DEPARTMENT OF CHEMISTRY

Mission Statement

The mission of the Department of Chemistry is to expand the frontiers of the chemical sciences by promoting discovery and collaboration through research; to inspire and educate the next generation to be excellent, responsible, and ethical chemists; and to maintain a respectful, inclusive, and collegial environment for the sharing of ideas among our students, colleagues, and the greater community.

General Information

The faculty, students, and staff of the Department of Chemistry study how reactions occur, make new materials to enhance current technologies, develop compounds that fight disease, create cleaner and more efficient processes for industry, and make many other fundamental discoveries that benefit society. Our research covers all the major areas of chemistry, including: Analytical, Biological, Inorganic, Organic, Medicinal, and Physical Chemistry. The goal of the program is to produce independent and creative scientists who have discipline-specific knowledge, technical and analytical training, and strong critical thinking and communication skills such that they are prepared to succeed in the multitude of careers available to graduates in the chemical sciences. Our award-winning faculty and state-of-the-art laboratory facilities provide students with opportunities for personal mentorship during individualized undergraduate research projects.

Program Outcomes

The Department of Chemistry programs provide students the opportunity to:

- Identify chemically reactive structures and make predictions regarding their chemical or physical properties and transformations.
- Calculate quantities relevant to chemical/physical states and changes.
- Plan and implement chemical research.
- Utilize instrumentation needed to determine conversions in physical or chemical phenomena and critically evaluate the data obtained from such instrumentation.
- Find and critically evaluate chemical literature.
- Effectively communicate the results of chemical experiments in group presentations and written documents.

Registration Policy

Students who are not Chemistry or Biochemistry majors are restricted from registering for upper-division (3000- and 4000-level) Biochemistry (BCH) and Chemistry (CHE) courses without the consent of the Department of Chemistry.

Degrees

The Department of Chemistry offers a Bachelor of Science (B.S.) Degree in Biochemistry, Bachelor of Science (B.S.) Degree in Chemistry, a Bachelor of Arts (B.A.) Degree in Chemistry, as well as a minor in Chemistry.

The **B.S. Degree in Biochemistry** is accredited by the American Society of Biochemistry and Molecular Biology and is designed to provide a foundation for the application of chemical principles to living organisms and can be applied to health-related disciplines or as entry into pharmaceutical development and analysis. Both degrees (B.S. in Chemistry and B.S. in Biochemistry) provide excellent preparation for advanced professional studies in health-related disciplines, including medicine, dentistry, and pharmacology.

The **B.S. Degree in Chemistry** is designed to provide students with rigorous preparation for a professional career in the chemical sciences. The degree is certified by the American Chemical Society and ensures that graduates have a broad knowledge of the central concepts of analytical, biological, inorganic, organic, and physical chemistry, as well as laboratory skills that can be applied in a variety of careers. These may include, for example, drug discovery, chemical synthesis, forensics, cheminformatics, agriculture and food production, patent law, environmental protection, energy production and storage, water treatment, toxicology, new materials and coatings development, and hazardous waste management, to name but a few.

The **B.A. Degree in Chemistry** provides a more general curriculum that may be used by students to apply chemistry to fields that require a technical background and knowledge. These include such areas as teaching secondary physical science (see UTeachSA), technical communications, public information and outreach, biotechnology, and forensic and environmental chemistry. This program can be a good option for students who plan to earn an additional degree or enter medical school.

A Minor in Chemistry is available to all UTSA students who seek to complement a different academic major with a stronger foundation in chemistry.

Health Careers Pathways

The Department of Chemistry offers programs that support students interested in pursuing professional or graduate programs (e.g., medical, dental) in health-related professions through the B.S. Biochemistry degree. Chemistry majors can also apply for the Joint Early Acceptance Program between UTSA and UT Health San Antonio, where students can earn their B.S. Chemistry degree from UTSA and a Master of Science (M.S.) in Medical Laboratory Sciences from UT Health San Antonio. See the Degrees (http://catalog.utsa.edu/undergraduate/sciences/integrativebiology/#degreestext) page and visit the UTSA Health Professions office (https://www.utsa.edu/healthprofessions/) for more information.

Student Involvement

Chemistry majors can partake in a variety of discipline-related activities that further enhance their experience in the program.

UTSA's American Chemical Society (ACS) Student Affiliated Chapter is a student-led organization that focuses on the academic and social enrichment of UTSA students with a passion for science! The focus of the chapter is to foster connections between chemistry students, participate in community service projects to promote science among youth, and provide opportunities for professional growth and development. The chapter also serves to expose students to undergraduate research, graduate schools, and career opportunities post-graduation. UTSA's society is nationally ranked by the American Chemical Society.

Many Chemistry majors get involved at an early stage of their education in meaningful laboratory research activities under the guidance of a faculty member. The many areas of ongoing research studies include such fields as inorganic and organic synthesis and analysis, biological chemistry, surface catalysis, new drug design, and theoretical and

computational modeling. These experiences are excellent preparation for graduate study and a professional career in chemistry and biochemistry and can lead to student participation in published research articles.

COS Signature Experiences in Chemistry

The Department of Chemistry offers experiential learning opportunities for undergraduate students in which they can gain real-world experiences while also learning about the broader impacts of their work within their fields of study. All undergraduate students have the option to participate in a College of Sciences (COS) Signature Experience. Students should contact the Undergraduate Advisor(s) of Record for the Biochemistry or Chemistry majors for a list of relevant signature experiences.

- B.S. Degree in Chemistry (p. 2)
- B.S. Degree in Biochemistry (p. 3)
- B.A. Degree in Chemistry (p. 5)

Bachelor of Science Degree in Chemistry

The Bachelor of Science (B.S.) degree in Chemistry provides opportunities for preparation for careers in industry, governmental agencies, environmental studies, preprofessional programs, and medical technology, and for graduate study in chemistry or other related fields. The degree plan, as described below for the B.S degree in Chemistry, meets the minimum requirements for professional chemists as defined by the American Chemical Society, and recipients receive a certificate from the American Chemical Society. Students seeking a Bachelor of Science Degree in Chemistry are encouraged to take full advantage of the scientific opportunities available in the department by joining a research group.

A minimum number of 120 semester credit hours is required for the B.S. in Chemistry, including Core Curriculum requirements. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses must be completed with a grade of "C-" or better.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. degree in Chemistry must fulfill University Core Curriculum requirements in the same manner as other students. The courses listed below satisfy both degree requirements and Core Curriculum requirements; however, if these courses are taken to satisfy both requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

MAT 1213 may be used to satisfy the core requirement in Mathematics as well as a major requirement. The following two courses may be used to satisfy the core requirement in Life and Physical Sciences and major requirements: PHY 1943 and PHY 1963. STA 1053 may be used to satisfy the Component Area Option core requirement and a major requirement.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentarearequirements/)

First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
Total Credit Hours	**42**

Degree Requirements

Code	Title	Credit Hours
A. Required courses in chemistry		
CHE 1103	General Chemistry I	3
CHE 1113	General Chemistry II	3
CHE 1121	General Chemistry I Laboratory	1
CHE 1131	General Chemistry II Laboratory	1
CHE 2214	Analytical Chemistry	4
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
BCH 3303	Essentials of Biochemistry	3
CHE 3464	Descriptive Inorganic Chemistry	4
CHE 3643	Organic Chemistry II	3
CHE 3652	Organic Chemistry II Laboratory	2
CHE 3804	Molecular Thermodynamics	4
CHE 3812	Physical Chemistry Laboratory	2
CHE 3824	Quantum Chemistry and Spectroscopy	4
CHE 3973	Chemical Communications	3
CHE 4213	Instrumental Analysis	3
CHE 4463	Inorganic Chemistry	3
CHE 4613	Introduction to Polymer Chemistry	3
CHE 4912	Independent Study	2
or CHE 4922	Special Project	
B. Approved upper-division chemistry electives		
Select 6 additional semester credit hours of approved upper-division chemistry electives.		6
C. Support work in science, mathematics, and statistics		
1. Required courses:		
MAT 1213	Calculus I	3
MAT 1223	Calculus II	3
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	4
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	4
STA 1053	Basic Statistics	3
2. Elective work from the College of Science approved by the advisor		6
D. Electives		
Select 6 semester credit hours of electives		6
Total Credit Hours		**88**

Course Sequence Guide for B.S. Degree in Chemistry

This course sequence guide is designed to assist students in completing their B.S. Degree in Chemistry. *This course sequence is only a guide and*

students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans. Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

B.S. in Chemistry – Recommended Four-Year Academic Plan

First Year		
Fall		**Credit Hours**
AIS 1243	AIS: Engineering, Mathematics, and Sciences	3
CHE 1103	General Chemistry I	3
CHE 1121	General Chemistry I Laboratory [1]	1
MAT 1213	Calculus I	3
WRC 1013	Freshman Composition I (core)	3
	Credit Hours	**13**
Spring		
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory [1]	1
STA 1053	Basic Statistics (core and major)	3
WRC 1023	Freshman Composition II (core)	3
MAT 1223	Calculus II	3
Creative Arts (core)		3
	Credit Hours	**16**
Second Year		
Fall		
CHE 2214	Analytical Chemistry	4
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory [1]	2
American History (core)		3
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory (core and major)	4
	Credit Hours	**16**
Spring		
CHE 3643	Organic Chemistry II	3
CHE 3652	Organic Chemistry II Laboratory [1]	2
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory (core and major)	4
American History (core)		3
Government-Political Science (core)		3
	Credit Hours	**15**
Third Year		
Fall		
BCH 3303	Essentials of Biochemistry [2]	3
CHE 3804	Molecular Thermodynamics [2]	4
CHE 3973	Chemical Communications	3
Government-Political Science (core)		3
Language, Philosophy & Culture (core)		3
	Credit Hours	**16**
Spring		
CHE 3464	Descriptive Inorganic Chemistry [3]	4
CHE 3812	Physical Chemistry Laboratory [3]	2
CHE 3824	Quantum Chemistry and Spectroscopy [3]	4
Social & Behavioral Sciences (core)		3
Upper-division College of Sciences Elective		3
	Credit Hours	**16**
Fourth Year		
Fall		
CHE 4463	Inorganic Chemistry [2]	3
CHE 4912 or CHE 4922	Independent Study or Special Project	2
Free Elective		3
Upper-division CHE elective		3
Upper-division CHE elective		3
	Credit Hours	**14**
Spring		
CHE 4213	Instrumental Analysis [3]	3
CHE 4613	Introduction to Polymer Chemistry [3]	3
Free elective		3
Upper-division College of Sciences Elective		3
CHE 4912 or CHE 4922	Independent Study or Special Project	2
	Credit Hours	**14**
	Total Credit Hours	**120**

[1] These laboratory courses include a lecture component as indicated on the University Schedule of Classes.
[2] Course only offered in Fall.
[3] Course only offered in Spring.

Note: Some courses are only offered once a year: Fall or Spring. Check with the Department of Chemistry for scheduling of courses.

Bachelor of Science Degree in Biochemistry

The Bachelor of Science (B.S.) degree in Biochemistry provides opportunities for preparation for careers in industry, governmental agencies, environmental studies, preprofessional programs, and medical technology, and for graduate study in biochemistry or other related fields. It utilizes courses from the Chemistry, Biology, and Physics departments to structure education in all the major aspects of Biochemistry. The degree plan, as described below for the B.S. degree in Biochemistry meets the standards for accreditation by the American Society for Biochemistry and Molecular Biology, and graduates earn a degree certified by the professional society.

A minimum number of 120 semester credit hours is required for the B.S. in Biochemistry, including Core Curriculum requirements. At least 39 of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses must be completed with a grade of "C-" or better.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. degree in Biochemistry must fulfill University Core Curriculum requirements in the same manner as other students. The courses listed below satisfy both degree requirements and Core Curriculum requirements; however, if these courses are taken to satisfy both requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

- MAT 1213 may be used to satisfy the core requirement in Mathematics as well as a major requirement.
- The following two courses may be used to satisfy the core requirement in Life and Physical Sciences and major requirements: PHY 1943 and PHY 1963.
- BIO 1203 may be used to satisfy the Component Area Option core requirement.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentarearequirements/)	
First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
Total Credit Hours	**42**

Degree Requirements

Code	Title	Credit Hours
A. Required chemistry courses		
CHE 1103	General Chemistry I	3
CHE 1113	General Chemistry II	3
CHE 1121	General Chemistry I Laboratory	1
CHE 1131	General Chemistry II Laboratory	1
CHE 2214	Analytical Chemistry	4
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
CHE 3464	Descriptive Inorganic Chemistry	4
CHE 3643	Organic Chemistry II	3
CHE 3652	Organic Chemistry II Laboratory	2
CHE 3973	Chemical Communications	3
CHE 4354	Biophysical Chemistry	4
CHE 4912	Independent Study	2
BCH 3313	Biochemistry I	3
BCH 3332	Biochemistry I Laboratory	2
BCH 4313	Biochemistry II	3
BCH 4332	Biochemistry II Laboratory	2
B. Required biology courses		
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors	4
BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors	4
BIO 2313	Genetics	3
BIO 2362	Molecular Genetics Laboratory	2
NDRB 3813	Cell Biology	3
C. Upper-division chemistry (CHE), biology (BIO), molecular microbiology and immunology (MMI), and neuroscience, developmental and regenerative biology (NDRB) electives		**12**
Select 6 additional semester credit hours of approved upper-division electives, which must be organized courses in chemistry (CHE), biology (BIO), molecular microbiology and immunology (MMI), and neuroscience, developmental and regenerative biology (NDRB) at the 3000 level or above. Also, select 6 additional semester credit hours of approved upper-division College of Sciences (COS) electives, which must be organized courses in chemistry (CHE), biology (BIO), molecular microbiology and immunology (MMI), and neuroscience, developmental and regenerative biology (NDRB) at the 4000 level or above. No more than 6 semester credit hours may be from CHE/BIO/NDRB/MMI 4911/4912/4913, or CHE 4993.		
D. Support work in science and mathematics		
1. Required courses		
STA 1053	Basic Statistics	3
or STA 1403	Probability and Statistics for the Biosciences	
MAT 1213	Calculus I	3
MAT 1223	Calculus II	3
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	4
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	4
Total Credit Hours		**90**

Course Sequence Guide for B.S. Degree in Biochemistry

This course sequence guide is designed to assist students in completing their B.S. Degree in Biochemistry. *This course sequence is only a guide, and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

B.S. in Biochemistry – Recommended Four-Year Academic Plan

First Year		
Fall		**Credit Hours**
AIS 1243	AIS: Engineering, Mathematics, and Sciences	3
BIO 1203 & BIO 1201	Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors	4
CHE 1103	General Chemistry I	3

CHE 1121	General Chemistry I Laboratory [1]	1
MAT 1213	Calculus I	3
	Credit Hours	**14**
Spring		
BIO 1223 & BIO 1221	Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors	4
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory [1]	1
MAT 1223	Calculus II	3
WRC 1013	Freshman Composition I (core)	3
	Credit Hours	**14**
Second Year		
Fall		
BIO 2313	Genetics	3
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory [1]	2
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory (core and major)	4
Government-Political Science (core)		3
	Credit Hours	**15**
Spring		
BIO 2362	Molecular Genetics Laboratory	2
CHE 3643	Organic Chemistry II	3
CHE 3652	Organic Chemistry II Laboratory [1]	2
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory (core and major)	4
WRC 1023	Freshman Composition II (core)	3
	Credit Hours	**14**
Third Year		
Fall		
BCH 3313	Biochemistry I [2]	3
BCH 3332	Biochemistry I Laboratory [2]	2
CHE 2214	Analytical Chemistry	4
NDRB 3813	Cell Biology	3
American History (core)		3
	Credit Hours	**15**
Spring		
BCH 4313	Biochemistry II [3]	3
BCH 4332	Biochemistry II Laboratory [3]	2
STA 1053 or STA 1403	Basic Statistics or Probability and Statistics for the Biosciences	3
American History (core)		3
Creative Arts (core)		3
COS Elective		3
	Credit Hours	**17**
Fourth Year		
Fall		
CHE 3973	Chemical Communications	3
CHE 4912	Independent Study	2
Government-Political Science (core)		3
Social & Behavioral Sciences (core)		3
Upper-division BIO or CHE elective I		3
	Credit Hours	**14**
Spring		
CHE 3464	Descriptive Inorganic Chemistry [3]	4
CHE 4354	Biophysical Chemistry [3]	4
Language, Philosophy, & Culture (core)		3
Upper-division BIO or CHE elective II		3
COS Elective		3
	Credit Hours	**17**
	Total Credit Hours	**120**

[1] These laboratory courses include a lecture component as indicated on the University Schedule of Classes.
[2] Course only offered in Fall.
[3] Course only offered in Spring.

Note: Some courses are only offered once a year: Fall or Spring. Check with the Departments of Chemistry and Biology for scheduling of courses.

Bachelor of Arts Degree in Chemistry

The Bachelor of Arts (B.A.) degree in Chemistry provides preparation for careers in industry, governmental agencies, environmental studies, educators seeking to teach courses at the secondary school level, and pre-professional programs, but it is not recommended for students planning to pursue graduate studies in chemistry or related fields. This degree plan does not meet the criteria for an American Chemical Society-approved degree in Chemistry.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 120, at least 39 of which must be at the upper-division level.

All major and support work courses must be completed with a grade of "C-" or better.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.A. degree in Chemistry must fulfill University Core Curriculum requirements in the same manner as other students. The courses listed below satisfy both degree requirements and Core Curriculum requirements; however, if these courses are taken to satisfy both requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

MAT 1213 may be used to satisfy the core requirement in Mathematics as well as a major requirement.

The following two courses may be used to satisfy the core requirement in Life and Physical Sciences and major requirements: PHY 1943 and PHY 1963.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentareareq uirements/)	
First Year Experience Requirement	3
Communication	6
Mathematics	3
Life and Physical Sciences	6
Language, Philosophy and Culture	3
Creative Arts	3
American History	6
Government-Political Science	6
Social and Behavioral Sciences	3
Component Area Option	3
Total Credit Hours	**42**

Degree Requirements

Code	Title	Credit Hours
A. Required chemistry courses		
CHE 1103	General Chemistry I	3
CHE 1113	General Chemistry II	3
CHE 1121	General Chemistry I Laboratory	1
CHE 1131	General Chemistry II Laboratory	1
CHE 2214	Analytical Chemistry	4
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
BCH 3303	Essentials of Biochemistry	3
CHE 3464	Descriptive Inorganic Chemistry	4
CHE 3643	Organic Chemistry II	3
CHE 3652	Organic Chemistry II Laboratory	2
CHE 3973	Chemical Communications	3
CHE 4354	Biophysical Chemistry	4
B. Upper-division chemistry electives		
Select 12 additional semester credit hours of approved upper-division chemistry electives; no more than 6 semester credit hours may be from CHE 4911, CHE 4912, CHE 4913, CHE 4922, CHE 4923, or CHE 4993.		12
C. Support work in science and mathematics		
1. Required courses:		
MAT 1213	Calculus I	3
MAT 1223	Calculus II	3
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory	4
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory	4
2. Select 18 additional semester credit hours of approved upper-division electives from the College of Sciences. Up to 6 semester credit hours may be from the Klesse College of Engineering and Integrated Design with departmental approval.		18
D. Electives		
Select 7 semester credit hours of electives		7
Total Credit Hours		**87**

Course Sequence Guide for B.A. Degree in Chemistry

This course sequence guide is designed to assist students in completing their B.A. Degree in Chemistry. *This course sequence is only a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

B.A. in Chemistry – Recommended Four-Year Academic Plan

First Year		
Fall		**Credit Hours**
AIS 1243	AIS: Engineering, Mathematics, and Sciences	3
CHE 1103	General Chemistry I	3
CHE 1121	General Chemistry I Laboratory [1]	1
MAT 1213	Calculus I	3
WRC 1013	Freshman Composition I (core)	3
	Credit Hours	**13**
Spring		
CHE 1113	General Chemistry II	3
CHE 1131	General Chemistry II Laboratory [1]	1
MAT 1223	Calculus II	3
WRC 1023	Freshman Composition II (core)	3
Social & Behavioral Sciences (core)		3
Creative Arts (Core)		3
	Credit Hours	**16**
Second Year		
Fall		
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory [1]	2
PHY 1943 & PHY 1951	Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory (core)	4
American History (core)		3
Government-Political Science (core)		3
	Credit Hours	**15**
Spring		
CHE 3643	Organic Chemistry II	3
CHE 3652	Organic Chemistry II Laboratory [1]	2
PHY 1963 & PHY 1971	Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory (Core)	4
Government-Political Science (core)		3
Language, Philosophy and Culture (core)		3
	Credit Hours	**15**
Third Year		
Fall		
BCH 3303	Essentials of Biochemistry	3
CHE 2214	Analytical Chemistry	4
Upper-division COS elective		3
Upper-division COS elective		3

American History (core)		3
	Credit Hours	**16**
Spring		
CHE 3464	Descriptive Inorganic Chemistry [3]	4
CHE 3973	Chemical Communications	3
Upper-division COS elective (CHE 4912 recommended)		2
Free Elective		3
Component Area Option (Core)		3
	Credit Hours	**15**
Fourth Year		
Fall		
Upper-division CHE elective		3
Upper-division CHE elective		3
Upper-division CHE elective		3
Upper-division COS elective		3
Upper-division COS elective		3
	Credit Hours	**15**
Spring		
CHE 4354	Biophysical Chemistry	4
Upper-division COS elective		3
Upper-division COS elective		3
Free elective		2
Free elective		3
	Credit Hours	**15**
	Total Credit Hours	**120**

[1] These laboratory courses include a lecture component as indicated on the University Schedule of Classes.
[2] Course only offered in Fall.
[3] Course only offered in Spring.

Note: Some courses are only offered once a year: Fall or Spring. Check with the Department of Chemistry for scheduling of courses

Minor in Chemistry

This minor permits students majoring in other areas to obtain a solid, broad-based knowledge of chemistry. The minor is applicable to students in other areas of science and in preprofessional programs. All coursework for the Minor in Chemistry must be completed with a grade of “C-” or better. All students pursuing the Minor in Chemistry must complete 23 semester credit hours. Proposed minor sequences: To receive a minor, students must complete at least 16 semester hours, including 7 hours at the upper-division level at UTSA, and must achieve a grade point average of at least 2.0 (on a 4.0 scale) on all work used to satisfy the requirements of a minor.

Code	Title	Credit Hours
A. Required courses		
CHE 1103	General Chemistry I	3
CHE 1113	General Chemistry II	3
CHE 1121	General Chemistry I Laboratory	1
CHE 1131	General Chemistry II Laboratory	1
CHE 2603	Organic Chemistry I	3
CHE 2612	Organic Chemistry I Laboratory	2
CHE 3643	Organic Chemistry II	3
B. Additional chemistry courses		
Select 7 additional hours of 3000- or 4000-level chemistry courses including at least one laboratory-based course:		7
BCH 3313	Biochemistry I	
BCH 3332	Biochemistry I Laboratory	
BCH 4313	Biochemistry II	
CHE 2214	Analytical Chemistry	
CHE 3464	Descriptive Inorganic Chemistry	
CHE 3652	Organic Chemistry II Laboratory	
CHE 3812	Physical Chemistry Laboratory	
CHE 4354	Biophysical Chemistry [1]	
CHE 3804	Molecular Thermodynamics	
CHE 3824	Quantum Chemistry and Spectroscopy	
Any 4000-level CHE course		
Total Credit Hours		**23**

[1] Course only offered in Spring.

To declare a Minor in Chemistry, obtain advice, or seek approval of substitutions for course requirements, students should consult their academic advisor.

Biochemistry (BCH) Courses

BCH 2903. Biochemistry for the Life Sciences. (3-0) 3 Credit Hours. Prerequisite: BIO 1203, BIO 1223, CHE 2603, and CHE 2612 with a grade of "C-" or better. This is a one-semester course designed for majors in Nutrition & Dietetics, and for Biology and Neuroscience majors not planning to pursue health-profession graduate programs that require further exposure to biochemistry and chemistry content. Introduction to biochemistry: amino acids, protein structure, enzymes, lipids, metabolism, nucleic acid structure, bioenergetics, and carbohydrates. (May not be applied to a B.S. in Biochemistry or Chemistry. Formerly BIO 3513. Credit cannot be earned for both BCH 2903 and BIO 3513.) Generally offered: Fall and Spring. Course Fee: DL01 $75.

BCH 3303. Essentials of Biochemistry. (3-0) 3 Credit Hours. Prerequisite: A grade of "C-" or better in CHE 3643. This is a one-semester course designed for majors in Chemistry and Microbiology & Immunology and all students planning to pursue health-profession graduate programs that require exposure to specific biochemistry and chemistry content, including those in Biology and Neuroscience majors on a pre-health track. This course will overview the structure and function relationships of biological molecules, energy production, storage and utilization, amino acids, nucleic acids, peptides and proteins, and intermediary metabolism. May not be applied to a B.S. in Biochemistry. (Formerly CHE 3303. Same as BIO 3513. Credit cannot be earned for BCH 3303 and any of the following: BIO 3513 or CHE 3303.) Generally offered: Fall and Spring. This course has Differential Tuition. Course Fee: DL01 $75.00.

BCH 3312. Biochemistry Laboratory for the Life Sciences. (1-4) 2 Credit Hours.
Prerequisite: BIO 2362, CHE 2612, and completion or concurrent enrollment in MAT 1093 or higher. This one-semester lab course is designed for all students majoring in Nutrition & Dietetics, Biology, Chemistry, and Neuroscience and those planning to pursue health-profession graduate programs. Microbiology and Immunology majors may choose this 1-course lab. A study of the microscopic, biochemical, and molecular techniques used to investigate biochemical reactions and the structure and function of proteins in cells and tissues. Techniques will include: protein extraction, protein characterization, enzyme kinetics, chromatography, western blotting, Immunofluorescence, and bioinformatics. May not be applied to a B.S. in Biochemistry. (Formerly BIO 3362, BIO 3522, BIO 3822, NDRB 3362, and BME 3114. Credit cannot be earned for BCH 3312 and any of the following: BIO 3362, BIO 3522, BIO 3822, NDRB 3362, or BME 3114.) Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: DL01 $50; IUC1 $15; L001 $30.

BCH 3313. Biochemistry I. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643. This course is the first of a two-semester sequence designed for Biochemistry majors. This course will study the structure and function of biological molecules (proteins, sugars, lipids, and nucleic acids) and the kinetics and regulation of enzymes. (Formerly CHE 3313 and CHE 4303. Credit cannot be earned for BCH 3313 and any of the following: CHE 3313 or CHE 4303.) Generally offered: Fall. This course has Differential Tuition.

BCH 3332. Biochemistry I Laboratory. (1-4) 2 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3652. This course is intended as the first of a two-semester sequence designed for Biochemistry majors. Microbiology and Immunology majors may choose this two-course lab sequence. It will include topics on biochemical laboratory techniques. (Formerly BIO 3362. Credit cannot be earned for both BIO 3362 and BCH 3332.) Generally offered: Fall. This course has Differential Tuition. Course Fee: IUC1 $15; L001 $30; DL01 $50.

BCH 4313. Biochemistry II. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in PHY 1963 and BCH 3313 (BCH 2903, BCH 3303, and CHE 3303 (in previous catalogs) are not acceptable substitutes for BCH 3313). This course is the continuation of the two-semester sequence designed for Biochemistry majors. This course will cover metabolic pathways. (Formerly CHE 4313. Credit cannot be earned for both BCH 4313 and CHE 4313.) Generally offered: Spring. This course has Differential Tuition. Course Fee: DL01 $75.

BCH 4332. Biochemistry II Laboratory. (1-4) 2 Credit Hours.
Prerequisite: A grade of "C-" or better in PHY 1971 or BCH 3332 (or BIO 3362 or NDRB 3362 in previous catalogs), and completion of or concurrent enrollment in BCH 4313. This course is the second of a two-semester sequence designed for Biochemistry majors. Microbiology and Immunology majors may choose this two-course lab sequence. This is a course-based undergraduate research experiential laboratory focusing on the methodologies of modern biochemistry. (Formerly CHE 4332. Credit cannot be earned for CHE 4332 and BCH 4332.) Generally offered: Spring. This course has Differential Tuition. Course Fee: DL01 $50; L001 $30; IUC1 $15.

Chemistry (CHE) Courses

CHE 1004. Chemistry for Allied Health Sciences. (3-3) 4 Credit Hours. (TCCN = CHEM 1405)
Introduction to atomic structure, chemical bonding, stoichiometry, states of matter, inorganic chemical reactions, and acids and bases. The course has a laboratory component to introduce general chemical laboratory techniques, principles, and methods to reinforce lecture topics. For majors in occupational therapy, pre-nursing, and dental hygiene. May not be applied to a major or minor in chemistry, biology, or clinical laboratory sciences. (Formerly CHE 1003 and CHE 1011. CHE 1083 cannot be taken as a substitution for CHE 1004. Credit can only be earned for one of the following: CHE 1003, CHE 1011, CHE 1083, or CHE 1004.). Generally offered: Fall and Spring. Course Fees: IUC1 $15; L001 $30; LRS1 $61.60; STSI $28.80.

CHE 1014. Elementary Organic and Biochemistry. (3-3) 4 Credit Hours. (TCCN = CHEM 1407)
Prerequisite: A grade of "C-" or better in CHE 1004. A survey of the structures and reactions of some important functional groups of organic chemistry, and the relationship of these functional groups to the chemistry of lipids, carbohydrates, nucleic acids, and proteins. May not be applied to a major or minor in chemistry. Laboratory examination of the properties of some simple organic and biological chemicals; topics include solubility, crystallization, organic reactions, titration, enzyme action, sugars, and vitamins which will directly reinforce lecture topics. (Formerly CHE 1013 and CHE 1203. CHE 1093 cannot be taken as a substitution for CHE 1014. Credit can be earned for only ONE of the following: CHE 1013, CHE 1014, CHE 1093, or CHE 1203.) Generally offered: Spring. Course Fees: IUC1 $15; L001 $30; LRS1 $61.60; STSI $28.80; DL01 $100.

CHE 1073. Basic Chemistry. (3-0) 3 Credit Hours.
A preparatory class for CHE 1103. This course focuses on traditionally difficult concepts encountered in CHE 1103. Topics include, but are not limited to, dimensional analysis, significant figures, inorganic nomenclature, and qualitative and quantitative analyses of basic chemical reactions. May not be applied to a B.S. or B.A. in Chemistry nor to the B.S. in Biochemistry. Generally offered: Fall, Spring, Summer. Course Fees: LRS1 $46.20; STSI $21.60; DL01 $75.

CHE 1083. Introduction to the Molecular Structure of Matter. (3-0) 3 Credit Hours.
This course is an introduction to the structure of matter, with a focus on the molecules of carbon that comprise living systems. Topics include covalent and ionic bonding, molecular structure, shape, and stability, isomers, organic functional groups and charge distribution in molecules, and bonding in solids. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (CHE 1004 cannot be taken as a substitution for CHE 1083, credit cannot be earned for both courses.) Course Fee: LRC1 $12; LRS1 $46.20; STSI $21.60; DL01 $75.

CHE 1093. Introduction to Molecular Transformations. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 1083 and in MAT 1073 or higher. This course is an introduction to chemical reactions, with a focus on basic organic and inorganic reactions that take place in the environment. Topics include classification of reactions, stoichiometry, reaction energetics, chemical equilibrium, acid-base chemistry, complex equilibria and reaction kinetics. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (CHE 1014 cannot be taken as a substitution for CHE 1093, credit cannot be earned for both courses.) Course Fee: DL01 $75; LRC1 $12; LRS1 $46.20; STSI $21.60.

CHE 1103. General Chemistry I. (3-0) 3 Credit Hours. (TCCN = CHEM 1311)
Prerequisite: AP Chemistry Score of 3 or greater, or a grade of "C-" or better in CHE 1073, or above 70% mastery in the ALEKS Chemistry assessment; concurrent enrollment in CHE 1121 is recommended. An introduction to descriptive inorganic chemistry and atomic-molecular structure, including such fundamental concepts as the periodic system of elements, valency, chemical bonding, reactions and reaction mechanisms, stoichiometry, equilibria, acids and bases, thermochemistry, molecular-kinetic theory, dimensional analysis, and states of matter. Generally offered: Fall, Spring, Summer. Course Fee: LRS1 $46.20; STSI $21.60; DL01 $75.

CHE 1113. General Chemistry II. (3-0) 3 Credit Hours. (TCCN = CHEM 1312)
Prerequisite: A grade of "C-" or better in CHE 1103 or the equivalent. A continuation of CHE 1103. Elementary inorganic and physical chemistry; topics include states of matter, solutions, electrolytes, oxidation-reduction reactions, reaction trends, coordination chemistry, basic thermodynamics, chemical kinetics, electrochemistry, acid-base chemistry, and nuclear chemistry. Primarily for science majors. Generally offered: Fall, Spring, Summer. Course Fee: LRS1 $46.20; STSI $21.60; DL01 $75.

CHE 1121. General Chemistry I Laboratory. (1-4) 1 Credit Hour. (TCCN = CHEM 1111)
Prerequisite: A grade of "C-" or better in CHE 1103 or concurrent enrollment in CHE 1103. An introduction to chemical problem solving and the basic operations of the chemical laboratory, chemical writing, and a survey of inorganic chemical reactions. This course consists of problem sessions, lecture-demonstrations, and/or laboratory experience. Laboratory to accompany CHE 1103. This laboratory includes a lecture component. Generally offered: Fall, Spring, Summer. Course Fee: IUC1 $15; L001 $30; LRS1 $15.40; STSI $7.20; DL01 $25.

CHE 1131. General Chemistry II Laboratory. (1-4) 1 Credit Hour. (TCCN = CHEM 1112)
Prerequisite: A grade of "C-" or better in CHE 1103 and CHE 1121, and a grade of "C-" or better or concurrent enrollment in CHE 1113. Techniques of qualitative and quantitative chemical analysis illustrated primarily via inorganic chemical systems, their reactions, and chemical writing. Laboratory to accompany CHE 1113. This laboratory includes a lecture component. Generally offered: Fall, Spring, Summer. Course Fee: IUC1 $15; L001 $30; LRS1 $15.40; STSI $7.20; DL01 $25.

CHE 2214. Analytical Chemistry. (2-6) 4 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 1113 and CHE 1131. Topics in quantitative chemical analysis based on the concepts of the analytical process, calibration plot, standard addition, internal standard, stoichiometry, concentration, chemical equilibrium, titration, solubility, acid-base chemistry, complexation, oxidation/reduction, voltaic/electrolytic cells, light absorption, chemical separations, and statistical error analysis (lecture and laboratory). Formerly CHE 3214. Credit cannot be earned for both CHE 3214 and CHE 2214. General offered: Fall, Spring. Differential tuition: $200. Course Fee: IUC1 $15; L001 $30.

CHE 2603. Organic Chemistry I. (3-0) 3 Credit Hours. (TCCN = CHEM 2323)
Prerequisite: A grade of "C-" or better in CHE 1113. A study of the fundamentals of organic chemistry including structure, reaction mechanisms, synthesis, and spectroscopy. Discussion and problems amplify and clarify the course topics. (Same as CHE 2703. Credit cannot be earned for more than one of the following: CHE 2603 or CHE 2703.) Generally offered: Fall, Spring, Summer. Course Fee: LRS1 $46.20; STSI $21.60; DL01 $75.

CHE 2612. Organic Chemistry I Laboratory. (1-4) 2 Credit Hours.
Prerequisites: A grade of "C-" or better, or concurrent enrollment, in CHE 1131 and CHE 2603. The first of two semesters of organic chemistry laboratory. Qualitative analysis and determination of the physical constants of organic compounds. Separation, identification, and elementary synthesis of organic compounds. Laboratory techniques —crystallization, distillation, chromatographic and spectroscopic techniques (IR, NMR, MS)—are emphasized. This laboratory includes a lecture component. Generally offered: Fall, Spring, Summer. Course Fees: IUC1 $15; L001 $30; LRS1 $30.80; STSI $14.40; DL01 $50.

CHE 3464. Descriptive Inorganic Chemistry. (3-3) 4 Credit Hours.
Prerequisites: A grade of "C-" or better in CHE 1113 and CHE 1131. The basic principles of inorganic chemistry applied to the properties, reactions, and periodicity of inorganic elements and compounds. Includes the synthesis and characterization of inorganic compounds, and the use of specialized laboratory techniques. Generally offered: Spring. This course has Differential Tuition. Course Fees: IUC1 $15; L001 $30.

CHE 3643. Organic Chemistry II. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 2603 (or CHE 2703 in previous catalogs). Continuing study of fundamentals of organic structure, reaction mechanisms, synthesis, and spectroscopy. A continuation of CHE 2603. Credit cannot be earned for both CHE 3703 and CHE 3643. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

CHE 3652. Organic Chemistry II Laboratory. (1-4) 2 Credit Hours.
Prerequisites: Grades of "C-" or better in CHE 2603 (or CHE 2703 in previous catalogs), and CHE 2612. Quantitative and continuing qualitative study of organic reactions and molecular structure through functional group interactions and spectroscopic techniques. Simple and multistep syntheses of organic compounds. A continuation of CHE 2612. This laboratory includes a lecture component. Generally offered: Fall, Spring, Summer. This course has Differential Tuition. Course Fees: IUC1 $15; L001 $30; DL01 $50.

CHE 3804. Molecular Thermodynamics. (4-0) 4 Credit Hours.
Prerequisites: A grade of "C-" or better in CHE 1113, MAT 1223 (MAT 1224 in previous catalogs), and PHY 1963. The laws of thermodynamics, free energy and chemical potential, ideal and non-ideal gases, phase transitions, equilibria, solutions, and kinetic theory of gases. Mathematical methods and concepts related to the study of thermodynamics. (Formerly titled "Physical Chemistry I and Laboratory.") Generally offered: Fall. This course has Differential Tuition. Course Fees: IUC1 $15; L001 $30; DL01 $100.

CHE 3812. Physical Chemistry Laboratory. (0-6) 2 Credit Hours.
Prerequisites: A grade of "C-" or better in CHE 1113, CHE 1131, CHE 3804 or CHE 3824, PHY 1963, and PHY 1971. Laboratory study of selected physiochemical principles and methods illustrating concepts developed in CHE 3804 and CHE 3824. Data acquisition, data analysis, and report writing are stressed. Generally offered: Spring. This course has Differential Tuition. Course Fees: IUC1 $15; L001 $30.

CHE 3824. Quantum Chemistry and Spectroscopy. (4-0) 4 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 1113, MAT 1223 (or MAT 1224 in previous catalogs), and PHY 1963. Introduction to atomic and molecular quantum chemistry, group theory, and electronic, rotational, vibrational, and electronic spectroscopies. Mathematical methods and concepts related to quantum theory and molecular spectroscopy. (Formerly titled "Physical Chemistry II and Laboratory.") Generally offered: Spring. This course has Differential Tuition. Course Fee: IUC1 $15; L001 $30; DL01 $100.

CHE 3973. Chemical Communications. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643 and CHE 3652. Introduction to communication techniques used in the chemistry profession, including writing résumés and proposals, researching topics in the chemical literature, review and analysis of articles and other scientific materials, and oral presentation of chemical research. Same as CHE 4971, credit cannot be earned for both CHE 3973 and CHE 4971. Generally offered: Fall, Spring. This course has Differential Tuition.

CHE 4213. Instrumental Analysis. (2-5) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 2214 and CHE 3652, and a grade of "C-" or better or concurrent enrollment in CHE 3824. The physical and chemical principles of modern instrumental techniques used for chemical analysis. Topics include emission, absorption, magnetic resonance, FTIR spectroscopies, mass spectrometry, and chromatography. The use of spectrometric and chromatographic instrumentation in the separation, identification, and quantitation of compounds in chemical systems. Generally offered: Spring. This course has Differential Tuition. Course Fee: IUC1 $15; L001 $30.

CHE 4273. Forensic Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 2214, CHE 3652, and CHE 3804 or CHE 4354 (formerly CHE 3854). Application of chemical analyses with real world and legal implications. Topics include statistics, sample handling and preparation, analysis of drugs, combustion products, inks and paints, and colors and colorants. The use of spectrometric and chromatographic instrumentation in the separation, identification, and quantitation of compounds in chemical systems will be developed. This course has Differential Tuition.

CHE 4354. Biophysical Chemistry. (3-3) 4 Credit Hours.
Prerequisite: A grade of "C-" or better in BCH 3313 (or CHE 3313 in previous catalogs), CHE 3643, MAT 1213 (or MAT 1214 in previous catalogs), PHY 1963 or PHY 1623, and PHY 1971 or PHY 1631. Fundamental aspects of the physical principles that drive biological processes, particularly as applied to proteins. Topics covered include protein structure, molecular thermodynamics, structure simulation, basic statistical mechanics, quantum mechanics, and spectroscopy. This course cannot be used as an upper-division chemistry elective by students pursuing a B.S. in Chemistry. Formerly CHE 3854. Credit cannot be earned for both CHE 4354 and CHE 3854. Generally offered: Spring. This course has Differential Tuition. Course Fee: IUC1 $15; L001 $30.

CHE 4443. Green Chemistry. (3-0) 3 Credit Hours.
Prerequisites: A grade of "C-" or better in CHE 3464 and CHE 3643, or consent of instructor. Overview of the 12 principles of green chemistry, the chemical tools utilized, and relevant examples of their practical use in commercial applications. The focus is on sustainability ethics and the primary challenges in green chemistry, including development and hazards to health and the environment. This course has Differential Tuition.

CHE 4463. Inorganic Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3464, and completion of or concurrent enrollment in CHE 3804 or CHE 4354 (formerly CHE 3854). A study of the structure, bonding, and properties of inorganic compounds, acid-base theory, crystalline state, coordination chemistry, and other advanced topics. Generally offered: Fall. This course has Differential Tuition.

CHE 4483. Solid State Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 1113. An introduction to inorganic materials and solid state chemistry for graduate students and advanced undergraduate students. The focus is on understanding solid state materials from a structural and chemical perspective and introducing general solid state synthesis methodologies and characterization techniques. This course has Differential Tuition.

CHE 4513. X-Ray Crystallography. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3464 or consent of instructor. Topics include a physical description of the crystalline state, symmetry in crystals, X-ray diffraction, modern methods of structural determination, crystallographic software and databases, and chemical interpretation of structural results. This course has Differential Tuition.

CHE 4613. Introduction to Polymer Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643. Introduction to principles of polymer chemistry. Molecular weight analysis, solution properties, structure-property relationships, mechanical and chemical properties, polymer synthesis, conducting polymers, biopolymers, and applications of polymers. Generally offered: Spring. This course has Differential Tuition.

CHE 4643. Advanced Topics in Organic Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643. This course prepares students for graduate study in organic chemistry. Topics include physical organic chemistry, molecular orbital theory, transition state theory, hard soft acid-base theory, organometallics, and catalysis. This course has Differential Tuition.

CHE 4683. Photochemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643. Principles of the interaction of light with molecular, polymer, and materials systems. Photophysical processes including light absorption, emission, and excited state kinetics. Mechanisms of organic and inorganic molecular photoreactions. Applications of photo processes including photocatalysis, solar cells, photochromism, and light-emitting diodes. This course has Differential Tuition.

CHE 4703. Drug Metabolism. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643 or consent of the instructor. This course covers how drugs are metabolized in the body, including the mechanisms for enzyme-catalyzed reactions, with an emphasis on how to propose and experimentally test various hypotheses. This course has Differential Tuition.

CHE 4723. Pharmaceutical Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643. Exploration of the process of drug discovery and development with particular emphasis on the role of organic chemistry. Topics include the design of new drugs, their interaction with biological targets, the application of medicinal chemistry in lead optimization, and large-scale drug synthesis and development. This course has Differential Tuition.

CHE 4753. NMR Spectroscopy. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643. Introduction to the techniques of 1H, 13C, and multinuclear NMR spectroscopy for structure elucidation in organic chemistry. Topics include the principles of NMR spectroscopy and the role of chemical shift, coupling constants, and splitting patterns. Multi-pulse experiments and 2-dimensional techniques are also discussed. Generally offered: Spring. This course has Differential Tuition.

CHE 4763. Medicinal Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643 and in BCH 3313 (or CHE 3313 in previous catalogs). Application of the principles of organic chemistry to medicinal studies, including drug discovery and design, drug synthesis, and chemical interactions in living systems. This course has Differential Tuition.

CHE 4773. Advanced Catalysis. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3643 and CHE 3464. Advanced topics in chemical catalysis and its application to the organic synthesis of complex molecules. Systems studied include important traditional catalytic processes and new methods introduced in the recent scientific literature. This course has Differential Tuition.

CHE 4823. Chemical Kinetics and Dynamics. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3804, and either MAT 1223 (or MAT 1224 in previous catalogs) or PHY 1963, or consent of the instructor. Mechanism and rate of chemical reactions from a fundamental point of view, the nature of collisions including cross section and rate constant, and theories of elementary bimolecular and decay processes. The course examines different rate laws, the method of steady-state approximation, and its application to chemical reactions. This course has Differential Tuition.

CHE 4853. Computational Chemistry. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3824 or consent of instructor. The application of molecular mechanical, molecular orbital, and density functional methods to problems of molecular structure, property, reactivity, and spectroscopy. Generally offered: Summer. This course has Differential Tuition.

CHE 4883. Introduction to Mass Spectrometry. (2-3) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3804 or CHE 4354, or consent of instructor. The basic principles of interpreting mass spectra and how they are produced. The effect the method of ion production has on the observed mass spectra, and the theory and operation of several types of mass spectrometers will be covered. The basic theory of ion-molecule reactions and principles and practice of biological mass spectrometry and other advanced topics will be presented. This course has Differential Tuition. Course Fee: IUC1 $15; L001 $30.

CHE 4911. Independent Study. (0-0) 1 Credit Hour.
Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; the registration form is available on the UTSA OneStop website. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

CHE 4912. Independent Study. (0-0) 2 Credit Hours.
Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; registration form available on the UTSA OneStop website. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

CHE 4913. Independent Study. (0-0) 3 Credit Hours.
Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; registration form available on the UTSA OneStop website. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

CHE 4922. Special Project. (0-0) 2 Credit Hours.
Special Project in Chemistry. A special laboratory research or library readings project under the direction of a faculty member that results in a report. Limited to science majors in their final year of undergraduate study. Course may not be repeated for more than 6 hours. This course has Differential Tuition.

CHE 4923. Special Project in Chemistry. (0-0) 3 Credit Hours.
Prerequisite: Consent of Department Chair (form available in department office). A special laboratory research or library readings project under the direction of a faculty member that results in a report. Limited to science majors in their final year of undergraduate study. This course has Differential Tuition.

CHE 4933. Internship. (0-0) 3 Credit Hours.
Prerequisite: Juniors or Seniors in Academic Good Standing and approval from the employer, the instructor, the Department Chair, and the Associate Dean for Undergraduate Studies; registration form available on the College of Sciences website. The opportunity for a semester-long work experience in a private business or public agency in a position related to the student's field of study. May be repeated for credit, but no more than 6 semester credit hours of CHE 4911, CHE 4912, CHE 4913, CHE 4933, and CHE 4993, regardless of discipline, will apply to a bachelor's degree. This course has Differential Tuition.

CHE 4943. Molecular Spectroscopy. (3-0) 3 Credit Hours.
Prerequisite: A grade of "C-" or better in CHE 3824. The foundation of spectroscopic methods and the interpretation of spectra for the identification and elucidation of structures and properties of molecules will be presented. Topics include the absorption and emission of radiation, group theory, microwave, infrared, Raman, UV/Visible, and photo-electron spectroscopies. This course has Differential Tuition.

CHE 4953. Special Studies in Chemistry. (3-0) 3 Credit Hours.
Prerequisite: Upper division standing and consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

CHE 4993. Directed Research. (0-0) 3 Credit Hours.
Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. Students may produce a thesis in addition to active research. May be repeated. This course can also be used for students pursuing the COS Undergraduate Thesis Option. Generally offered: Fall, Spring. This course has Differential Tuition.