

DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

Science and Technology Center (McNulty Hall)

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<https://www.shu.edu/chemistry/>

Faculty: Antonacci; Badillo; Buonopane; Fadeev; Goldsmith; Gorun; Hanson (Director, Graduate Studies); Kazakevich; Kelty (*Chair*); Khan; Marzabadi; Murphy; Rezae; Snow; Wiedman

Faculty Retired and Emeritus: Huchital

The Department of Chemistry and Biochemistry offers programs of study in analytical, inorganic, organic and physical chemistry along with, biochemistry, leading to the degrees of Master of Science or Doctor of Philosophy in Chemistry. The programs are open to full-time and part-time students.

Programs of Study

Four different programs of study are available leading to the Master of Science degree. Plan A, with thesis, is intended for students who wish to engage in an original research project as part of the M.S. degree requirements. Plan B is awarded to Ph.D. students passing the matriculation examination. Plans C and D, without thesis, are primarily for students who are not interested in a research-oriented degree program. Plan D, which includes a minor in Business Administration, is designed to enhance the student's understanding of the legal, managerial, financial and technical aspects of the chemical industry and related fields (such as the pharmaceutical industry).

Students may choose to be admitted to the Ph.D. or one of the M.S. programs. In addition, part-time students may choose to initiate graduate study on a non-matriculated basis. Non-matriculated students can transfer up to four graduate courses to a matriculated program. Students interested in this option may choose it when creating their graduate application account. Transfer into a matriculated program can be initiated at any time. Descriptions of the programs of study including current course offerings with detailed descriptions for the upcoming two year period, faculty biographies and research interests, and other pertinent information can be accessed from the departmental webpage at www.shu.edu/academics/artsci/graduate-chemistry-programs.cfm (<http://www.shu.edu/academics/artsci/graduate-chemistry-programs.cfm>).

Admission

In addition to the general University requirements for admission to graduate studies, the Department of Chemistry and Biochemistry requires the following of all degree applicants:

- a minimum of 30 credits in chemistry, including a two-semester course in physical chemistry;
- a one-year course in physics;
- mathematics through differential and integral calculus; and
- three letters of recommendation from individuals competent to evaluate the applicant's scientific ability; and
- applicants for whom English is not their native language must submit TOEFL score results. The department requires a minimum total score of 550 on the paper based test (PBT) or 100 on the Internet test

(IBT) with at least a 22 in the speaking skill component in order to be considered for admission. Transcript evaluations are accepted from WES and ECE.

Dates for submission of completed applications to graduate programs are:

- July 1 – Fall Semester
- November 1 – Spring Semester
Late applicants may be admitted as special students pending evaluation.

Applications may be obtained online from the College of Arts and Sciences' webpage <https://www.shu.edu/arts-sciences/apply.cfm>. If submitting an online application, the applicant must also submit the special application form from the department, available from the department web page. <https://www.shu.edu/chemistry/upload/Chemistry-Supplemental-Form.pdf>.

Leaves of Absence and Readmission

Students requiring a leave of absence for any reason must submit a written request to the Director of Graduate Studies and the University Registrar. For further details regarding leaves of absence, please see the Graduate Catalogue section covering this topic. Upon readmission to the program, any new degree requirements instituted by the department during the students' leave will be required for graduation.

Financial Aid

The Department of Chemistry and Biochemistry offers teaching assistantships for students in the Ph.D. program to provide teaching and research support for Ph.D. degree candidates. A number of research fellowships also are available to students at the beginning of their second year of graduate study. Details are available from the department.

Distribution Requirement

Each student must take at least one course in each of the following groups:

Code	Title	Hours
Analytical Chemistry		
CHEM 6203		3
CHEM 6204	Spectrochem Meth-Analy	3
CHEM 6205	Modern Separation Tech	3
CHEM 6206		3
Organic Chemistry		
CHEM 6301	Theoretical Organic Chem I	3
CHEM 6303	Synthetic Organic Chemistry	3
Physical Chemistry		
CHEM 6401	Chemical Thermodynamics	3
CHEM 6403	Quantum Chemistry	3
CHEM 6404	Surface Chemistry	3
CHEM 6405	Princ Colloid - Interface Chem	3
Biochemistry		
CHEM 6501	General Biochemistry I	3
CHEM 6502	Bio-Organic Chemistry	3
Inorganic Chemistry		
CHEM 6601	Advanced Inorganic Chem I	3

The distribution requirement will normally be completed by the end of the third semester of full-time study or its equivalent.

Evaluations

After the course distribution requirements are completed, each student's performance in courses and seminar is evaluated by the faculty.

The student is then:

- advised to take the matriculation examination for Ph.D. candidacy; or
- advised to continue studies toward the master's degree (Plan A) with the possibility of reevaluation for Ph.D. candidacy after the attainment of the degree; or
- advised to continue studies toward the master's degree as a terminal degree; or
- required to discontinue study in the graduate degree programs in chemistry.

Students may be evaluated earlier if their records so warrant.

Seminar Requirement

A departmental seminar is held each week of the academic year. All full-time and part-time students are required to register for and attend this seminar series each semester prior to completion of the degree requirements. Students should sign up for CHEM 6710 Chemistry Seminar each semester until they graduate except for the semester when they present their formal seminar. This usually occurs during the second year of full-time study or its equivalent. When presenting their formal seminar, students should enroll in CHEM 6712 Chemistry Seminar. In this semester they will receive a grade from faculty members. In addition, those students who have initiated a research program (M.S. Plans A and B, or Ph.D. program) and who have not otherwise presented a formal seminar during the current year, are required to present a poster on their research activities at the Petersheim Academic Exposition, usually held in April.

Prizes and Awards

Each year the Department of Chemistry and Biochemistry honors outstanding graduate students in the areas of academic excellence (Ander Award), research (Petersheim Award and Garrigan Award) and teaching.

Laboratories

The research facilities of the Department of Chemistry and Biochemistry are housed in the Science and Technology Center (McNulty Hall) which is shared with the physics and biological sciences departments. Within the department are the Center for Applied Catalysis and Green Chemistry, the Center for Computational Research and the Center for Functional Materials. The department maintains a comprehensive array of experimental and computational instrumentation. Please see the department web page for additional pages.

Major

- Chemistry Major (M.S.) (<http://catalogue.shu.edu/graduate/college-arts-sciences/department-chemistry-biochemistry/chemistry-ms/>)
- Chemistry Major (Ph.D.) (<http://catalogue.shu.edu/graduate/college-arts-sciences/department-chemistry-biochemistry/chemistry-phd/>)

Note to Students: The following listing represents those courses that are in the active rotation for each department, i.e., have been offered in the

past five years. Some departments have additional courses offered more rarely but still available – to find the complete list of all official courses for a department, please use the “Course Catalogue Search” function in Self-Service Banner.

CHEM 6204 Spectrochem Meth-Analy (3 Credits)

The application of electromagnetic absorption and emission processes to the characterization of chemical systems. Emphasis on experimental techniques in all regions of the spectrum.

CHEM 6205 Modern Separation Tech (3 Credits)

Principles and practice of chemical and physical separation methods, gas and liquid chromatography, electrophoresis, membrane separation methods, extraction, distillation. Theory, instrumentation and applications of each technique.

CHEM 6301 Theoretical Organic Chem I (3 Credits)

Correlation of structure and mechanism in organic chemistry. Major topics include bonding; aromaticity; substituent effects, including linear free energy relationships, kinetics and rate studies; isotope effects; solvent effects and solvent scales; nucleophilicity; acid and base catalysis. Specific reactions covered include additions to carbon-carbon multiple bonds, additions to carbonyls, acyl transfer reactions, conservation of orbital symmetry for electrocyclic reactions and cycloadditions.

CHEM 6303 Synthetic Organic Chemistry (3 Credits)

Reactions commonly used in the synthesis of organic compounds; discussion of their selectivity and stereochemistry and the extent to which they can be utilized in the preparation of complex materials.

CHEM 6323 Sem Org Chem Entrpr Cosmetics (1 Credit)

CHEM 6401 Chemical Thermodynamics (3 Credits)

The course will review classical thermodynamics, including Laws of Thermodynamics with application to real and ideal systems. The course will cover an introduction to statistical thermodynamics including application to gases, liquids and solid-state systems.

CHEM 6403 Quantum Chemistry (3 Credits)

Use of quantum theory applied to the structure of atoms and molecules; Topics to be covered include angular momentum and spin, harmonic oscillators, electronic quantum states, and variational and perturbation many-body approximation methods.

CHEM 6404 Surface Chemistry (3 Credits)

The fundamentals and the applications of solid surfaces and interfaces, including solid-vapor, solid-liquid and solid-solid will be covered. Advanced topics will include surface thermodynamics, adsorption, electronic structure of surfaces, surface modification and organic monolayers, and nanostructured materials. The course will review surface sensitive techniques including, XPS, FTIR, UPS, LEED, STM/AFM, Adsorption, and Contact Angles. The application of surface modified materials to separation science, wettability and adhesion control, optical and electronic devices will be discussed.

CHEM 6405 Princ Colloid - Interface Chem (3 Credits)

The course will introduce the fundamentals of colloid and interface chemistry. The main topics include: thermodynamics of flat and curved surfaces, surface energy and surface tension, capillarity, monolayers, surfactants, nucleation, adsorption and wetting phenomena, molecular and surface forces, and stability of colloidal systems. An overview of characterization methods and applications of colloids and surfaces in industry and research will be provided. 3 credits

CHEM 6411 Intro to Polymer Chem (3 Credits)

Classification of macromolecules; methods and mechanisms of polymerizations; methods of polymer characterization; properties of polymeric solids.

CHEM 6423 Computational Chemistry (3 Credits)

The course will cover the fundamental theory and application of Molecular Mechanics, Classical Molecular Dynamics, Semi-empirical, Ab Initio and Density Functional simulation and modeling techniques to atoms, molecules, and solids. Available application programs will be used by the students to demonstrate the principles and provide hands-on experience with modern computational chemistry tools.

CHEM 6501 General Biochemistry I (3 Credits)

The course focus will be directed to selected aspects of the biomacromolecules (carbohydrates, lipids, proteins, enzymes, nucleic acids) involved in cell architecture and dynamics. Cell dynamics will be addressed from a molecular-level perspective, with emphasis on the fine-tuned interplay between the energetic and kinetic components of the main metabolic pathways.

CHEM 6502 Bio-Organic Chemistry (3 Credits)

The course covers synthetic methods in organic chemistry applied to the major classes of biological molecules and their derivatives, such as those belonging to the: carbohydrates, amino acids, peptides, proteins, nucleic acids, terpenes, lipids and natural products. Emphasis will be dedicated to the reactions and mechanisms that contribute to their applications in biological systems.

CHEM 6601 Advanced Inorganic Chem I (3 Credits)

A survey of transition metal chemistry focusing on the structural and dynamic properties of transition metal complexes. The presentation begins with a discussion of ions and their environment followed by a description of the bonding theories for transition metal complexes. Electronic spectra, magnetism and reactivity of these molecules will be explained in terms of these bonding theories. Related topics of main group compounds, organometallic complexes and bioinorganic chemistry also will be covered.

CHEM 6710 Chemistry Seminar (0 Credits)**CHEM 6712 Chemistry Seminar (1 Credit)**

Discussion of current literature topics by staff and students. One credit for two semesters.

CHEM 7399 Spec Topics-Organic Chemistry (3 Credits)

Selected topics in organic chemistry chosen by the instructor.

CHEM 7512 General Biochemistry II (3 Credits)

Course deals with topics not usually covered in CHEM 6501, such as biosynthetic pathways, nucleic acid chemistry (including replication, repair, transcription, translation) and integration/ chemical control of metabolism. Prerequisite: CHEM 6501.

Prerequisites: CHEM 6501 (may be taken concurrently)

CHEM 7991 Advanced Topics in Chemistry (1 Credit)

Offers advanced topics in chemistry to meet the present and future needs of graduate students and other professionals in the surrounding chemical industry. Topics include chiral separations, asymmetric synthesis, medicinal chemistry and biotechnology.

CHEM 8701 Matriculation Exam (0 Credits)**CHEM 8702 Cumulative Examination (0 Credits)****CHEM 8703 Perm to Write Dissertation (0 Credits)****CHEM 8704 Ph.D. Seminar (0 Credits)****CHEM 8831 Introduction to Research (2 Credits)**

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8832 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8833 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8834 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8835 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8836 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8837 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8838 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8839 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 8840 Introduction to Research (2 Credits)

Acceptable written research report or thesis on work performed in these courses must be filed with the research supervisor in order to count these credits toward the requirements for any graduate degree.

CHEM 9931 Research for Doctorate (3 Credits)

Research courses are taken only after the student has successfully passed the matriculation examination.

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CHEM 9937 Research for Doctorate (3 Credits)

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CHEM 9938 Research for Doctorate (3 Credits)

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CHEM 9939 Research for Doctorate (3 Credits)

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CHEM 9940 Research for Doctorate (3 Credits)

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