

## Requirements for Chemistry and Biochemistry Majors - Class of 2023

### College and University Requirements:

Critical Thinking & Writing: \_\_\_ Adv Writing \_\_\_ Ethics: \_\_\_ Science, Technology & Society: \_\_\_  
 Cultures and Ideas: \_\_\_ Civic Engagement: \_\_\_ Social Science: \_\_\_  
 Religions, Theology & Culture: \_\_\_ Diversity: \_\_\_ Pathways: \_\_\_  
 Second Language: \_\_\_ Arts: \_\_\_ Experiential Learning: \_\_\_

### Lower-Division Requirements for All Chemistry/Biochemistry Degrees

Chemistry: 11 \_\_\_ 12 \_\_\_ 15 \_\_\_ 50 \_\_\_ 31 \_\_\_ 32 \_\_\_ 33 \_\_\_ (or 14 \_\_\_ instead of 11 and 12 based on AP credit)

Physics: 11 \_\_\_ 12 \_\_\_ 13 \_\_\_; or 31 \_\_\_ 32 \_\_\_ 33 \_\_\_ (This sequence is required for an ACS Certified degree)

Math: 11 \_\_\_ 12 \_\_\_ 13 \_\_\_ or 35 \_\_\_ 36 \_\_\_ 13 \_\_\_

### Chemistry and Biochemistry majors must choose one of the degree options listed below:

Bachelor of Arts in Chemistry	Bachelor of Science in Chemistry	Bachelor of Science in Biochemistry
Upper-Division Chemistry: CHEM 141 ___ CHEM 111 ___ Four quarters of CHEM 115: _____ CHEM 101 or 102 ___ CHEM 150 or 151 or 152 ___ Two upper-division chemistry/biochemistry electives*: ___ ___ 30 hours of upper-division lab: CHEM 102 ___ or 143 ___ or 154 ___ or 182 (1 unit) ___ <i>*Chem 182 does not count as an elective. Chem 183 and 184 do count.</i>	Upper-Division Chemistry: CHEM 141 ___ CHEM 111 ___ Four quarters of CHEM 115: _____ CHEM 102 ___ CHEM 151 ___ 152 ___ 154 ___ Three upper-division chemistry/biochemistry electives*: ___ ___ ___ <i>*Chem 182 does not count as an elective. Chem 183 and 184 do count.</i>	BIOL 1A ___ 1B ___ 1C ___ 175 ___ Upper-Division Chemistry: CHEM 141 ___ 142 ___ 143 ___ CHEM 111 ___ Four quarters of CHEM 115: _____ CHEM 101 ___ CHEM 150 ___, 151 or 152 ___ Two upper-division chemistry/biochemistry electives*#: ___ ___ <i>*Chem 182 does not count as an elective. Chem 183 and 184 do count.                      #BIOL 110, 113, 174, or 176 may be taken to satisfy one of these two electives.</i>
Chemistry Minor	Bachelor of Science in Chemistry – ACS Certified	Bachelor of Science in Biochemistry – ACS Certified
CHEM 11 ___ 12 ___; or Chem 14 CHEM 31 ___ 32 ___ 33 ___ Twenty (20) units of upper-division chemistry/biochemistry electives, including Chem 50: _____ <i>*CHEM 115 and CHEM 182 do not count as an elective. Chem 183 and 184 do count.</i>	Upper-Division Chemistry: CHEM 141 ___ CHEM 111 ___ Four quarters of CHEM 115: _____ CHEM 102 ___ CHEM 150 ___ 151 ___ 152 ___ 154 ___ Two upper-division chemistry/biochemistry electives*: ___ ___ Senior Research: CHEM 183 ___ 184 ___ <i>*Chem 182 does not count as an elective.</i>	BIOL 1A ___, 1B ___, 1C ___, 175 ___ Upper-Division Chemistry: CHEM 141 ___, 142 ___, 143 ___ CHEM 111 ___ Four quarters of CHEM 115: _____ CHEM 101 ___ CHEM 150 ___ 151 or 152 ___ 154 ___ Two upper-division chemistry/biochemistry electives*#: ___ ___ Senior Research: CHEM 183 ___ 184 ___ <i>*Chem 182 does not count as an elective.                      #BIOL 110, 113, 174, or 176 may be taken to satisfy one of these two electives.</i>

Students are personally responsible for knowing all the academic regulations affecting their program of study and for completing all degree requirements as set forth by the University, their College or School, and academic department. Failure to understand these regulations and requirements does not relieve a student of responsibility (Undergraduate Bulletin).

### LOWER-DIVISION COURSES

**11. Bonding and Energy.** Topics include chemical properties and structure, quantitative problem solving, chemical bonding, ions, stoichiometry, and an introduction to thermodynamics. Recitation is offered by placement based on a Readiness Exam. Laboratory 3 hours per week. (5 units)

**12. Molecules in Motion.** Topics include gases, intermolecular forces, kinetics, and acid-base chemistry. Recitation offered to students based on their performance in Chem 11; 1 hour per week. Laboratory 3 hours per week. Prerequisite: Chem 11. Students who received a passing grade of a D+ or below in Chem 11 are required to enroll in the Chem 12 Recitation section and encouraged to meet with their instructor. Students who received a C- in Chem 11 are encouraged to enroll in the Chem 12 Recitation section and meet with their instructor during the first week of class. (5 units)

**12H. General Chemistry II Honors.** Accelerated treatment of CHEM 12 material and other topics not normally covered in general chemistry. Laboratory 3 hrs/wk. Prerequisites: permission of instructor and strong performance in CHEM 11 (5 units) Offered Winter quarter.

**14. Advanced Chemical Principles.** Subjects include accelerated treatment of topics covered in Chemistry 11 and Chemistry 12. This course is open to students with AP scores in chemistry of 4 or 5 who will be taking chemistry courses beyond Chem 14. Laboratory 3hrs./wk. (5 units)

**15. Introduction to Research.** This course introduces students to opportunities for undergraduate research in the department. Departmental faculty present their current research. Also, an overview of typical tools used in pursuing scientific research projects is provided. Students interested in the chemistry major/minor should ordinarily take this course before the end of their sophomore year. (1 unit) Offered Winter or Spring quarter.

**31. Organic Chemistry I.** Topics include organic structure and conformations, stereochemistry, structure-reactivity relationships, and the chemistry of alkyl halides and alkenes. Special emphasis is placed on understanding reaction mechanisms. Laboratory 3 hrs/wk. Prerequisite: Chem 12 or 14. Additionally, students receiving a grade lower than C- in Chem 12 or 14 are strongly urged to meet with their instructor before continuing with Chem 31. (5 units)

**32. Organic Chemistry II.** Topics include spectroscopy and the chemistry of alkynes, ethers, alcohols, and carbonyl compounds. Laboratory 3 hrs/wk. *Prerequisite:* Chem 31. *Additionally, students receiving a grade lower than a C- in Chem 31 are strongly urged to meet with their instructor before continuing with Chem 32 (5 units) Offered Winter quarter.*

**33. Organic Chemistry III.** Topics include carbonyl condensation reactions, aromatic substitutions, amines, carbohydrates, and peptide and protein synthesis. Other advanced topics may include pericyclic reactions and natural product synthesis. Laboratory 3 hrs/wk. *Prerequisite:* Chem 32. *Additionally, students receiving a grade lower than a C- are strongly urged to meet with their instructor before continuing with Chem 33. (5 units) Offered Spring quarter.*

**50. Quantitative Analysis.** Topics include quantitatively rigorous treatment of thermodynamics and kinetics, gases, and electrochemistry. Laboratory focuses on quantitative analysis of titrations, spectroscopy, and equilibria. Laboratory 3 hours per week. *Prerequisite:* Chemistry 12 or 14. Pre- or co-requisite: Math 13. (5 units)

#### UPPER-DIVISION COURSES

**101. Bioinorganic Chemistry.** Structure, properties, and reactivity of metal complexes and the function of metal ions in biological processes. *Prerequisite:* CHEM 32. (5 units) *Usually offered Spring quarter.*

**102. Inorganic Chemistry.** Introduction to inorganic chemistry with emphasis on the nonmetals. Laboratory 3 hrs/wk. *Prerequisite:* CHEM 111, 150, 151 or 152. (5 units) *Offered Spring quarter.*

**103. Environmental Chemistry** Sources, reactions, and transport of contaminants in soil, water, and air. Kinetic and thermodynamic models for smog formation, ozone layer depletion, acid rain, and the transport and degradation of contaminants in natural waters and soil, plus a brief look at global climate modeling. *Fulfills STS (Science, Technology and Society) requirement. Prerequisite: Must be enrolled in, or have taken, CHEM 150, 151, or 152. (5 units)*

**111. Instrumental Analysis.** Principles and use of instrumentation. Focus on electronics, spectroscopic methods, mass spectrometry, and chemical separations. Laboratory 4 hrs/wk. Pre- or co-requisite: CHEM 32. CHEM 50 recommended. (5 units)

**112. Bioanalytical Chemistry.** A focused investigation of the application of modern methods of analytical chemistry to understanding biological systems at molecular level. Topics depend on recent developments in bioanalytical research but may include sub-cellular analyses, proteomics, electrochemical methods, and nanoparticle-based approaches to analysis. The course stresses extensive reading of recent literature in bioanalytical chemistry, critical evaluation of published scientific papers, and development of skills in scientific writing. *Prerequisites: CTW1, CTW2; & CHEM 111 or consent of instructor (5 units). Fulfills advance writing requirement. Offered spring quarter in alternate years.*

**115. Chemistry Seminar.** Active areas of research in university, industrial, and government laboratories, presented by guest speakers. May be repeated for credit. P/NP. *Pre or co-requisite: CHEM 33. (0.5 units) Offered every quarter.*

**130. Organic Syntheses.** Modern synthetic methods applied to the preparation of structurally complex target compounds, such as bioactive natural products and pharmaceuticals. Extensive discussion of synthetic planning, known as retrosynthetic analysis, emphasizing the standard bond-forming methods learned in CHEM 31–33. *Prerequisite: CHEM 33 (5 units) Offered Winter quarter in alternate years.*

**131. Bioorganic Chemistry.** Chemical synthesis of carbohydrates, nucleic acids, peptides, proteins, and reaction mechanisms of biological cofactors. *Prerequisite: CHEM 33. (5 units) Offered Winter quarter in alternate years.*

**132. Polymer Chemistry.** Detailed study of polymer synthesis and characterization, with a special emphasis on mechanisms and classifications of reaction pathways. Kinetic and thermodynamic aspects of polymerization processes will be discussed. Much of the content will come from current literature. *Prerequisites: CTW1, CTW2; & Chem 33 (or Chem 32 with permission of instructor) Fulfills advance writing requirement (5 units)*

**133. Medicinal Chemistry.** Medicinal chemistry will engage students in the study of the scientific processes and experiments involved in drug discovery, including how drugs interact with biomolecules and biological systems. This course satisfies the Science, Technology and Societies requirement. *Prerequisite: Chem 33. (5 units)*

**141. Biochemistry I.** An introduction to structure/function relationships of biologically important molecules, enzymology, membrane biochemistry, and selected aspects of the intermediary metabolism of carbohydrates. *Pre or co-requisite CHEM 33. (5 units) Offered Fall and Spring quarters.*

**142. Biochemistry II.** Includes a study of various aspects of the intermediary metabolism of carbohydrates, lipids, and amino acids, as well as nucleic acid structure and function, protein synthesis, and subcellular sorting, and more advanced molecular physiology, including membrane biochemistry, signal transduction, and hormone action. *Prerequisite: CHEM 141. (5 units) Offered Winter quarter.*

**143. Biochemical Techniques.** A laboratory course emphasizing fundamental theory and practice in biochemical laboratory techniques, including preparation and handling of reagents; isolation, purification, and characterization of biomolecules; enzyme kinetics; spectrophotometric assays; and electrophoretic techniques. Laboratory 8 hrs/wk. *Prerequisites: CHEM 141 and consent of instructor. (3 units) Offered Spring quarter and, depending on demand, Fall quarter.*

**150. Biophysical Chemistry** Introduction to the physical behavior of biomolecules. Topics include transport properties, reaction kinetics, sedimentation, electrophoresis, binding dynamics, and molecular motion. *Prerequisites: MATH 13 and CHEM 50, or consent of instructor. (5 units)*

**151. Quantum Chemistry** Fundamentals of quantum mechanics, including wave functions and probability, rotational, vibrational, and electronic transitions, atomic and molecular electronic structure, and magnetic resonance. *Prerequisites: MATH 13 and CHEM 50. (5 units) Offered Spring quarter.*

**152. Chemical Thermodynamics.** Fundamental laws of thermodynamics, and applications to ideal and real gas equations of state, ideal and real solutions, phase equilibria, and electrochemistry. *Prerequisite: MATH 13 and CHEM 50. (5 units) Offered Winter quarter.*

**154. Physical Chemistry Laboratory.** Experimental applications of thermodynamics, kinetics, spectroscopy, and other aspects of physical chemistry. Laboratory 8 hrs/wk. *Prerequisite: Credit or registration for CHEM 151 or CHEM 152. (3 units) Offered Winter quarter.*

**182. Undergraduate Research.** Experimental research project supervised by chemistry and biochemistry faculty members. Each unit requires a minimum of 30 hours of laboratory work. May be repeated for credit. *Prerequisite: Consent of instructor. (1–3 units) Offered every quarter.*

**183. Senior Research Experience.** Individual research supervised by a chemistry and biochemistry faculty member, culminating in a comprehensive progress report. Laboratory at least 9 hrs/wk. *Prerequisites: Senior standing in chemistry and consent of instructor. (3 units) Offered every quarter.*

**184. Capstone Research Experience.** Continuation of individual research supervised by a chemistry and biochemistry faculty member, culminating in a thesis and oral presentation. Laboratory at least 9 hrs/wk. *Prerequisites: CHEM 182 or CHEM 183 and consent of instructor. (3 units) Offered every quarter.*

**190. Special Topics in Chemistry.** Special Topics courses may be offered as 2–5 unit courses covering advanced topics in any of the five areas of study in chemistry. These courses may be offered as once a week seminars or follow more traditional course schedules. The course units will vary based on the number of course meetings per quarter and the course workload. Possible course topics are organic mechanisms, transition metals in organic synthesis, materials, medicinal chemistry, nanotechnology, photochemistry, electrochemistry, molecular physiology, and membrane biochemistry. This course with a different topic may be repeated for credit. (2–5 units) *Offered on an occasional basis.*

**199. Independent Study.** Directed study under the supervision of a faculty member in an area or topic in chemistry or biochemistry not covered in regular courses. *Registration by permission by the professor directing the study only. (1–5 units)*

#### Biology Course Titles and Prerequisites

Complete course descriptions can be found in the most recent University undergraduate bulletin (<http://www.scu.edu/bulletin/>) or the Biology Department's webpage (<http://www.scu.edu/cas/biology/academicprograms/course-descriptions.cfm>).

**1A. Transformations of Energy and Matter L&L.** *Prerequisite: CHEM 11 and concurrent enrollment in or completion of Chem 12). (4 units)*

**1 B. Biological Information and Evolution L&L** *Prerequisites: Completion of BIOL 1A with a C- or better and concurrent enrollment in or completion of CHEM 13 with C- or better. (4 units)*

**1C. Biological Systems L&L** *Prerequisites: Completion of BIOL 1B and CHEM 13, both with a C- or better (5 units).*

**110. Genetics L&L.** Lab 30 hours. *Prerequisite: BIOL 1C (5 units)*

**113. Microbiology L&L.** Lab 30 hours. *Prerequisite: BIOL 1C. (5 units)*

**171. Ethical Issues in Biotechnology and Genetics.** Satisfies the third religion requirement. *Prerequisite: BIOL 1C (5 Units).*

**174. Cell Biology L&L.** Lab 30 hours. *Prerequisite: BIOL 1C. (5 units)*

**175. Molecular Biology L&L.** Laboratory 30 hours. *Prerequisite: BIOL 1C. (5 units)*

**176. Biotechnology Lab I: Recombinant DNA L&L.** Laboratory 60 hours. *Prerequisites: BIOL 1C and at least one upper-division biology laboratory course (Does not include field courses). BIOL 175 recommended. (5 units)*

**SUMMER SESSION:** Chemistry 11, 12, 31 and 31, 32, 33 are offered in Summer sessions as intensive three-week courses. These courses are particularly recommended for students who will miss a course in one of these sequences due to study abroad or need to catch up on lower-division chemistry courses due to a late change of major or not meeting the performance standards. Chemistry 141 is offered over five weeks during one Summer session. Summer courses are fast-paced and challenging; consult with your advisor before registering for these classes.