CHEMISTRY

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Bachelor of Science in Chemistry / Sample Four-Year Program for Bachelor of Science in Chemistry / Bachelor of Arts in Chemistry / Sample Four-year Program for Bachelor of Arts in Chemistry / Bachelor of Arts in Chemistry: Biochemistry / Sample Four-year Program for Bachelor of Arts in Chemistry: Biochemistry/ Chemistry Minor or Secondary Education Teaching Credential Preparation / Individual Class Descriptions

Programs offered

Bachelor of Science in Chemistry (certified by the American Chemical Society)
Bachelor of Arts in Chemistry

Bachelor of Arts in Chemistry with Concentration in Biochemistry
Minor in Chemistry

Teaching Credential Preparation

Chemistry is the study of matter, its properties, and how it changes. An understanding of chemical principles is required to fully understand most scientific disciplines such as biology, medicine, physics, environmental science, geology, materials science, pharmaceuticals, agriculture, forensic science, most branches of engineering, and even studio art. Chemists not only study molecules that nature provides but they also synthesize new molecules to be used in many of these fields. Sonoma State University is fortunate to be situated within the greater Bay Area, which is rapidly becoming a leading area for research in disciplines such as biotechnology, pharmaceuticals, materials science, and proteomics.

The department offers both bachelor of arts and bachelor of science degrees. Both degrees provide a student with a solid chemical foundation to prepare them for graduate school, professional school, or to enter the workforce. The B.S. degree requires more science coursework while the B.A. allows more flexibility for other academic interests. The B.A. with concentration in biochemistry is designed for students with an interest in the biological aspects of chemistry.

Sonoma State graduates have a high success rate for acceptance into advanced degree programs in chemistry, biochemistry, medical, dental, and veterinary schools, cell and molecular biology, and materials science. They have also entered the job market in a variety of careers, including government agencies (FBI, forensics), technical writing, chemical and biochemical research, cosmetics and perfumes, space chemistry, teaching at all levels, medical technology, pharmaceuticals, patent law, materials research, consulting, and applications of chemistry in business.

Students seeking a teaching credential may elect chemistry as their major within the teaching credential program in science.

The small size and educational philosophy of the department encourage students to develop close relationships with other students, faculty and staff. Coursework and individual research projects place an emphasis on laboratory experiences in which students are expected to become familiar with a variety of techniques and instruments. The department is well equipped with many modern, computerized instruments that are available for laboratory courses and research projects.

Instrumentation includes ultraviolet, visible, infrared, atomic absorption, and fluorescence spectrophotometers; nuclear magnetic resonance spectrometer; high-pressure liquid, gas, and ion exchange chromatographs; and a gas chromatograph with mass spectrometer detector.

Bachelor of Science in Chemistry (certified by the American Chemical Society)

The B.S. degree provides thorough preparation for students who wish to pursue advanced degrees in the chemical sciences, go to professional school, or work as chemists in industry. All courses in the major core, major electives, and supporting courses must be taken in the traditional grading mode (A-F). It is highly recommended that students perform undergraduate research with a faculty member. Transcripts will be noted as approved by the American Chemical Society.

Please see the current approved curriculum on the SSU official catalog web page.

Major Core Requirements

CHEM 115AB, General Chemistry (10 units, 5 in the major, 5 in general education (GE B1))	5
CHEM 255, Quantitative Analysis	4
CHEM 310AB, Physical Chemistry	6
CHEM 316, Physical Chemistry Laboratory	2
CHEM 325, Inorganic Chemistry	3
CHEM 335AB, Organic Chemistry	8
CHEM 336, Organic Chemistry Laboratory	2
CHEM 401, Chemical Syntheses and Characterization I	3
CHEM 402, Chemical Syntheses and Characterization II	3
CHEM 445, 446 or 340, Biochemistry	3
CHEM 494, Undergraduate Research	2
CHEM 497, Research Seminar	1
Total units in the major core	**42**

Supporting Courses

MATH 161, Calculus I (4 units, counts as GE B4)	0
MATH 211, Calculus II	4
MATH 261, Calculus (IV)	4
PHYS 114, Introduction to Physics I	4
PHYS 116, Introduction to Physics Laboratory I	1
PHYS 214, Introduction to Physics II	4
PHYS 216, Introduction to Physics Laboratory II	1
Total units in supporting courses	**18**
Strongly Recommended: CHEM 494, Undergraduate Research	1-6

Sample Four-year Program for B.S. in Chemistry

Freshman Year:

Fall semester (15 Units)	**Spring semester (15 Units)**
CHEM 115A (5)	CHEM 115B (5)
MATH 161 (4)	MATH 211 (4)
GE (3)	GE (3)
GE (3)	GE (3)

Sophomore Year:

Fall semester (14 Units)	Spring semester (16 Units)
CHEM 335A (5)	CHEM 335B (3)
MATH 261 (4)	CHEM 336 (2)
PHYS 114 (4)	PHYS 214 (4)
PHYS 116 (1)	PHYS 216 (1)
	GE (3)
	GE (3)

Junior Year:

Fall semester (16 Units)	Spring semester (14 Units)
CHEM 255 (4)	CHEM 310B (3)
CHEM 445 (3)	CHEM 316 (2)
CHEM 310A (3)	CHEM 325 (3)
GE (3)	GE (3)
GE (3)	GE (3)

Senior Year:

Fall semester (14 Units)	Spring semester (16 Units)
CHEM 401 (3)	CHEM 402 (3)
CHEM 494 (2)	MATH 497 (1)
GE (3)	GE (3)
GE (3)	GE (3)
GE (3)	Elective (1)
	Elective (3)
Total semester units:	**120**

Bachelor of Arts in Chemistry

The B.A. degree provides a solid foundation in chemistry so students have the same career options as those with the B.S. degree, while allowing students the flexibility to pursue other academic interests. All courses in the major core, major electives, and supporting courses must be taken in the traditional grading mode (AF). It is highly recommended that students perform undergraduate research with a faculty member.

Please see the current approved curriculum on the SSU official catalog web page.

Major Core Requirements

CHEM 115AB, General Chemistry (10 units, 5 in the major, 5 in general education (GE B1))	5
CHEM 255, Quantitative Analysis	4
CHEM 310AB, Physical Chemistry	6
CHEM 316, Physical Chemistry Laboratory	2
CHEM 325, Inorganic Chemistry	3
CHEM 335AB, Organic Chemistry	8
CHEM 401, Chemical Syntheses and Characterization I	3
CHEM 497, Research Seminar	1
Elective (upper-division chemistry)	1
Total units in the major core	**33**

Supporting Courses

MATH 161, Calculus I (4 units, counts as GE B4)	0

MATH 211, Calculus II	4
PHYS 114 or 210A, Physics I	3-4
PHYS 116 or 209A, Physics Laboratory I	1
PHYS 214 or 210B, Physics II	3-4
PHYS 216 or 209B, Physics Laboratory II	1
Total units in supporting courses	**12-14**
Strongly Recommended: CHEM 494, Undergraduate Research	1-6

Sample Four-year Program for B.A. in Chemistry

Freshman Year:

Fall semester (15 units)	**Spring semester (15 units)**
CHEM 115A (5)	CHEM 115B (5)
MATH 161 (4)	MATH 211 (4)
GE (3)	GE (3)
GE (3)	GE (3)

Sophomore Year:

Fall semester (14 units)	**Spring semester (16 units)**
CHEM 335A (5)	CHEM 335B (3)
MATH 261 (4)	CHEM 336 (2)
PHYS 114 (4)	PHYS 214 (4)
PHYS 116 (1)	PHYS 216 (1)
	GE (3)
	GE (3)

Junior Year:

Fall semester (16 units)	**Spring semester (14 units)**
CHEM 255 (4)	CHEM 310B (3)
CHEM 310A (3)	CHEM 316 (2)
GE (3)	CHEM 325 (3)
GE (3)	GE (3)
Elective (3)	GE (3)

Senior Year:

Fall semester (15 units)	**Spring semester (15 units)**
CHEM 401 (3)	CHEM 497 (3)
CHEM 494 (1)	GE (3)
GE (3)	GE (3)
GE (3)	GE (3)
Elective (2)	Elective (3)
Elective (3)	
Total semester units:	**120**

Bachelor of Arts in Chemistry with a Concentration in Biochemistry

The B.A. degree with a concentration in biochemistry is appropriate for students interested in the medical fields, graduate study in chemistry or biochemistry, or employment in the biochemical, pharmaceutical or biotechnology industries. All courses in the major core, major electives and

supporting courses must be taken in the traditional grading mode (AF). It is highly recommended that students perform undergraduate research with a faculty member.

Please see the current approved curriculum on the SSU official catalog web page.

Major Core Requirements

CHEM 115AB, General Chemistry (10 units, 5 in the major, 5 in general education (GE))	5
CHEM 255, Quantitative Analysis	4
CHEM 310AB, Physical Chemistry	6
CHEM 316, Physical Chemistry Laboratory	2
CHEM 325, Inorganic Chemistry	3
CHEM 335AB, Organic Chemistry	8
CHEM 336, Organic Chemistry Laboratory	2
CHEM 401, Chemical Syntheses and Characterization I	3
CHEM 441, Biochemical Methods	3
CHEM 445, Biochemistry I	3
CHEM 446, Biochemistry II	3
CHEM 497, Research Seminar	1
Elective (upper-division chemistry)	1
Total units in the major core	**44**

Biology Courses

BIOL 123, Molecular and Cell Biology (GE B3)	4
Choose **2** from the following:	
BIOL 320, Molecular Genetics	4
BIOL 324, Animal Physiology	4
BIOL 325, Cell Biology	4
BIOL 334, Plant Physiology	4
BIOL 340, General Bacteriology	4
BIOL 544, Advanced Cell Biology	4
Total units in biology courses	**12**

Supporting Courses

MATH 161, Calculus I (4 units, counts as GE)	0
MATH 211, Calculus II	4
PHYS 114 or 210A, Physics I	3-4
PHYS 116 or 209A, Physics Laboratory I	1
PHYS 214 or 210B, Physics II	3-4
PHYS 216 or 209B, Physics Laboratory II	1
Total units in supporting courses	12-14
Strongly Recommended: CHEM 494, Undergraduate Research	1-6

Sample Four-year Program for B.A. in Chemistry with a Concentration in Biochemistry

Freshman Year:

Fall semester (15 units)	**Spring semester (15 units)**
CHEM 115A (5)	CHEM 115B (5)
MATH 161 (4)	MATH 211 (4)
GE (3)	GE (3)

GE (3)	GE (3)

Sophomore Year:

Fall semester (16 units)	**Spring semester (16 units)**
CHEM 335A (5)	CHEM 335B (3)
PHYS 114 (4)	CHEM 336 (2)
PHYS 116 (1)	PHYS 214 (4)
GE (3)	PHYS 216 (1)
GE (3)	GE (3)
	GE (3)

Junior Year:

Fall semester (16 units)	**Spring semester (15 units)**
CHEM 255 (4)	CHEM 310B (3)
CHEM 310A (3)	CHEM 316 (2)
GE (3)	CHEM 325 (3)
GE (3)	BIOL 123 (4)
GE (3)	GE (3)

Senior Year:

Fall semester (14 units)	**Spring semester (14 units)**
CHEM 401 (3)	CHEM 441 (3)
CHEM 445 (3)	CHEM 446 (3)
CHEM 494 (1)	CHEM 497 (1)
BIOL elective (4)	BIOL elective (4)
GE (3)	GE (3)
Total semester units:	**121**

Minor in Chemistry

Completion of a minimum of 20 units in chemistry courses. The 20 units must include a minimum of 6 upper-division course units and courses in general chemistry, organic chemistry, and Quantitative Analysis, or, a curriculum approved by the department. At least two courses beyond general chemistry must be taken in residence at SSU.

Secondary Education Teaching Credential Preparation

Chemistry students must demonstrate competence in the natural sciences by passing the subject matter examination required by the California Commission on Teacher Credentialing. One part of the examination will test breadth of knowledge in biology, chemistry, physics, astronomy, and geology. Another part of the examination will test depth of knowledge in a particular area, such as chemistry. The B.A. or B.S. degree in chemistry is recommended to prepare for the part of the examination that tests depth of knowledge in chemistry. For recommended course selection to help prepare for the part of the examination that tests breadth of scientific knowledge, please see page 284. For more information, please contact the Chemistry Department office, Darwin Hall 126, (707) 664-2334.

Chemistry Courses (CHEM)

Classes are offered in the semesters indicated. Please see the Schedule of Classes for most current information and faculty teaching assignments.

101 Chemistry and Society (3) Fall, Spring

Lecture, 3 hours. An introductory course in chemistry for students majoring in subjects other than the sciences. This course covers many of the ideas of chemistry in a way that requires only basic algebra. An emphasis is placed on the role of chemistry in daily life and decision-making. Satisfies GE, category B1 (Physical Sciences).

102 Chemistry and Society (3)/ Fall, Spring

Lecture, 2 hours; laboratory, 3 hours. An introductory course in chemistry for students majoring in subjects other than the sciences. This course covers many of the ideas of chemistry in a way that requires only basic algebra. An emphasis is placed on the role of chemistry in daily life and decision-making. The laboratory will consist of experiments covering chemical principles and phenomena discussed in the lecture. Satisfies GE, category B1 (Physical Sciences) and GE laboratory requirement.

105 Elements of General, Organic and Biochemistry (4, 4) /Fall

Lecture, 4 hours; laboratory, 3 hours. A survey of the principles of chemistry, with emphasis placed on the chemistry of living systems. The course is designed for students in pre-nursing and majors that do not require further courses in chemistry. This course is not a prerequisite for any other chemistry courses. Satisfies GE, category B1 (Physical Science) and GE laboratory requirement.

115AB General Chemistry (5, 5) Both 115A and 115B offered Fall, Spring

Lecture, 3 hours; laboratory, 3 hours. Principles of chemistry for students in science, pre-health and related areas of study. This course will introduce students to science and scientific thought by using problem-solving strategies in both a conceptual and mathematical manner. Topics include atomic and molecular structure, states of matter, chemical reactions, stoichiometry and thermodynamics. Required enrollment in CHEM 116A. CAN CHEM 2.

195 Lower-Division Special Studies (1-3)

May be repeated.

255 Quantitative Analysis (4) / Fall

Lecture, 2 hours; laboratory, 6 hours. Theory and practice of methods of analysis, including volumetric, gravimetric, and selected instrumental techniques. Prerequisite: CHEM 115B. CAN CHEM 12.

310AB Fundamentals of Physical Chemistry (3, 3) A, Fall; B, Spring

Lecture, 3 hours. Development and applications of the concepts of thermodynamics, equilibrium, kinetics, quantum mechanics, and spectroscopy to chemical systems. Prerequisites: CHEM 255; MATH 211S; PHYS 210AB or 214 and 216; or consent of instructor.

313 Analog and Digital Electronics (3)

Lecture, 3 hours. DC and AC circuit theory, applications of diodes, transistors, and operational amplifiers, electronic test instruments; electronic transducers; waveform generators; noise; logic gates and Boolean algebra; number systems and codes; combinational logic circuits; applications of circuit simulation programs. Crosslisted with PHYS 313. Prerequisites: concurrent enrollment in CHEM 313L is mandatory. MATH 107, PHYS 210B or 214; or consent of instructor.

313L Analog and Digital Electronics Laboratory (1)

Laboratory, 3 hours. Laboratory to accompany CHEM 313. Cross-listed with PHYS 313L. Experiments in this lab are designed to address the major topics of CHEM 313 lecture course. Students will experiment with physical and simulated circuits. Prerequisite: concurrent enrollment in CHEM 313 is mandatory.

316 Fundamentals of Physical Chemistry Laboratory (2) / Spring

Lecture, 1 hour; laboratory, 3 hours. Physiochemical measurements, with an emphasis on error analysis, instrumental techniques, report writing and presentation. Prerequisites: CHEM 310A; concurrent enrollment in CHEM 310B.

325 Inorganic Chemistry (3) / Spring

Lecture, 3 hours. Topics include atomic structure, symmetry and group theory of small molecules and the relationship of these concepts to bonding theory and molecular spectroscopy. Applications of symmetry and group theory to coordination chemistry of transition metal complexes in organometallic, environmental, bioinorganic and materials chemistry. Other topics include kinetics and mechanisms of inorganic and organometallic reactions including electron transfer.

335A Organic Chemistry (5) / Fall, Spring

Lecture, 3 hours; laboratory lecture, 1 hour; laboratory, 3 hours. Basic course in the general theory and reactions of organic chemistry. Emphasis on basic principles. Recommended for science and pre-professional majors. Prerequisite: CHEM 115B or consent of instructor.

335B Organic Chemistry (3) / Fall, Spring

Lecture, 3 hours. Continuation of CHEM 335A. Prerequisite: CHEM 335A.

336 Organic Chemistry Laboratory (2) / Fall, Spring

Laboratory lecture, 1 hour; laboratory, 3 hours. Fundamental techniques of organic chemistry, emphasizing synthetic organic chemistry, modern instrumental methods, and qualitative organic analysis. Designed to complement CHEM 335B. Prerequisite: CHEM 335A.

397 Chemistry Practicum (1-6) / Fall, Spring

Supervised chemistry work experiences that involve practical application of previously studied theory. Intended for professional growth and/or collection of data for future theoretical interpretation. Not applicable toward the chemistry major or minor. May be repeated for up to a total of 6 units. Two hours of work per week for each unit of credit. Cr/NC only. Prerequisite: junior standing or consent of instructor.

401 Chemical Syntheses and Characterizations I (3)

Lecture, 1 hour; laboratory 6 hours. Syntheses and purifications of selected organic, inorganic, and organometallic compounds and their characterizations through analyses, kinetics, thermodynamics, spectroscopy, and structures. Prerequisites: CHEM 255, 336 and consent of instructor.

402 Chemical Syntheses and Characterizations II (3)

Lecture, 1 hour; laboratory 6 hours. Continuation of CHEM 401. Prerequisite: CHEM 401.

441 Biochemical Methods (3) / Spring

Lecture, 1 hour; laboratory, 6 hours. Project-based laboratory course involving isolation, purification and characterization of proteins from natural sources. The course provides an introduction to biochemical methods, instrumentation and experimental design techniques common in biotechnology and research. Prerequisites: CHEM 445 or BIO 123, and a foundation in spectroscopy, kinetics and thermodynamics, or consent of instructor.

445 Biochemistry: Structural Materials and Protein Synthesis (3) / Fall

Lecture, 3 hour. A study of the structure:function relationships of amino acids, proteins and enzymes, carbohydrates, lipids and nucleic acids. Includes protein and DNA/RNA metabolism, membrane transport and signaling. Prerequisites: CHEM 335B, and a foundation in spectroscopy, kinetics and thermodynamics, or consent of instructor.

446 Biochemistry: Enzymes and Metabolism (3) Spring

Lecture, 3 hours. A study of bioenergetics and metabolism of carbohydrates, lipids and proteins. Includes a brief review of enzyme kinetics. Prerequisites: CHEM 445 or BIO 123 (for biology majors only), and a foundation in spectroscopy, kinetics and thermodynamics, or consent of instructor.

481 Applied Nuclear Chemistry and Physics (2) / Fall

Lecture, 2 hours. This course offers a working knowledge of nuclear radiations, radioactive sources and nuclear reactors. Interaction of ionizing radiation with matter; physical, chemical and biological effects. Radiochemical dating. Nuclear models. Nuclear reactor theory and neutron activation. Radioactive tracer methods. Cross-listed as PHYS 481. Prerequisites: PHYS 214, CHEM 115B, CHEM 116B and one upper-division course in the natural sciences.

482 Applied Nuclear Chemistry and Physics Laboratory (2) / Fall

Laboratory lecture, 1 hour; laboratory, 3 hours. The use and production of radioactive sources and nuclear reactor problems using a neutron howitzer. Applications to detection of trace elements, nuclear chemical phenomena, radiological safety. State-of-the-art instrumentation and laboratory practices. Cross-listed as PHYS 482. Prerequisites: PHYS 216 and 481 or concurrent enrollment in PHYS 481.

494 Undergraduate Research (1-6) / Fall, Spring

Individual investigation of either student- or faculty-initiated experimental or theoretical chemical problems under the supervision of a member of the chemistry faculty. May be taken only by petition to the Chemistry Department. May be repeated. Prerequisites: CHEM 335B; previous or concurrent enrollment in CHEM 310B or 375B; and consent of instructor.

495 Special Studies (1-3) / Fall, Spring

Investigation of existing information on a specific or general topic of interest to the student. May be repeated. Prerequisite: consent of instructor; upper-division standing in chemistry or closely related science.

496 Selected Topics in Chemistry (1-3)

A study of an advanced topic in chemistry. May be repeated for credit with new subject matter.

497 Research Seminar (1) / Fall, Spring

Laboratory, 3 hours. Capstone course. Practice and final oral presentation of a chemistry research project at a scientific meeting or a departmental seminar based on papers concerning a topic selected from the recent chemical literature. Instruction includes the appropriate coverage of material and the preparation and use of presentation, graphic, and web-based applications to make an informative talk. Prerequisites: CHEM 335B; previous or concurrent enrollment in Physical Chemistry lecture course; or consent of instructor.

499 Internship (1-4) / Fall, Spring

Chemistry field experience in industrial, hospital, or similar laboratory settings. Enrollment by prior arrangement with supervising faculty member and community sponsor. Please see department advisor for details. Three hours of work per week for each unit of credit. Internship assignments may be paid. Cr/NC only. May be repeated.

THE CALIFORNIA STATE UNIVERSITY