be used as a prerequisite for the Chemistry major program. Three lecture hours and one three hour laboratory. Prerequisite: MATH 115 or MATH 119 (either may be taken concurrently). Must be admitted to the Honors College. Students who have successfully completed the non-honors version of this course will not receive additional credit for this course.

CHEM 112 HONORS CHEMISTRY AND CURRENT PROBLEMS (3)
Discussion of a selected aspect of chemistry and its applications to technology, environment and society. Topics will vary. Three lecture-demonstration hours. Prerequisites: high school chemistry recommended. Honors College. Students who have successfully completed the non-honors version of this course will not receive additional credit for this course.

CHEM 115 HONORS CHEMISTRY FOR ALLIED HEALTH PROFESSIONS II (4)
An introduction to atomic structure, chemical reactions, chemical properties of liquids, solids and solutions, kinetics, equilibrium, acids, bases and buffers, chemical equilibrium, reaction energies and rates. Not open to those who successfully completed CHEM 105/ CHEM 115. CHEM 121 is a quantitative course and students are expected to be proficient in algebraic manipulations, exponentials, logarithms and graphical interpretation. Corequisite: CHEM 121L. Core: Biological & Physical Sciences. Lab/Class fee will be assessed.

CHEM 121 ALLIED HEALTH CHEMISTRY I LECTURE (3)
Atomic and molecular structure, stoichiometry, chemical reactions, states of matter, solutions, intermolecular forces, acids, bases and buffers, chemical equilibrium, reaction energies and rates. Not open to those who successfully completed CHEM 105/ CHEM 115. CHEM 121 is a quantitative course and students are expected to be proficient in algebraic manipulations, exponentials, logarithms and graphical interpretation. Corequisite: CHEM 121L. Core: Biological and Physical Sciences.

CHEM 121L ALLIED HEALTH CHEMISTRY I LABORATORY (1)
Laboratory experiments to support concepts of Allied Health Chemistry I Lecture. Not open to those who successfully completed CHEM 105/ CHEM 115. Corequisite: CHEM 121. Core: Biological and Physical Sciences. Lab/class fee will be assessed.

CHEM 131 GENERAL CHEMISTRY I LECTURE (3)
Atomic and molecular structure; theories of bonding, stoichiometry; chemical reactions; gases; solutions. Open to science/math majors/ minors only. Not open to those who successfully completed CHEM 110. CHEM 131 is a quantitative course and students are expected to be proficient in algebraic manipulations and graphical interpretation. Corequisite: CHEM 131L. Core: Biological & Physical Sciences. Lab/Class fee will be assessed.

CHEM 131L GENERAL CHEMISTRY I LABORATORY (1)
Laboratory experiments to support concepts of General Chemistry I Lecture. Not open to those who successfully completed CHEM 110. Corequisite: CHEM 131. Core: Biological & Physical Sciences. Lab/class fee will be assessed.

CHEM 132 GENERAL CHEMISTRY II LECTURE (3)
Physical properties of liquids, solids and solutions, kinetics, equilibrium, acids and bases, chemical thermodynamics and electrochemistry. Not open to those who successfully completed CHEM 111. CHEM 132 is a quantitative course and students are expected to be proficient in algebraic manipulations, exponentials, logarithms and graphical interpretation. Corequisite: CHEM 132L. Prerequisites: CHEM 131 & CHEM 131L. Core: Biological & Physical Sciences.

CHEM 132L GENERAL CHEMISTRY II LABORATORY (1)
Laboratory experiments to support concepts of General Chemistry II Lecture. Not open to those who successfully completed CHEM 111. Corequisite: CHEM 132. Core: Biological & Physical Sciences. Lab/class fee will be assessed.

CHEM 220 ANALYTICAL CHEMISTRY [Lecture] (3)
Theory and practice of statistical analysis, equilibrium and polyprotic acid/base chemistry, titrometry, chromatography, electrochemistry, and spectrophotometry. Students who have successfully completed CHEM 210 will not receive additional credit for CHEM 220. Corequisite: CHEM 220L. Prerequisites: CHEM 132 and CHEM 132L.

CHEM 220L ANALYTICAL CHEMISTRY [Lab] (2)
Laboratory experiments to support concepts of analytical chemistry. One laboratory-lecture hour, and three hours of laboratory. Students who have successfully completed CHEM 210 will not receive additional credit for CHEM 220L. Corequisite: CHEM 220L. Prerequisites: CHEM 132 and CHEM 132L. Lab/Class fee will be assessed.

CHEM 301 PROFESSIONAL ETHICS FOR SCIENTISTS (3)
Integrity of scientific literature and the responsibilities of scientists to associates and the public. Discussion of principles and case studies emphasizing the physical sciences. Not open to those who have successfully completed WRIT 335, CHEM 335 or IDNM 305. Does not count toward Chemistry major or minor. Requires grade of C or better to fulfill Core requirement. Prerequisites: three courses in ASTR, BIOL, CHEM, ENV, GED, PHYS, or PHSC and at least two courses with laboratory; ENGL 102 or ENGL 190 or equivalent. Core: Advanced Writing Seminar.

CHEM 310 INSTRUMENTAL ANALYSIS (4)
Theory and practice of spectroscopic, chromatographic, and electrochemical instruments, their design and modification to solve practical problems. Three lecture hours and four laboratory hours. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210), and CHEM 330 or CHEM 331. Lab/Class fee will be assessed.

CHEM 323 INORGANIC CHEMISTRY (4)
Atomic Structure; Valence-bond, Molecular orbital, and crystal-field theories of bonding; structure and bonding in ionic and metallic solids; chemistry of main-group and transition-metal compounds; acid-base theories; organometallic compounds; syntheses and characterizations of main-group and transition-metal compounds. Three lecture hours and three laboratory hours. Students who have successfully completed CHEM 321 will not receive additional credit for CHEM 323. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210) and CHEM 331 or CHEM 330. Lab/Class fee will be assessed.
CHEM 330 ESSENTIALS OF ORGANIC CHEMISTRY (5)
A one-term survey course in organic chemistry for non-chemistry majors taught on a conceptual basis. Not part of a traditional two-term organic chemistry sequence. Emphasis will be on principles, mechanisms, and modern techniques. Laboratory will include synthesis and identification of organic compounds. Three lecture hours, one recitation hour, and one three-hour lab. Prerequisites: CHEM 132 and CHEM 132L. Lab/Class fee will be assessed.

CHEM 331 ORGANIC CHEMISTRY I (5)
Structure, stereochemistry, reactions and their mechanisms, preparation and properties of alkanes, alkenes, alkynes, alkyl halides and alcohols. Laboratory techniques include purification, spectroscopic (IR, NMR) and chromatographic (GLPC) methods of identification, and synthesis. Three lecture hours, one hour of laboratory lecture, and one three-hour lab. CHEM 331 and CHEM 332 comprise a traditional two-term organic chemistry sequence. Prerequisites: CHEM 132 and CHEM 132L. Lab/Class fee will be assessed.

CHEM 332 ORGANIC CHEMISTRY II (5)
Structure, reactions and their mechanisms, preparation and properties of alcohols, ethers, aldehydes, ketones, carboxylic acids and their derivatives, amines, carbohydrates, etc. Laboratory emphasizes synthetic techniques and modern qualitative organic analysis using chemical reactions and IR, UV, and NMR. Three lecture hours, one hour of laboratory lecture and one three-hour lab. CHEM 331 and CHEM 332 comprise a traditional two-term organic chemistry sequence. Prerequisite: CHEM 331. Lab/Class fee will be assessed.

CHEM 345 PRINCIPLES OF PHYSICAL CHEMISTRY (3)
Empirical derivations of the unifying physical principles of chemistry. Topics of particular interest include the principles of thermodynamics, chemical kinetics, quantum mechanics and spectroscopy, and their applications in chemical systems. Quantitative problem solving involving integral and differential calculus is emphasized. Prerequisites: CHEM 132 and CHEM 132L and (MATH 211 or MATH 273) and (PHYS 211 or PHYS 241).

CHEM 346 THEORETICAL FOUNDATIONS OF PHYSICAL CHEMISTRY (3)
Theoretical principles unifying the vast body of chemical observations. Extensive use of differential and integral calculus in developing mathematical models describing the behavior of chemical systems. Prerequisites: CHEM 345, MATH 274, PHYS 212 or PHYS 242.

CHEM 351 BIOCHEMISTRY I (3)
An overview of the chemistry of proteins, nucleic acids, carbohydrates, and lipids. Basic enzyme catalysis and kinetics, biochemical genetics, membrane structure, bioenergetics, and analytical methods. General principles of metabolism applied to several major pathways. Three lecture hours. Prerequisite: CHEM 330 or CHEM 332.

CHEM 356 BIOCHEMISTRY LAB (2)
Physical methods in biochemistry including spectrophotometry, centrifugation and ultra-centrifugation, electrophoresis, and chromatography. Isolation and purification of proteins and nucleic acids. Enzyme kinetics and the binding of small molecules to macromolecules. One lecture hour and three laboratory hours. Prerequisite: CHEM 351 (may be taken concurrently). Lab/Class fee will be assessed.

CHEM 357 BIOCHEMISTRY II (3)
Carbohydrate and lipid metabolism and their regulation, overview of amino acid and nucleotide metabolism, membrane structure and function, DNA-protein interactions and regulation of gene expression, and other topics in biochemistry. Prerequisite: CHEM 351.

CHEM 372 PHYSICAL CHEMISTRY LABORATORY (2)
Introductory experiments in physical chemistry involving thermodynamics, kinetics and spectroscopy to characterize properties of materials and chemical systems. Four laboratory-lecture hours. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210), and CHEM 345 (CHEM 345 may be taken concurrently). Lab/Class fee will be assessed.

CHEM 391 SPECIAL PROBLEMS IN CHEMISTRY I (1-3)
A laboratory or library problem in chemistry to be selected by the student in consultation with the instructor. Students are required to submit a written report. May be repeated for a maximum of 6 units provided a different topic is taken. Prerequisite: consent of the instructor.

CHEM 392 SPECIAL PROBLEMS IN CHEMISTRY II (1-3)
A laboratory or library problem in chemistry to be selected by the student in consultation with the instructor. Students are required to submit a written report. May be repeated for a maximum of 6 units. Prerequisite: consent of the instructor.

CHEM 393 SPECIAL PROBLEMS IN CHEMISTRY III (1-3)
A laboratory or library problem in chemistry to be selected by the student in consultation with the instructor. Students are required to submit a written report. May be repeated for a maximum of 6 units. Prerequisite: consent of the instructor.

CHEM 394 SPECIAL PROBLEMS IN CHEMISTRY IV (1-3)
A laboratory or library problem in chemistry to be selected by the student in consultation with the instructor. Students are required to submit a written report. May be repeated for a maximum of 6 units. Prerequisite: consent of the instructor.

CHEM 395 INTERNSHIP IN CHEMISTRY (3)
Students will be given credit in this cooperative education program for approved experience in chemistry or forensic chemistry in the private or public sector. A written report of their work will be submitted by students and evaluated by the Chemistry or Forensic Chemistry Faculty. May be repeated once for a maximum of 6 units. Graded S/U. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210) and CHEM 332, 3.0 GPA overall and junior class standing.

CHEM 401 COMMUNICATION SKILLS IN CHEMISTRY (1)
Effective scientific communication skills will be developed, culminating in student presentations to the Chemistry Department. Topics will be selected from chemical literature. Attendance at departmental seminars is required. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210), CHEM 332.

CHEM 461 ADVANCED LECTURE TOPICS (1-3)
Advanced studies in one of the major topics in chemistry. Content will depend on instructor. This course may be repeated for a maximum of 9 units with a different topic. Prerequisites: CHEM 345, CHEM 332 and consent of instructor.

CHEM 462 ADVANCED LABORATORY TECHNIQUES (1-2)
An advanced, focused laboratory in chemistry. Content will depend on the instructor. This course may be repeated for a maximum of 6 units as a laboratory experience with a different focus. Prerequisites: CHEM 332, CHEM 372 and consent of instructor. Lab/Class fee will be assessed.
CHEM 472 APPLICATIONS OF ENVIRONMENTAL CHEMISTRY (3)
Fate and transport of chemical contaminants; physico-chemical processes controlling pollutant partitioning and distribution; implications of chemical speciation on toxicity to biota. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210); CHEM 330 or CHEM 332; or consent of instructor.

CHEM 480 CHEMICAL TOXICOLOGY (3)
Study of the fate, effects, and mechanisms of action of toxicants; physical and biological factors affecting transport, transformation and toxicity of chemical stressors; emphasis on forensic and environmental applications. Prerequisites: CHEM 351, BIOL 200/ BIOL 200L (BIOL 201), or consent of instructor.

CHEM 491 RESEARCH IN CHEMISTRY (1-3)
An original experimental or theoretical investigation to be conducted under the supervision of a chemistry or forensic chemistry faculty member. Projects may span multiple semesters, and students may repeat the course for credit provided a different topic description is specified for each semester. A student should expect to complete a formal written report and/or presentation. Prerequisite: consent of instructor.

CHEM 499 HONORS THESIS IN CHEMISTRY (2)
Writing of an honors thesis based on independent research done under the direction of a faculty member. Oral presentation of the work in a public seminar. Students who have successfully completed the non-honors version of this course will not receive additional credit for this course. Prerequisites: consent of instructor, and open only to students who have been approved as departmental honors candidates.

Forensic Science Courses
FRSC 363 CHEMISTRY OF DANGEROUS DRUGS (3)
A study of the chemistry, methods of detection and analysis of narcotics, depressants, stimulants and hallucinogens. Also, the influence of physiochemical properties upon the pharmacological effects of drug receptor interactions. Historical, forensic, and socio-economic implications associated with drug abuse will also be reviewed. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210) and CHEM 332.

FRSC 367 FORENSIC CHEMISTRY (3)
Introduction to chemical and physical analyses used by a modern crime laboratory in the evaluation of physical evidence encountered in criminal acts. Areas of concentration will include forensic microscopy, drug analysis, toxicology, explosives analysis, arson examination, and trace evidence. Emphasis will be placed on the value of such examinations as presented by the expert witness in a criminal trial. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210) and CHEM 332.

FRSC 368 PROFESSIONAL PRACTICES IN FORENSIC SCIENCE (3)
Introduction to the various professional practices encountered in forensic science including Laboratory Safety, Quality Assurance and Quality Control, Documentation, Ethics, Chain of Custody, and Expert Witness Testimony. Prerequisites: CHEM 220/ CHEM 220L (CHEM 210), CHEM 332.

FRSC 401 FORENSIC SCIENCE CAPSTONE (3)
An integrative forensic science course where students demonstrate their scientific literacy, in-depth understanding of forensic problems, communication skills, presentation and writing skills, critical thinking and analysis skills obtained throughout their undergraduate academic experience. Prerequisite: FRSC 367.