CHEMISTRY AND BIOCHEMISTRY

Chair: John L. Wood
Director of Graduate Affairs: Michael A. Trakselis

Director of Graduate Recruiting: Darrin J. Bellert

The Department of Chemistry & Biochemistry at Baylor University offers a unique combination of direct faculty-student training and mentoring, graduate student-operated instrumentation, and growth-focused education leading to impactful science. Our department operates in a close-knit and friendly community. The department offers the Master of Science and Doctor of Philosophy degrees.

Admission

A bachelor’s degree equivalent to a B.S. degree in chemistry or biochemistry at Baylor is the standard requirement for admission. A personal statement from the applicant as well as three letters of reference are also required. A current TOEFL/IELTS/Duolingo exam score is required for all international applicants. Prior research experience at the undergraduate level, or in the workplace is valued highly. Complete application packages for admission to the Ph.D. program will be evaluated holistically by the Graduate Admissions Committee of the Department of Chemistry and Biochemistry.

Requirements

Students are required to qualify in three areas of chemistry either by taking ACS style division exams or by passing appropriate coursework with a grade of B or better no later than by the end of the second semester. A student will take at least three courses within their major field of specialization and two courses outside of that area, as well as CHE 5260 Scientific Communication and CHE 5101 Responsible Conduct of Research. The student’s dissertation or thesis committee may require any coursework that it deems proper and advisable. The Ph.D. Dissertation Committee will consist of at least 5 members, the Advisor, two members from the student’s division, one member from Chemistry and Biochemistry outside of the student’s division, and one member from outside the Department of Chemistry and Biochemistry. The M.S. Thesis Committee will consist of at least four members, the Advisor, one member from the student’s division, one member from Chemistry and Biochemistry outside of the student’s division and one member from outside of the Department of Chemistry and Biochemistry. All Committee members must be Graduate Faculty. M.S. and Ph.D. students specialize in one of the following areas: analytical, biochemistry, inorganic, organic, or physical, as set forth below. A written Thesis/Dissertation of the student’s research is required for the thesis M.S. and the Ph.D. degrees. The Ph.D. Dissertation Committee will also consider progress toward and/or the actual publication of research results for the defense. All doctoral degree program students must fulfill at least two semesters as a graduate teaching assistant. There is no foreign language requirement for the Ph.D.

Note: The requirement for a minor field of study (as described in the Graduate Catalog) does not apply to the graduate degrees in chemistry and biochemistry.

- Chemistry and Biochemistry, M.S. (https://catalog.baylor.edu/graduate-school/curriculum-departments-institutes-instruction/college-arts-sciences/chemistry-biochemistry/chemistry-biochemistry-ms/)
- Chemistry and Biochemistry, Ph.D. (https://catalog.baylor.edu/graduate-school/curriculum-departments-institutes-instruction/college-arts-sciences/chemistry-biochemistry/chemistry-biochemistry-phd/)

Chemistry (CHE)

CHE 4334 Organic Spectroscopy (3)
Pre-requisite(s): Either CHE 3238 and 3332 with grades of B or above; or CHE 3332 with a grade of B or above and credit or concurrent enrollment in CHE 4237
The most common spectroscopic methods including infrared, ultraviolet-visible, nuclear magnetic resonance and mass spectrometries, with emphasis on the practical use of NMR and MS in structure determination problems.

CHE 5050 Chemistry Colloquium (0)
A weekly, graduate-level seminar featuring speakers from science departments at Baylor, industry, medical schools, and other universities.

CHE 5101 Responsible Conduct of Research (1)
Covers ethical and regulatory issues regarding modern scientific research.

CHE 5150 Graduate Seminar (1)
Pre-requisite(s): Enrollment in the graduate program
A seminar program in which students will be required to present a paper for evaluation before the graduate faculty and other graduate students. Must be taken two times for the master’s degree and three times for the Ph.D. degree.

CHE 5179 Research Seminar (1)
Pre-requisite(s): Enrollment in the graduate program
A weekly colloquium in which students are required to present papers and study the literature in the area of their research project. May be repeated, but no more than three semester hours may be counted on a master’s degree and no more than six may be counted on the Ph.D. degree. May not be used to fulfill coursework requirements.

CHE 5260 Scientific Communication (2)
Pre-requisite(s): Graduate standing
This experiential-learning course, designed for first-year graduate students, provides instruction and practice in the development of an original research proposal. Strategies for effective oral and written communication of scientific information are emphasized, along with the importance of mastering primary literature in the chosen field of interest.

CHE 5301 Chemistry of the Elements (3)
Pre-requisite(s): CHE 4301 or consent of instructor
Comparative chemistry of the Main Group and Transition elements; relationships between structure and reactivity; energetics and kinetics of inorganic reactions.

CHE 5302 Symmetry and Group Theory in Chemistry (3)
Pre-requisite(s): CHE 4301 or consent of instructor
Application of symmetry and group theory to chemical bonding and spectroscopic selection rules; use of character tables; electronic and vibration spectroscopy.

CHE 5303 Physical Methods in Inorganic Chemistry (3)
CHE 5304 Special Topics in Inorganic Chemistry (3)
This course concerns characterization of redox active inorganic complexes by a number of physical methods. Topics covered include electronic structure and geometry (Group theory, MO diagrams), orbital energies of ground and excited states (UV-vis absorbance/emission), and ways of accessing and interpreting changes in oxidation states (electrochemistry, Marcus theory). Symmetry and group theory are fundamental to many of these applications, and will be introduced.

CHE 5305 Organometallic Chemistry and Homogenous Catalysis (3)
Pre-requisite(s): Consent of instructor
Chemical reactions of organometallic compounds and their role in homogeneous catalysis with emphasis on the transition metals. Reactivity patterns and reaction mechanisms in organometallic chemistry. Factors influencing stabilities and reactivities of metal-carbon bonds.

CHE 5306 Bioinorganic Chemistry (3)
An overview of the biological chemistry of metal ions. Emphasis will be on the structural motifs of metalloproteins and their associated reactivities in relation to physiological function.

CHE 5310 Advanced Chemical Instrumentation (3)
Pre-requisite(s): CHE 4217 and 4316
Principles of chemical instrumentation, including principles of electronic signal handling, sources of noise and signal-to-noise theory, noise reduction techniques such as modulation and phase-sensitive detection, introductory information theory, introductory geometrical optics, and vacuum systems.

CHE 5312 Advanced X-omics Mass Spectrometry (3)
Understanding of chemical interactions within complex mixtures, such as biological fluids and environmental samples, requires simultaneous characterization of all sample components at the molecular level. State-of-the-art high performance mass spectrometers, coupled to various separation techniques, provide the necessary sensitivity, resolving power, and multidimensionality for comprehensive characterization of complex mixtures. This course covers current topics in x-omics research (including genomics, metabolomics, proteomics, and proteomics) with a focus on bioanalytical aspects of utilizing ion generation methods, ion-molecule reactions, ion fragmentation techniques, particle analyzers/detectors, and multidimensional data generation/analyses. Moreover, fundamental aspects and practical significance of accurate mass measurements and conformational analyses in biomedical research and drug development strategies are presented.

CHE 5314 Separation Science (3)
Pre-requisite(s): CHE 4316 or consent of instructor
Theoretical foundations and practical applications of analytical separations with emphasis on gas, liquid, supercritical fluid, and ion chromatographies.

CHE 5315 Electroanalytical Chemistry (3)
Pre-requisite(s): CHE 4316 or consent of instructor
Modern electroanalytical techniques and their application to analytical, kinetic, mechanistic, and synthetic problems.

CHE 5316 Analytical Spectroscopy (3)
Pre-requisite(s): CHE 4316
Theoretical and practical aspects of analytical optical spectroscopy with emphasis on instrumentation.

CHE 5320 Thermodynamics and Statistical Thermodynamics (3)
Pre-requisite(s): CHE 4322
Principles of classical and statistical thermodynamics.

CHE 5322 Chemical Kinetics and Mechanisms (3)
Pre-requisite(s): CHE 4322
Theory of rate processes and the use of kinetic data in the interpretation of reaction mechanisms.

CHE 5323 Structural Studies by X-ray Crystallography (3)
Pre-requisite(s): CHE 4324
Preliminary studies of X-ray structure determination and solving the phase problem by various techniques to be learned before employing methods of structural refinement. Results and conclusions derived from refined structures will be applied to chemical research problems. Practical experience of crystal structure analysis will be the main emphasis.

CHE 5325 Quantum Chemistry (3)
Pre-requisite(s): CHE 4322
Comparison of classical and quantum mechanics and application of quantum mechanics to electronic structure of the atoms and to the study of molecules and chemical bonds.

CHE 5326 Lasers and Molecular Spectroscopy (3)
Pre-requisite(s): CHE 4321 and 4322
Properties of lasers and the fundamental principles of laser operation. Modern application of lasers to the study of spectroscopy and energy flow in atoms and molecules.

CHE 5331 Stereochemistry (3)
Pre-requisite(s): CHE 3332 and credit or concurrent enrollment in CHE 4322
The stereochemistry of compounds of carbon and other elements, steric effects on physical and chemical properties of compounds, and recent developments in the field.

CHE 5334 Heterocyclic Chemistry (3)
Pre-requisite(s): CHE 3238, 3332 with grades of B or above; or consent of instructor
The chemistry of heterocyclic compounds including substances containing nitrogen, oxygen, and sulfur. Synthesis, typical reactions and reaction mechanisms will be emphasized.

CHE 5335 Physical Organic Chemistry (3)
Pre-requisite(s): CHE 3238 and 3332 with grades of B or above; and credit or concurrent enrollment in CHE 4321; or consent of instructor
Organic reaction mechanisms, including kinetics, steric and electronic effects, and molecular orbital considerations.

CHE 5336 Advanced Synthesis and Natural Products (3)
Pre-requisite(s): CHE 4332 or consent of instructor
A study of modern synthetic organic chemistry with particular emphasis on the synthesis of complex natural products and reaction mechanisms.

CHE 5345 Selected Topics in Bioanalytical Chemistry (3)
This current topics course covers current breakthroughs in the development and application of bioanalytical tools. Applications of bioanalytical tools in fundamental biochemical science, as well as in biomedical applications, are included.

CHE 5346 Chemical Biology (3)
Pre-requisite(s): CHE 4341 or BIO 4307
Revolutionary transformations in chemistry and biology have led to a merging at the boundary of these disciplines where contributions from both fields impact our molecular and quantitative understanding of biology. This course covers current research in chemical biology with a focus on enzyme mechanisms, molecular probes, biological pathways, chemical tools, and analytical methods to study biology, while also harnessing biological activity for chemical syntheses and commercial applications.
CHE 5347  Physical Biochemistry (3)
Pre-requisite(s): CHE 4341 or BIO 4341; and CHE 4321 or 4327; or consent of instructor
Theory and applications of physical chemistry to systems of biological interest including such topics as reaction kinetics, protein folding and denaturation, ligand interactions, x-ray diffraction of proteins and nuclear magnetic resonance spectroscopy.

CHE 5348  Enzymology (3)
Pre-requisite(s): CHE 4341 or BIO 4307
Kinetics, mechanisms, regulation, and other topics related to enzyme-catalyzed reactions.

CHE 5380  Principles of Biochemistry (3)
Pre-requisite(s): At least one year of course work in each of the following: chemistry, physics, organic chemistry, biology
In addition to concurrent enrollment in the Medical Sciences M.S. degree program. Online biochemistry course for students in the Medical Sciences Master’s degree program. Foundational principles of molecular structure and function are followed by in-depth study of biomolecules, enzymatic processes, and metabolic pathways.

CHE 5V60  Advanced Special Topics in Chemistry (1-3)
Topics in chemistry that are not covered in other graduate chemistry courses. May be repeated for credit if topic is different.

CHE 5V98  Graduate Research (1-10)
Pre-requisite(s): Graduate standing
Required of all graduate students. For research credit prior to admission to candidacy for an advanced degree. Credit will be given for the amount of work done. May be repeated for credit through 45 hours.

CHE 5V99  Thesis (1-9)
Credit for the amount of work done. In no case will fewer than six semester hours be accepted for a thesis. Required of all master’s students.

CHE 6V99  Dissertation (1-9)
Required of all doctoral candidates. In no case will fewer than twelve semester hours be accepted for a dissertation.