Vertically-related courses in this subject field are:

- CHEM 111 -- CHEM 112 -- CHEM 253
- CHEM 101 -- CHEM 275

**CHEM 101 Introduction to Chemistry**
3 credits
*Gen Ed: Natural and Applied Sciences*
Full credit may be earned in only one of the following: CHEM 101 or CHEM 111. General treatment of the fundamentals of chemistry. Does not satisfy the prerequisite for CHEM 112.

**CHEM 101L Introduction to Chemistry Laboratory**
1 credit
*Gen Ed: Natural and Applied Sciences*
This is the companion laboratory course to CHEM 101 and provides an introduction to Chemistry lab practices. It does not satisfy the lab requirement for CHEM 111 or CHEM 112. One 3-hour lab per week.

**CHEM 111 General Chemistry I**
3 credits
*Gen Ed: Natural and Applied Sciences*
Full credit may be earned in only one of the following: CHEM 101, or CHEM 111. Note that grades in CHEM 111 will supersede any grades earned in CHEM 101. Intensive treatment of principles and applications of chemistry. Recommended Preparation: A grade of 'B' or better in a high school chemistry course.

**CHEM 111L General Chemistry I Laboratory**
1 credit
*Gen Ed: Natural and Applied Sciences*
This is the companion laboratory course to CHEM 111 and provides an intensive treatment of Chemistry lab practices. One 3-hour lab per week.

**CHEM 112 General Chemistry II**
3 credits
*Gen Ed: Natural and Applied Sciences*
Continuation of CHEM 111. Some work in inorganic chemistry, kinetics, equilibrium, liquids, solids, acid-base, electrochemistry, nuclear chemistry, thermodynamics, and qualitative inorganic analysis.

**CHEM 112L General Chemistry II Laboratory**
2 credits
*Gen Ed: Natural and Applied Sciences*
This is the companion laboratory course to CHEM 112 and teaches Chemistry lab practices in inorganic chemistry, kinetics, equilibrium, acid-base, electrochemistry, thermodynamics, and qualitative analysis. One 3-hour lab and one recitation hour per week.

**CHEM 121 Glassblowing**
1 credit
Techniques used in constructing scientific apparatus from glass. Graded P/F. One 3-hour lab per week.

**CHEM 200 (s) Seminar**
Credit arranged

**CHEM 204 (s) Special Topics**
Credit arranged

**CHEM 253 Quantitative Analysis**
3 credits
Fundamental principles and techniques of chemical analysis; intro to sampling, standardization, data evaluation, gravimetric/volumetric methods, and instrumental techniques. (Fall only)

**CHEM 254 Quantitative Analysis: Lab**
2 credits
Laboratory portion of Quantitative Analysis (CHEM 253).

**CHEM 275 Carbon Compounds**
3 credits
Aspects of organic chemistry important to students in the life sciences.

**CHEM 276 Carbon Compounds Lab**
1 credit
Lab to accompany CHEM 275; for students who need only 1 credit of lab. One 3-hour lab per week.

**CHEM 277 Organic Chemistry I**
3 credits
Principles and theories of organic chemistry; properties, preparation, and reactions of organic compounds.

**CHEM 278 Organic Chemistry I: Lab**
1 credit
One 3-hour lab per week.

**CHEM 299 (s) Directed Study**
Credit arranged

**CHEM 302 Principles of Physical Chemistry**
3 credits
Emphasis on topics important to biological and agricultural science. (Fall only)

**CHEM 303 Principles of Physical Chemistry Lab**
1 credit
Lab to accompany CHEM 302. One 3-hour lab per week. (Fall only)

**CHEM 305 Physical Chemistry**
3 credits
Kinetic theory, thermodynamics (work, heat and energy); state functions, thermochemistry, the second law of thermodynamics; free energy and mixtures; electrolyte solutions and phase equilibrium; chemical and electrochemical equilibrium. (Fall only)

**CHEM 306 Physical Chemistry Lab**
1 credit
Lab to accompany CHEM 305. One 3-hour lab per week. (Fall only)

**CHEM 307 Physical Chemistry II**
3 credits
Thermodynamics, phase equilibria; chemical and electrochemical equilibrium; chemical kinetics. (Fall only)

**CHEM 308 Physical Chemistry II Lab**
1 credit
Lab to accompany CHEM 307. (Fall only)
CHEM 306 Physical Chemistry II
3 credits
Kinetic theory, atomic and molecular structure, quantum mechanics, statistical mechanics. (Spring only)
Prereq: CHEM 305

CHEM 307 Physical Chemistry Lab
1 credit
Lab to accompany CHEM 305, CHEM 306. One 3-hour lab per week. (Fall only)
Prereq or Coreq: CHEM 305

CHEM 308 Physical Chemistry Lab
1 credit
Lab to accompany CHEM 305, CHEM 306. One 3-hour lab per week. (Spring only)
Prereq or Coreq: CHEM 306

CHEM 372 Organic Chemistry II
3 credits
Continuation of CHEM 277. (Spring only)
Prereq: CHEM 277

CHEM 374 Organic Chemistry II: Lab
1 credit
Lab to accompany CHEM 372; includes synthesis, structure determination, and mechanisms. One 3-hour lab per week. (Spring only)
Prereq: CHEM 278
Prereq or Coreq: CHEM 372

CHEM 400 (s) Seminar
Credit arranged

CHEM 404 (s) Special Topics
Credit arranged

CHEM 409 Proseminar
1 credit
Gen Ed: Senior Experience
Current publications in chemistry and chemical engineering with reports on typical scientific papers. Preparation of application materials for graduate work and/or careers in chemistry.
Prereq: CHEM 372 and junior standing

CHEM 418 Environmental Chemistry
3 credits
Joint-listed with CHEM 518. Chemistry of atmosphere, soil, and water; pollution monitoring and remediation; treatment of waste in the environment. Additional projects/assignments required for graduate credit. (Spring only)
Prereq: CHEM 253, CHEM 254, and CHEM 275 or CHEM 277, or Permission

CHEM 436 Electronics for Scientists
2-4 credits, max 4
Joint-listed with CHEM 535. Theory and application of analog and digital electronics used in scientific instrumentation. Registration for CHEM 535 requires completion of an additional term paper or other assignment (Fall, alt/years).
Prereq: Permission

CHEM 454 Instrumental Analysis
3-4 credits
For students in chemistry and allied fields. Techniques in operating new and specialized instruments for qualitative and quantitative analysis and analytical methods of an advanced nature. Three lectures and one 4-hour lab per week. Permission required to register for 3 credits. (Spring only)
Prereq: CHEM 253, CHEM 254, and CHEM 305
Prereq or Coreq: CHEM 306

CHEM 455 Survey of Analytical Chemistry
3 credits
Fundamentals of modern analytical chemistry. Open only to chemistry M.S. and Ph.D. students. Credit is not allowed in both CHEM 454 and CHEM 455.
Prereq: Permission

CHEM 463 Inorganic Chemistry
3 credits
Principles, complex ions and coordination compounds, theory of acids and bases, bonding theory, non-aqueous solvents, familiar elements and their relationship to the periodic table. (Fall only)
Prereq: CHEM 305 or Permission

CHEM 464 Inorganic Chemistry
3 credits
Principles, complex ions and coordination compounds, theory of acids and bases, bonding theory, non-aqueous solvents, familiar elements and their relationship to the periodic table. Additional projects/assignments required for graduate credit. (Spring only)
Prereq or Coreq: CHEM 463, or CHEM 466, or Permission

CHEM 465 Inorganic Chemistry Laboratory
1 credit
Lab to accompany CHEM 464. One 3-hour lab per week. (Spring only)
Coreq: CHEM 464

CHEM 472 Medicinal Chemistry
3 credits
Joint-listed with CHEM 572. Synthetic chemistry necessary for design and preparation of medicinal agents, and mechanistic chemistry germane to action of pharmaceuticals. Graduate students are required to write an original research proposal on a topic related to drug discovery. (Alt/years)
Prereq or Coreq: CHEM 473, CHEM 476 or Permission

CHEM 473 Intermediate Organic Chemistry
3 credits
Theories and mechanisms of organic chemistry. (Fall only)
Prereq: CHEM 372
Prereq or Coreq: CHEM 306

CHEM 476 Survey of Organic Chemistry
3 credits
Fundamentals of modern organic chemistry. Open only to chemistry M.S. and Ph.D. students. Credit is not allowed in both CHEM 473 and CHEM 476.
Prereq: Permission
CHEM 491 (s) Research
1-6 credits, max 12
Submission of a report of the research done for placement in the permanent department files is required.
Prereq: Permission of department

CHEM 495 Statistical Thermodynamics
3 credits
Cross-listed with PHYS 333
Classical thermodynamics, entropy, thermodynamic potentials, kinetic theory, classical and quantum statistical mechanics, ensembles, partition functions, introduction to phase transitions.
Prereq: CHEM 306 or PHYS 305 or equivalent.

CHEM 496 Survey of Physical Chemistry
3 credits
Fundamentals of modern physical chemistry. Open only to chemistry M.S. and Ph.D. students. Credit is not allowed in both CHEM 495 and CHEM 496.
Prereq: Permission

CHEM 498 (s) Internship
Credit arranged

CHEM 499 (s) Directed Study
Credit arranged

CHEM 500 Master's Research and Thesis
Credit arranged

CHEM 501 (s) Seminar
1 credit, max 2

CHEM 502 (s) Directed Study
Credit arranged

CHEM 503 (s) Workshop
Credit arranged

CHEM 504 (s) Special Topics
Credit arranged

CHEM 505 (s) Professional Development
Credit arranged

CHEM 506 Introduction to Teaching and Research Skills
2 credits
Skills required of teaching assistants in laboratory, recitations, office hours, help sessions; skills required for research; use of library; introduction to faculty research. Graded P/F. (Fall only)
Prereq: Permission

CHEM 509 Advanced Physical Chemistry
3 credits
Application of quantum theory to chemical bonding, molecular spectroscopy, and molecular structure. (Spring only)
Prereq: CHEM 306, CHEM 495, CHEM 496, or Permission

CHEM 511 Seminar
0 credits

CHEM 518 Environmental Chemistry
3 credits
Joint-listed with CHEM 418.
Chemistry of atmosphere, soil, and water; pollution monitoring and remediation; treatment of waste in the environment. Additional projects/assignments required for graduate credit. (Spring only)
Prereq: CHEM 253, CHEM 254, and CHEM 275 or CHEM 277, or Permission

CHEM 535 Electronics for Scientists
2-4 credits, max 4
Theory and application of analog and digital electronics used in scientific instrumentation. Registration for CHEM 535 requires completion of an additional term paper or other assignment (Fall, alt/years).
Prereq: Permission

CHEM 542 Biochemistry and Molecular Biology
3 credits
Cross-listed with BIOL 554.
Intermediate biochemistry; areas of emphasis include molecular biology, nitrogen and lipid metabolism. Extra oral and/or written assignments required for graduate credit. (Spring only)
Prereq: CHEM 372; BIOL 380 or CHEM 302 or CHEM 306; or Permission

CHEM 550 Radioanalytical Chemistry
2 credits
Fundamental concepts of radiochemistry, including the principles of radioactive decay processes and counting techniques; in-depth treatment of radioanalytical techniques, especially neutron activation and isotope dilution methods; decay processes as sources of x-rays; the use of synchrotron radiation in analytical chemistry. (Alt/years)
Prereq: CHEM 454, or CHEM 455, or Permission

CHEM 551 Electronic Spectrometry
2-3 credits, max 3
A brief review of fundamental concepts, including electronic transitions, optical properties of materials, and laws of radiation absorption; detailed coverage of instrumentation used for ultraviolet and visible absorption spectroscopy, with regard to optical components, overall design strategy, and signal processing; analytical performance related to these aspects and presented from both theoretical and practical standpoints; in-depth coverage of luminescence spectroscopy, including phosphorimetry and fluorimetry; atomic spectroscopy (both flame and plasma-based versions), including principles of operation, instrumental requirements, and analytical application; survey of x-ray absorption and fluorescence spectroscopy. (Alt/years)
Prereq: CHEM 454, CHEM 455 or Permission

CHEM 556 Molecular Spectroscopy
3 credits
Interpretation of IR, UV, NMR, and mass spectra. Registration for CHEM 556 requires completion of additional assignments.
Prereq: CHEM 306 or Permission

CHEM 558 Electrochemistry
2-3 credits, max 3
Fundamental concepts of electrochemistry, including the principles of redox processes; in-depth treatment of electroanalytical techniques, especially voltammetric and potentiometric methods; advanced treatment of selected topics, including ultramicro and in vivo electrochemical techniques. (Alt/years)
Prereq: CHEM 454, or CHEM 455, or Permission

CHEM 571 (s) Topics In Organic Chem
1-9 credits, max 9
Selected topics from the current literature.
Prereq: CHEM 473, CHEM 476, or Permission
CHEM 572 Medicinal Chemistry
3 credits
Joint-listed with CHEM 472
Synthetic chemistry necessary for design and preparation of medicinal agents, and mechanistic chemistry germane to action of pharmaceuticals. Graduate students are required to write an original research proposal on a topic related to drug discovery. (Alt/years)
Prereq or Coreq: CHEM 473, CHEM 476 or Permission

CHEM 590 Doctoral Research Proposal
1 credit
Taken no later than one semester after completion of cumulative exams; required for advancement to Ph.D. candidacy. Includes review of relevant literature and original research proposal describing the student's intended research project.

CHEM 598 (s) Internship
Credit arranged

CHEM 599 (s) Non-thesis Master's Research
Credit arranged

CHEM 600 Doctoral Research and Dissertation
Credit arranged