The School offers courses in chemistry and biochemistry required for various engineering and science curricula, as well as for students interested in medical, dental, and pharmacy school, for the Bachelor of Science in Biochemistry and Bachelor of Science in Chemistry degrees, and for graduate work leading to the degrees

**Master of Science**
- Chemistry,
- Computational Science and Engineering,
- Paper Science and Engineering, and

**Doctor of Philosophy**
- Chemistry,
- Computational Science and Engineering,
- Bioinformatics, and
- Paper Science and Engineering

**Minors**
- Minor in Chemistry (http://www.catalog.gatech.edu/programs/minor-chemistry)
- Minor in Biochemistry (http://www.catalog.gatech.edu/programs/minor-biochemistry)

**Bachelor's Degrees**
- Bachelor of Science in Chemistry (http://www.catalog.gatech.edu/programs/chemistry-bs)
- Bachelor of Science in Biochemistry (http://www.catalog.gatech.edu/programs/biochemistry-bs)

**Master's Degrees**
- Master of Science in Chemistry (http://www.catalog.gatech.edu/programs/chemistry-ms)
- Master of Science in Computational Science and Engineering (http://www.catalog.gatech.edu/programs/computational-science-engineering-ms)
- Master of Science in Paper Science and Engineering (http://www.catalog.gatech.edu/programs/paper-science-ms)

**Doctoral Degrees**
- Doctor of Philosophy with a Major in Bioinformatics (http://www.catalog.gatech.edu/programs/bioinformatics-phd)
- Doctor of Philosophy with a Major in Chemistry (http://www.catalog.gatech.edu/programs/chemistry-phd)
- Doctor of Philosophy with a Major in Computational Science and Engineering (http://www.catalog.gatech.edu/programs/computational-science-engineering-phd)
- Doctor of Philosophy with a Major in Paper Science and Engineering (http://catalog.gatech.edu/programs/paper-science-phd)
- Doctor of Philosophy with a Major in Quantitative Biosciences (http://www.catalog.gatech.edu/programs/quantitative-biosciences-phd)

**School of Chemistry and Biochemistry**

Established in 1906

CHEM 1211K. Chemical Principles I. 4 Credit Hours.
Topics to be covered include atomic structure, bonding, properties of matter, thermodynamics and physical equilibria. Laboratory exercises supplement the lecture material. Credit not allowed for both CHEM 1310 and CHEM 1211K.

CHEM 1212K. Chemical Principles II. 4 Credit Hours.
Topics to be covered include chemical equilibria, acids and bases, aqueous equilibria, electrochemistry, kinetics, main group and transition elements. Laboratory exercises supplement the lecture material. Credit not allowed for both CHEM 1311/1312 and CHEM 1212K.

CHEM 12X1. Transfer General Chem. 4 Credit Hours.

CHEM 1310. General Chemistry. 4 Credit Hours.
Fundamental laws and theories of chemical reactions. Topics include atomic structure; bonding theory; stoichiometry; properties of solids, liquids and gases; chemical thermodynamics; electrochemistry; and kinetics. Credit not allowed for both CHEM 1211K and CHEM 1310.

CHEM 1315. Survey of Organic Chemistry. 3 Credit Hours.
Survey of organic chemistry as the basis for biochemical processes and commercial applications.

CHEM 1801. Special Topics. 1 Credit Hour.

CHEM 1802. Special Topics. 2 Credit Hours.

CHEM 1803. Special Topics. 3 Credit Hours.

CHEM 1XXX. Chemistry Elective. 1-21 Credit Hours.

CHEM 2211. Introduction to Quantitative Analysis. 3 Credit Hours.
Laboratory experimentation emphasizing quantitative chemical analysis. Credit not allowed for both CHEM 2211 and CHEM 1313.

CHEM 2311. Organic Chemistry I. 3 Credit Hours.
An introduction to structure and reactivity of organic molecules.

CHEM 2312. Organic Chemistry II. 3 Credit Hours.
The second course in the series dealing with the structure and reactivity of organic molecules.

CHEM 2313. Organic and Bioorganic Chemistry. 3 Credit Hours.
A second course in organic chemistry that extends the study to topics in biochemistry.

CHEM 2380. Synthesis Laboratory I. 2 Credit Hours.
Methods for preparation, isolation, and characterization of complex organic molecules, natural products, and polymers.

CHEM 2694. Intern Assistantship (Undergraduate Internship for Pay). 1-21 Credit Hours.
Undergraduate Internship for which the student is paid, Freshmen and Sophomores only.

CHEM 2695. Undergraduate Internship (Undergraduate Internship for Academic Credit). 1-21 Credit Hours.
Undergraduate Internship for academic credit, Freshmen and Sophomores only.

CHEM 2698. Undergraduate Research Assistantship. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

CHEM 2699. Undergraduate Research. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

CHEM 2801. Special Topics. 1 Credit Hour.
Lecture course in current special topics in chemistry and biochemistry. Topics will vary from year to year.
CHEM 2802. Special Topics. 2 Credit Hours.
Lecture course in current special topics in chemistry and biochemistry. Topics will vary from year to year.

CHEM 2803. Special Topics. 3 Credit Hours.
Lecture course in current special topics in chemistry and biochemistry. Topics will vary from year to year.

CHEM 2812. Special Topics. 2 Credit Hours.
Lecture course in current special topics in chemistry and biochemistry. Topics will vary from year to year.

CHEM 2901. Special Problems in Chemistry. 1-21 Credit Hours.
Course of individual instruction, which will include library conference and laboratory experience.

CHEM 2902. Special Problems in Chemistry. 1-21 Credit Hours.
Course of individuated instruction, which will include library, conference and laboratory experience.

CHEM 2903. Special Problems in Chemistry. 1-21 Credit Hours.
Course of individuated instruction, which will include library conference and laboratory experience.

CHEM 2XXX. Chemistry Elective. 1-21 Credit Hours.
Course of individual instruction, which will include library conference and laboratory experience.

CHEM 3111. Inorganic Chemistry II. 3 Credit Hours.
A study of the reactions and structures of inorganic compounds and principles, generalizations and theories that assist in understanding their behavior.

CHEM 3211. Analytical Chemistry. 5 Credit Hours.
Introduction to the theory and practice of modern chemical analysis.

CHEM 3281. Instrumental Analysis for Engineers. 4 Credit Hours.
Provides a background to modern analytical chemistry and instrumental methods of analysis with applications to engineering and other areas.

CHEM 3371. Organic Chemistry Laboratory. 2 Credit Hours.
Multi-step organic synthesis and inorganic synthesis. Use of chemical literature and advanced spectroscopic techniques.

CHEM 3380. Synthesis Laboratory II. 3 Credit Hours.
Multi-step organic and inorganic synthesis. Use of the chemical literature and advanced spectroscopic techniques.

CHEM 3411. Physical Chemistry I. 3 Credit Hours.
Chemical thermodynamics, energetics of chemical reactions, changes of state, and electrochemistry.

CHEM 3412. Physical Chemistry II. 3 Credit Hours.
Quantum mechanics, atomic and molecular structure, bonding theory, molecular spectroscopy, statistical mechanics.

CHEM 3481. Physical Chemistry Laboratory I. 2 Credit Hours.
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3482. Physical Chemistry Laboratory II. 2 Credit Hours.
Laboratory investigations of physical principles applied to chemical systems.

CHEM 3511. Biochemistry. 3 Credit Hours.
Introductory course in biochemistry dealing with the chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 3700. The Science of Alternative Energy. 3 Credit Hours.
Scientific principles governing the current and future approaches in solar photo-voltaics, fuel cells, biomass conversion, nuclear energy and wind power.

CHEM 3XXX. Chemistry Elective. 1-21 Credit Hours.
CHEM 4113. Applications of Inorganic Chemistry in Current Energy Research. 3 Credit Hours.
The principles of coordination chemistry applied to theories and mechanisms of energy conversion and storage in chemistry and biology. Students cannot receive credit for CHEM 4113 and CHEM 6171.

CHEM 4311. Advanced Organic Chemistry. 3 Credit Hours.
Construction reactions and functional group interconversions as applied to multistep organic synthesis.

CHEM 4341. Applied Spectroscopy. 3 Credit Hours.
Theory and application of NMR, mass spectrometry, and infrared spectroscopy in the determination of organic structures.

CHEM 4401. Physical Chemistry. 3 Credit Hours.
Introduction to the theory and applications of molecular spectroscopy, including electronic, vibrational, rotational transitions, and selection rules.

CHEM 4452. Chemistry of the Solid State. 3 Credit Hours.
Application of the concepts of physical and inorganic chemistry to the structure of solids and their chemical and physical properties.

CHEM 4511. Biochemistry I. 3 Credit Hours.
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4512. Biochemistry II. 3 Credit Hours.
The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 4521. Biophysical Chemistry. 3 Credit Hours.
The physical chemistry of biological systems, biological macromolecules, and biological aggregates.

CHEM 4581. Biochemistry Laboratory I. 3 Credit Hours.
Modern biochemical techniques including methods for protein, nucleic acid, and lipid isolation and characterization; enzyme assays; chromatography; electrophoresis; and use of databases.

CHEM 4582. Biochemistry Laboratory II. 3 Credit Hours.
Laboratory techniques in the isolation and characterization of biological molecules with special emphasis on modern techniques.

CHEM 4601. Chemistry Seminar. 2 Credit Hours.
Student presentations of recent research topics in chemistry or biochemistry based on lab experience and/or literature searches.

CHEM 4684. Advanced Chemistry Lab. 4 Credit Hours.
A modular laboratory involving a series of multipart experiments that build upon chemical principles and experimental techniques introduced in earlier courses and instructional laboratories. Credit not allowed for both CHEM 4684 and CHEM 4681.

CHEM 4694. Intern Assistantship (Undergraduate Internship for Pay). 1-21 Credit Hours.
Undergraduate Internship for which the student is paid, Juniors and Seniors only.

CHEM 4695. Undergraduate Internship (Undergraduate Internship for Academic Credit). 1-21 Credit Hours.
Undergraduate Internship for academic credit, Juniors and Seniors only.

CHEM 4698. Undergraduate Research Assistantship. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.

CHEM 4699. Undergraduate Research. 1-12 Credit Hours.
Independent research conducted under the guidance of a faculty member.
CHEM 4740. Atmospheric Chemistry. 3 Credit Hours.
This course provides a general chemical description of the Earth’s atmospheric system with a major focus on the two lowest layers of the atmosphere, i.e., the troposphere and the stratosphere. Crosslisted with EAS 4740.

CHEM 4760. Biocatalysis and Metabolic Engineering. 3 Credit Hours.
This course provides an in-depth coverage of various topics in biocatalysis and metabolic engineering. Goals of this course are the development of an understanding of proteins as catalysts, their functioning in metabolic networks, their application in various industries, recognition of their potential for addressing future challenges in science and engineering. Crosslisted with CHBE 4760.

CHEM 4765. Drug Design, Development, and Delivery. 3 Credit Hours.
Introduction to the pharmaceutical development process, including design of new drugs, synthesis and manufacturing issues, and methods for delivery into the body. Includes student presentations. Crosslisted with CHBE and BMED 4765.

CHEM 4775. Polymer Science and Engineering I: Formation and Properties. 3 Credit Hours.
An introduction to the chemistry, structure, and formation of polymers, physical states and transitions, physical and mechanical properties of polymer fluids and solids. Crosslisted with CHE, ME, MSE, and PTFE 4775.

CHEM 4776. Polymer Science and Engineering II: Analysis, Processing, and Laboratory. 3 Credit Hours.
Polymer fabrication processes and methods of characterization and identification of polymers are presented. Experiments in polymerization, processing, and property evaluation of polymers. Crosslisted with CHE, ME, MSE, and TFE 4776.

CHEM 4801. Special Topics. 1 Credit Hour.
Topics of current interest not included in the regular course offerings.

CHEM 4802. Special Topics. 2 Credit Hours.
Topics of current interest not included in the regular course offerings.

CHEM 4803. Special Topics. 3 Credit Hours.
Topics of current interest not included in the regular course offerings.

CHEM 4804. Special Topics. 4 Credit Hours.
Topics of current interest not included in the regular course offerings.

CHEM 4805. Special Topics. 5 Credit Hours.
Topics of current interest not included in the regular course offerings.

CHEM 4901. Special Problems. 1-21 Credit Hours.
Course of individualized instruction, which will include library, conference, and laboratory investigations.

CHEM 4902. Special Problems. 1-21 Credit Hours.
Course of individualized instruction, which will include library, conference, and laboratory investigations.

CHEM 4903. Special Problems. 1-21 Credit Hours.
Course of individualized instruction, which will include library, conference, and laboratory investigations.

CHEM 4XXX. Chemistry Elective. 1-21 Credit Hours.

CHEM 6170. Inorganic Chemistry I. 3 Credit Hours.
A series of key topics in inorganic chemistry will be reviewed: acids/bases, redox processes, bonding and structure, transition metal chemistry, coordination complexes.

CHEM 6171. Inorganic Chemistry II. 3 Credit Hours.
Contemporary topics in inorganic chemistry including bioinorganic chemistry, reaction mechanisms and kinetics, optical and magnetic properties of molecular species, and inorganic materials.

CHEM 6172. Physical Methods in Inorganic Chemistry. 3 Credit Hours.
An introduction to the use of physical methods in inorganic chemistry including vibrational spectroscopy, multinuclear NMR, EST, Mossbauer, magnetometry, NQR, PES, diffraction, and EXAFS.

CHEM 6181. Chemical Crystallography. 3 Credit Hours.
The collection and interpretation of diffraction data. Single crystal structure analysis, powder diffraction for phase identification and quantitative analysis, and Rietveld refinement.

CHEM 6182. Chemistry of the Solid State. 3 Credit Hours.
An introduction to the chemistry of the solid state. Synthetic methods, measurement of properties, structure of solids, theory of electrical, optical, and magnetic properties.

CHEM 6183. Organometallic Chemistry. 3 Credit Hours.
The chemistry of main group and transition metal organometalics. Including synthetic methods, homogeneous catalysis and catalytic cycles, and synthetically useful organometallic reagents.

CHEM 6271. Analytical Chemistry I. 3 Credit Hours.
Discussion of chemical equilibrium, separations, and bioanalytical methods.

CHEM 6272. Analytical Chemistry II. 3 Credit Hours.
Topics include experimental design, electronics, and spectroscopy.

CHEM 6281. Mass Spectrometry. 3 Credit Hours.
Topics include sample handling, ionization methods, MS/MS, and quantitative analysis.

CHEM 6282. Chemical Sensors. 3 Credit Hours.
Origins of selectivity, principles of transduction mechanisms, construction and applications of modern chemical sensors.

CHEM 6283. Electroanalytical Chemistry. 3 Credit Hours.
Coulometry, electrolytic separations, polargraphy chronopotentiometry, coulometric titrations, voltammetry, and hydrodynamic electrochemical methods of analysis.

CHEM 6284. Environmental Analytical Chemistry. 3 Credit Hours.
Application of techniques from analytical chemistry in monitoring the environment.

CHEM 6285. Analytical Spectroscopy. 3 Credit Hours.
Modern analytical spectroscopy and use of analytical techniques in chemistry and chemical engineering.

CHEM 6287. Scanned Probe Techniques. 3 Credit Hours.
An in-depth analysis of the theory, practice and application of scanning probe microscopy techniques.

CHEM 6371. Identification of Organic Compounds. 3 Credit Hours.
Description of molecular structure and identification of organic compounds using spectroscopic techniques.

CHEM 6372. Physical Organic Chemistry. 3 Credit Hours.
Physical methods in organic chemistry; determination of reaction pathways.

CHEM 6373. Organic Synthesis. 3 Credit Hours.
Methods and strategy for the preparation of complex organic compounds.

CHEM 6381. Advanced Organic Synthesis. 3 Credit Hours.
Advanced topics in the synthesis of complex organic molecules.
CHEM 6382. Computational Methods in Organic Chemistry and Biochemistry. 3 Credit Hours.
The development of approximate methods in molecular orbital theory and molecular mechanics and their application to problems in organic and biochemistry.

CHEM 6471. Chemical Thermodynamics and Kinetics. 3 Credit Hours.
Laws of classical thermodynamics and their chemical applications. Introduction to statistical mechanics and chemical kinetics.

CHEM 6472. Quantum Chemistry and Molecular Spectroscopy. 3 Credit Hours.
Introduction to quantum mechanics and its application to molecular systems, atomic and molecular spectroscopy.

CHEM 6481. Statistical Mechanics. 3 Credit Hours.
Statistical thermodynamics, lattice statistics, molecular distribution and correlation functions, the theories of liquids and solutions, phase transitions, cluster theory, and measurement.

CHEM 6482. Chemical Kinetics and Reaction Dynamics. 3 Credit Hours.
Modern theoretical and experimental methods for studying macroscopic and microscopic bimolecular and unimolecular processes are discussed, as are methods for describing complex kinetic systems.

CHEM 6483. Chemistry of Electronic Organic Materials. 3 Credit Hours. This course provides a broad description of the basic chemical and physical concepts that determine the properties of electrically active materials.

CHEM 6484. Chemistry of Optical Organic Materials. 3 Credit Hours. Course description includes synthesis, electronic structure, physico-chemical characterization, and device applications of optically active organic materials.

CHEM 6485. Computational Chemistry. 3 Credit Hours. Introductory course in computational chemistry, discussing electronic structure theory, semiempirical methods, molecular mechanics, transition-state searching, and computation of thermodynamic quantities.

CHEM 6492. Molecular Spectroscopy. 3 Credit Hours. Study of energy of electronic transitions in molecules, selection rules, excitation processes, and laser spectroscopy.

CHEM 6501. Biochemistry I. 3 Credit Hours. The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 6502. Biochemistry II. 3 Credit Hours. The chemistry and biochemistry of proteins, lipids, carbohydrates, nucleic acids, and other biomolecules.

CHEM 6571. Enzymology and Metabolism. 3 Credit Hours. Structure and chemistry of enzymes, enzyme mechanism, enzyme kinetics, enzyme inhibitors, and medicinal chemistry.

CHEM 6572. Macromolecular Structure. 3 Credit Hours. Principles of protein, nucleic acid, and membrane structure. Major emphasis on protein folding, detailed description of three-dimensional structure of proteins and nucleic acids.

CHEM 6573. Molecular Biochemistry. 3 Credit Hours. Current topics in molecular biology including eukaryotic transcriptions, RNA processing, repair and recombination, immunity, viruses, DNA fingerprinting, and genome sequencing.

CHEM 6581. Protein Crystallography. 3 Credit Hours. Application of crystallographic principles to the structure determination of macromolecules by molecular replacement, multiple isomorphous replacements. High-speed data collection methods and cryocrystallography.

CHEM 6582. Biophysical Chemistry. 3 Credit Hours. Applications of the principles and techniques of physical chemistry in biochemistry, with emphasis in the equilibrium and dynamic behavior of macromolecules in solution.

CHEM 6583. Drug Design and Discovery. 3 Credit Hours. Application of principles of chemistry and biology to the creation of knowledge leading to the introduction of new therapeutic agents.

CHEM 6584. Contemporary Biochemistry. 3 Credit Hours. Topics vary from year to year, but will include subjects from the biochemical literature, such as in Journal of Biological Chemistry.

CHEM 6585. Theoretical Chemistry of Polymers. 3 Credit Hours. Study of polymer solutions, polymer miscibility, absorptions, sorptions, plasticization, molecular weights, molecular weight distributions, and interfacial phenomena using thermodynamics and statistical mechanics. Crosslisted with CHE and CEE 6585.

CHEM 6586. Physical Chemistry of Polymer Solutions. 3 Credit Hours. This course introduces the student to surface, near-surface, and structural methods of polymer characterization. Specialized techniques critical to physical structure are emphasized. Crosslisted with CHE, MSE, and CEE 6586.

CHEM 6587. Theoretical Chemistry of Polymers. 3 Credit Hours. Thermodynamics and microscopic dynamics of polymers. Fundamental concepts, including scaling concepts, governing anisotropy of polarizability, phase transitions, morphology, time-dependent correlations, etc. are discussed. Crosslisted with MSE and PTFE 6587.

CHEM 6588. Discovery of Signaling Molecules. 3 Credit Hours. The diversity of chemical signals between organisms and their structural specificities will be presented along with chemical and biological methods for isolating signaling molecules. Crosslisted with BIOL 6588 and CHE 6588.

CHEM 6589. Biocatalysis and Metabolic Engineering. 3 Credit Hours. This course provides in-depth coverage of various topics in biocatalysis and metabolic engineering. Goals of this course are the development of an understanding of proteins as catalysts, their functioning in metabolic networks, their application in various industries, and recognition of their potential for addressing future challenges in science and engineering. Crosslisted with CHBE 6589.

CHEM 6590. Biophysics. 3 Credit Hours. Introduction to the pharmaceutical development process, including design of new drugs, synthesis and manufacturing issues, and methods of delivery into the body. Includes student presentations. Crosslisted with BMED 6590 and CHBE 6590.
CHEM 6801. Special Topics. 1 Credit Hour.
CHEM 6802. Special Topics. 2 Credit Hours.
CHEM 6803. Special Topics. 3 Credit Hours.
CHEM 6XXX. Chemistry Elective. 1-21 Credit Hours.
CHEM 7000. Master's Thesis. 1-21 Credit Hours.
CHEM 7001. Introduction to Research. 3 Credit Hours.
Introduction to laboratory techniques, experimental design, library and
database searching, presentations.
CHEM 8000. Seminar in Chemistry. 1 Credit Hour.
CHEM 8001. Faculty Seminar. 2 Credit Hours.
CHEM 8002. Information Resources for Chemists and Biochemists. 2
Credit Hours.
CHEM 8003. Student Seminar. 2 Credit Hours.
CHEM 8813. Special Topics in Inorganic Chemistry. 3 Credit Hours.
Topics from the inorganic chemistry research literature.
CHEM 8823. Special Topics in Analytical Chemistry. 3 Credit Hours.
Topics from the analytical chemistry research literature.
CHEM 8833. Special Topics in Organic Chemistry. 3 Credit Hours.
Topics from the organic chemistry research literature.
CHEM 8843. Special Topics in Physical Chemistry. 3 Credit Hours.
Topics from the physical chemistry research literature.
CHEM 8853. Special Topics in Biochemistry. 3 Credit Hours.
Topics from the biochemistry research literature.
CHEM 8873. Special Topics in Polymer Chemistry. 3 Credit Hours.
Topics from the polymer chemistry research literature.
CHEM 88X2. Xfer-Spec Top-Org Chem. 2 Credit Hours.
CHEM 8901. Special Problems. 1-21 Credit Hours.
CHEM 8902. Special Problems. 1-21 Credit Hours.
CHEM 8903. Special Problems. 1-21 Credit Hours.
CHEM 8997. Teaching Assistantship. 1-9 Credit Hours.
For graduate students holding graduate teaching assistantships.
CHEM 8998. Research Assistantship. 1-9 Credit Hours.
For graduate students holding graduate research assistantships.
CHEM 9000. Doctoral Thesis. 1-21 Credit Hours.