

- BIOL 790 Paleontology of Lower Vertebrates (3).
 BIOL 791 Paleontology of Higher Vertebrates (3).
 BIOL 792 Ichthyology (4).
 BIOL 793 Ornithology (3).
 BIOL 794 Mammalogy (3).
 BIOL 795 Biology of Amphibians (3).
 BIOL 796 Biology of Reptiles (3).
 BIOL 797 Field Course in Vertebrate Paleontology (3-6).
 BIOL 798 Principles and Practices of Museum Collection Management (3).
 BIOL 799 Natural History Museum Apprenticeship (1-6).

Bosnian/Croatian/Serbian

See Slavic Languages and Literatures in this chapter of the catalog.

Botany

A bachelor's degree with a major in botany is not offered, but the student may obtain a degree in biology with emphasis in botany. Any course in the plant sciences numbered 699 or below is appropriate for the undergraduate emphasis. See Biology Undergraduate Program in this chapter of the catalog. For those planning to go on for advanced degrees, the following courses are recommended:

- BIOL 533 Biology of Fungi
 BIOL 555 General Plant Physiology
 BIOL 602 Plant Ecology
 BIOL 603 Systematic Botany

Brazilian Studies

See Spanish and Portuguese in this chapter of the catalog.

Caribbean Studies

See African and African-American Studies in this chapter of the catalog.

Cell Biology

Students may concentrate in cell biology by seeking a B.S. in biology. See Biology Undergraduate Program in this chapter of the catalog.

Chemistry

Chair: Joseph A. Heppert
 Malott Hall, 1251 Wescoe Hall Dr., Room 2010
 Lawrence, KS 66045-7582, www.chem.ku.edu, (785) 864-4673
 Degrees offered: B.A., B.S., M.S., Ph.D.

Why study chemistry? Because understanding the atomic and molecular nature of matter informs us about ourselves and our universe, and creating and finding applications for new and modified forms of matter helps to conserve and enhance our world.

Chemistry course work educates students to become professional chemists or to do graduate work in chemistry. It also provides the basic chemistry background for students entering such fields as biochemistry, biological sciences, dentistry, engineering, environmental science, geology, medicine, pharmacy, physics, and secondary-level science education. Courses in chemistry provide general knowledge and appreciation of chemistry and its impact on society.

Courses for Nonmajors

Students taking chemistry as preparatory study for another field should consult the courses listed for that field in this catalog. CHEM 124 and CHEM 125 are introductory courses for the non-science major who wants to study the general principles, methods, role, and significance of chemistry in the modern world, for prenursing students, and for students who plan to take no additional courses in chemistry. Premedical students and chemistry or other science majors should not take CHEM 124 or CHEM

125. CHEM 124 is lecture only. CHEM 125 includes a laboratory. Engineering students who need only one semester of chemistry should take CHEM 184. CHEM 184 is an introductory course for students who plan to take more than one year of college chemistry, including chemical engineering, premedical, prepharmacy, and pre dental students and students in biological sciences who must take organic chemistry. Students should continue with CHEM 188 in the same academic year that they take CHEM 184.

Advanced Placement

Students who have taken the Advanced Placement Examination in chemistry should have the results forwarded to the Office of Admissions and Scholarships. Students who earn a score of 5 need not take CHEM 184 and CHEM 188 and receive 10 hours of credit. With departmental permission, those who earn a score of 3 or 4 receive credit for CHEM 184. Credit for CHEM 188 also may be given to those who pass a special examination. Students who receive a score of at least 50 on the College Level Examination Program general chemistry examination receive 5 hours of credit in CHEM 125.

Majors

The B.S. prepares students for graduate school and professional careers. The B.A. is for the student who wants to understand the fundamental principles of chemistry and to study a number of other fields. Both are based on a high school background that includes at least one and one half years of algebra and one year of geometry. High school courses in chemistry and physics are desirable but are not required.

Many chemistry majors are preparing for medical school or for graduate study in chemistry and related fields. For graduate school, the common body of knowledge in the B.A. program is the minimum prerequisite. For premedical students, much of the knowledge will be important in their careers. Even more important, however, is the training in logical thinking, drawing conclusions from experimental observations, and digesting and understanding scientific information.

First- and Second-year Preparation. Because study in chemistry requires preparation in mathematics and physics as well as a structured series of courses in chemistry, students should begin meeting major requirements in the first year. Students planning to major in chemistry should consult a chemistry department major adviser during their first semester to develop a four-year plan for degree completion. It is particularly important to take CHEM 184 (or CHEM 185) and CHEM 188 (or CHEM 189) in the first year and CHEM 624 (or CHEM 628) and CHEM 625 in the second year. For those seeking a B.S. degree it is also important to complete CHEM 626 (or CHEM 630) and CHEM 627 in the second year as well as their mathematics preparation (MATH 121, MATH 122, MATH 223, and MATH 290) and physics preparation (PHSX 211 and PHSX 212) in the first two years.

Requirements for the B.A. Major. In addition to the common College requirements for the B.A., a minimum of 29 to 30 hours in chemistry (including 5 hours each of analytical, organic, and physical chemistry lecture and laboratory) and one year each of calculus and physics (prerequisites for physical chemistry) are required. These courses fulfill the requirements:

Chemistry Courses (29 hours)	
CHEM 184 (or CHEM 185) Foundations of Chemistry I	5
CHEM 188 (or CHEM 189) Foundations of Chemistry II	5
CHEM 622 Fundamentals of Organic Chemistry (3) or	
CHEM 624 (or CHEM 628) Organic Chemistry I (3)	3
CHEM 625 Organic Chemistry I Laboratory	2
CHEM 516 Analytical Chemistry	3
CHEM 517 Analytical Chemistry Laboratory	2
CHEM 640 Biological Physical Chemistry (3) and	
CHEM 641 Biological Physical Chemistry Lab (2) or	
CHEM 646 Physical Chemistry I (3) and	
CHEM 647 Physical Chemistry I Laboratory (2)	5
CHEM 696 Junior/Senior Seminar	1
Additional chemistry course	3

Mathematics and Physics (14-18 hours)

MATH 115 Calculus I (3) or MATH 121 Calculus I (5)	3-5
MATH 116 Calculus I (3) or MATH 122 Calculus II (5)	3-5
PHSX 114 College Physics I (4) or PHSX 211 General Physics I (4)	4
PHSX 115 College Physics II (4) or PHSX 212 General Physics II (4)	4

Courses that fulfill the additional 3 hours for the major are CHEM 626 (or CHEM 630) Organic Chemistry II, CHEM 635 and CHEM 636 Instrumental Methods of Analysis and Laboratory, CHEM 648 Physical Chemistry II, or CHEM 667 Systematic Inorganic Chemistry. Note that CHEM 648 has CHEM 646, MATH 223 and MATH 290 as prerequisites. Students in premedical programs should be aware that a year of organic chemistry lecture and laboratory (CHEM 624 or CHEM 628, CHEM 625, CHEM 626 or CHEM 630, and CHEM 627) is required for admission to virtually all medical schools. Students who need only one semester of organic chemistry should substitute CHEM 622 (the one-semester organic chemistry lecture course) for CHEM 624, when possible.

Requirements for the B.A. Major: Environmental Chemistry

Option. This option is available to students who plan to use their chemistry background in environmentally related areas. The additional courses required provide background in other environmental sciences as well as further exposure to important methods used in environmental laboratories.

In addition to all of the requirements for the regular B.A. major, the following courses are required:

¹ CHEM 626 (or CHEM 630) Organic Chemistry II	3
CHEM 627 Organic Chemistry II Laboratory	2
CHEM 635 Instrumental Methods of Analysis	2
CHEM 636 Instrumental Methods of Analysis Laboratory	2
Plus two electives	6

(In consultation with a faculty major adviser, choose two courses from those listed in Group I or Group II in Requirements for the B.S. Degree in Chemistry: Environmental Chemistry Option.)

Requirements for the B.A. Major: Biological Chemistry Option.

This option is available to students interested in the biological applications of chemistry. The curriculum is compatible with many pre-health-professions programs and prepares the student for graduate study or career opportunities.

In addition to all of the requirements for the regular B.A. major, the following courses are required:

¹ CHEM 626 (or CHEM 630) Organic Chemistry II	3
CHEM 627 Organic Chemistry II Laboratory	2
BIOL 600 Introductory Biochemistry, Lectures	4
Plus two electives	6

(In consultation with a faculty major adviser, choose two courses from those listed under Group I or Group II in Requirements for the B.S. Degree in Chemistry: Biological Chemistry Option.)

¹Select this course as the additional chemistry course.

Requirements for the B.S. Degree. The significant differences between the B.S. and B.A. lie in the distribution requirements and the required subjects. This outline lists all required courses and some suggested electives. The program satisfies College requirements as well as certification standards of the American Chemical Society.

Chemistry Courses (50 hours)

CHEM 184 (or CHEM 185) Foundations of Chemistry I	5
CHEM 188 (or CHEM 189) Foundations of Chemistry II	5
CHEM 516 Analytical Chemistry	3
CHEM 517 Analytical Chemistry Laboratory	2
CHEM 624 (or CHEM 628) Organic Chemistry I	3
CHEM 625 Organic Chemistry I Laboratory	2
CHEM 626 (or CHEM 630) Organic Chemistry II	3
CHEM 627 Organic Chemistry II Laboratory	2
CHEM 635 Instrumental Methods of Analysis	2
CHEM 636 Instrumental Methods of Analysis Laboratory	2
CHEM 646 Physical Chemistry I	3
CHEM 647 Physical Chemistry I Laboratory	2
CHEM 648 Physical Chemistry II	4
CHEM 649 Physical Chemistry II Laboratory	2
CHEM 667 Systematic Inorganic Chemistry	3
CHEM 668 Advanced Inorganic Laboratory	2

CHEM 696 Junior/Senior Seminar	1
Plus one or more of the following courses: CHEM 698 (or CHEM 699) Undergraduate Research Problems or 700-level course	4

Mathematics, Physics, and Biochemistry (26-27 hours)

MATH 121 and MATH 122 Calculus I and II	10
MATH 223 Vector Calculus	3
MATH 290 Elementary Linear Algebra	2
PHSX 211 and PHSX 212 General Physics I and II	8
BIOL 600 Introductory Biochemistry, Lectures (4) or BIOL 636 Biochemistry I (3)	3-4

Other Requirements (27-29 hours)

² Additional language or skill (A course in French, German, Russian, Japanese, Chinese, Spanish, or EECS 138, CHEM 711, MATH 526, or MATH 320, or another language or skill course)	3-5
English (ENGL 101 and ENGL 102)	6
Western civilization	6
Humanities	6
Social sciences	6
Additional courses may be taken in free electives to complete the total of 124 hours for the degree. An overall average grade of C must be earned in all upper- level KU courses in chemistry.	

Requirements for the B.S. Degree in Chemistry: Environmental Chemistry Option.

This option allows students to focus on environmental issues and to understand how chemistry may be applied to environmental problems. Students are prepared for graduate programs or employment. The curriculum substitutes four environmentally related courses for four courses in the standard B.S. program. The program satisfies College requirements as well as American Chemical Society standards.

Chemistry Courses (44 hours)

CHEM 184 (or CHEM 185) Foundations of Chemistry I	5
CHEM 188 (or CHEM 189) Foundations of Chemistry II	5
CHEM 516 Analytical Chemistry	3
CHEM 517 Analytical Chemistry Laboratory	2
CHEM 624 (or CHEM 628) Organic Chemistry I	3
CHEM 625 Organic Chemistry I Laboratory	2
CHEM 626 (or CHEM 630) Organic Chemistry II	3
CHEM 627 Organic Chemistry II Laboratory	2
CHEM 635 Instrumental Methods of Analysis	2
CHEM 636 Instrumental Methods of Analysis Laboratory	2
CHEM 646 Physical Chemistry I	3
CHEM 647 Physical Chemistry I Laboratory	2
CHEM 648 Physical Chemistry II	4
CHEM 649 Physical Chemistry II Laboratory	2
CHEM 667 Systematic Inorganic Chemistry	3
CHEM 696 Junior/Senior Seminar	1

Mathematics and Physics (23 hours)

MATH 121 and MATH 122 Calculus I and II	10
MATH 223 Vector Calculus	3
MATH 290 Elementary Linear Algebra	2
PHSX 211 and PHSX 212 General Physics I and II	8

Group I (6-8 hours). Choose two courses:

BIOL 100 Principles of Biology (3) or BIOL 150 Principles of Molecular and Cellular Biology (4)	
EVRN 148 Scientific Principles of Environmental Studies (3)	
GEOG 304 Environmental Conservation (3)	
GEO 351 Environmental Geology (3)	
BIOL 400 Fundamentals of Microbiology (3)	
BIOL 414 Principles of Ecology (3)	
BIOL 600 Introductory Biochemistry, Lectures (4)	
ATMO 105 Introductory Meteorology (5)	

Group II (6-7 hours). Choose two courses:

BIOL 660 Lake Ecology (with or without BIOL 662 Aquatic Ecology Laboratory) (3-4)	
CE 477 Introduction to Environmental Engineering and Science (3)	
GEO 552 Introduction to Hydrogeology (3)	
ATMO 525 Air Pollution Meteorology (3)	
EVRN 611 Water Quality, Land Use, and Watershed Ecosystems (3)	
CHEM 698 Undergraduate Research Problems (3) (CHEM 698 is strongly recom- mended for all students in this option. To count toward this option, the research must have a clear environmental focus and may not be taken until completion of CHEM 516 and CHEM 517 and consultation with a chemistry major adviser.)	

Students who intend to major in chemistry should begin planning their programs during the first year.

In addition to degree programs in general chemistry, the Department of Chemistry offers B.A. and B.S. degree options in biochemistry, environmental and biological chemistry, and chemical physics.

Note: All four courses chosen from Groups I and II may not be in the same department or division.

Other Requirements (26 hours)

²Additional language or skill (A course in French, German, Russian, Japanese, Chinese, Spanish, or EECS 138, CHEM 711, MATH 526, or MATH 320, or another language or skill course) 5
 English (ENGL 101 and ENGL 102) 6
 Western civilization 6
 Humanities 3
 Social sciences 6
 Free electives may complete the total of 124 hours. An overall average grade of C must be earned in all upper-level chemistry courses.

²Native speakers must demonstrate ability to translate selected material into acceptable scientific English. Although foreign language is no longer required for the B.S. degree, both the chemistry department and the ACS strongly recommend study of a foreign language.

Requirements for the B.S. Degree in Chemistry: Biochemistry Option

Chemistry Courses (50 hours)
 CHEM 184 (or CHEM 185) Foundations of Chemistry I 5
 CHEM 188 (or CHEM 189) Foundations of Chemistry II 5
 CHEM 516 Analytical Chemistry 3
 CHEM 517 Analytical Chemistry Laboratory 2
 CHEM 624 (or CHEM 628) Organic Chemistry I 3
 CHEM 625 Organic Chemistry I Laboratory 2
 CHEM 626 (or CHEM 630) Organic Chemistry II 3
 CHEM 627 Organic Chemistry II Laboratory 2
 CHEM 635 Instrumental Methods of Analysis 2
 CHEM 636 Instrumental Methods of Analysis Laboratory 2
 CHEM 646 Physical Chemistry I 3
 CHEM 647 Physical Chemistry I Laboratory 2
 CHEM 648 Physical Chemistry II 4
 CHEM 649 Physical Chemistry II Laboratory 2
 CHEM 667 Systematic Inorganic Chemistry 3
 CHEM 668 Advanced Inorganic Laboratory 2
 CHEM 696 Junior/Senior Seminar 1
 Plus one or more of the following courses: CHEM 698 (or CHEM 699)
 Undergraduate Research Problems or 700-level course 4

Biology and Biochemistry Courses (13 hours)

BIOL 150 Principles of Molecular and Cellular Biology (or honors equivalent) 4
 BIOL 636 Biochemistry I 3
 BIOL 637 Introductory Biochemistry Laboratory 3
 BIOL 638 Biochemistry II 3

Biology Option Group (3 hours). Choose one of the following: 3
 BIOL 350 Principles of Genetics (3)
 BIOL 400 Fundamentals of Microbiology (3)
 BIOL 416 Cell Structure and Function (3)

Mathematics and Physics (23 hours)

MATH 121 and MATH 122 Calculus I and II 10
 MATH 223 Vector Calculus 3
 MATH 290 Elementary Linear Algebra 2
 PHSX 211 and PHSX 212 General Physics I and II 8

Other Requirements (21 hours)

English (ENGL 101 and ENGL 102) 6
 Western civilization 6
 Humanities 3
 Social sciences 6

Additional courses may be taken in free electives to complete the total of 124 hours for the degree. An overall average grade of C must be earned in all upper-level KU courses in chemistry.

Requirements for the B.S. Degree in Chemistry: Chemical

Physics Option. This option allows students to focus on the theoretical basis of chemistry. Students are prepared for graduate programs or employment. The curriculum substitutes four physics or mathematics courses for four courses in the standard program.

Chemistry Courses (46 hours)

CHEM 184 (or CHEM 185) Foundations of Chemistry I 5
 CHEM 188 (or CHEM 189) Foundations of Chemistry II 5
 CHEM 516 Analytical Chemistry 3
 CHEM 517 Analytical Chemistry Laboratory 2
 CHEM 624 (or CHEM 628) Organic Chemistry I 3
 CHEM 625 Organic Chemistry I Laboratory 2
 CHEM 626 (or CHEM 630) Organic Chemistry II 3
 CHEM 627 Organic Chemistry II Laboratory 2
 CHEM 635 Instrumental Methods of Analysis 2
 CHEM 636 Instrumental Methods of Analysis Laboratory 2
 CHEM 646 Physical Chemistry I 3
 CHEM 647 Physical Chemistry I Laboratory 2
 CHEM 648 Physical Chemistry II 4
 CHEM 649 Physical Chemistry II Laboratory 2
 CHEM 667 Systematic Inorganic Chemistry 3
 CHEM 668 Advanced Inorganic Laboratory 2
 CHEM 696 Junior/Senior Seminar 1

Mathematics, Physics, and Biology (29-30 hours)

MATH 121 and MATH 122 Calculus I and II (or honors equivalents) 10
 MATH 223 Vector Calculus 3
 MATH 290 Elementary Linear Algebra 2
 MATH 320 Elementary Differential Equations (or honors equivalent) 3
 PHSX 211 and PHSX 212 General Physics I and II (or honors equivalents) ... 8
 BIOL 600 Introductory Biochemistry, Lectures (4) **or**
 BIOL 636 Biochemistry I (3) 3-4

Chemical Physics Option Group I (6-7 hours). Choose two: 6-7

PHSX 313 General Physics III and
 PHSX 316 Intermediate Physics Laboratory I (4)
 PHSX 518 Mathematical Physics (3)
 PHSX 615 Numerical and Computational Methods in Physics (3)
 PHSX 521 Mechanics I (3)
 PHSX 623 Physics of Fluids (3)
 PHSX 655 Optics (3)
 PHSX 681 Concepts in Solids (3)

Chemical Physics Option Group II (6 hours). Choose two: 6

PHSX 531 Electricity and Magnetism (3)
 PHSX 621 Mechanics II (3)
 MATH 646 Complex Variable and Applications (3)
 MATH 647 Applied Partial Differential Equations (3)
 CHEM 698 (or CHEM 699) Undergraduate Research (3)
 (To count toward the chemical physics option, the research must have a clear chemical physics focus.)
 CHEM 750 Quantum Chemistry and Spectroscopy (3)
 CHEM 752 Statistical Thermodynamics (3)

Other Requirements (21 hours)

English (ENGL 101 and ENGL 102) 6
 Western civilization 6
 Humanities 3
 Social sciences 6

Requirements for the Minor. The minor allows students outside the department to obtain a strong, distributed background in the discipline. It is particularly useful for students anticipating careers in medicine, allied health, biological sciences, environmental sciences, chemical engineering, business, law, secondary education, or any career in which a basic understanding of the molecular sciences is helpful. A total of 23 to 25 credit hours is required, including 12 hours of upper-division work and at least two upper-division laboratories. Students should see a chemistry department adviser early in the junior year.

Required Courses (15 hours)

CHEM 184 (or CHEM 185) Foundations of Chemistry I 5
 CHEM 188 (or CHEM 189) Foundations of Chemistry II 5
 CHEM 622 Fundamentals of Organic Chemistry (3) **or**
 CHEM 624 Organic Chemistry I (3) **or** CHEM 628 Organic Chemistry I (3) ... 3
 CHEM 625 Organic Chemistry I Laboratory 2

Elective Group I (5-6 hours). Choose one of the following: 5-6

CHEM 640 Biological Physical Chemistry (3) and
 CHEM 641 Biological Physical Chemistry Laboratory (fall only) (2) **or**
 CHEM 646 Physical Chemistry I (3) and
 CHEM 647 Physical Chemistry Laboratory I (2)
 CHEM 516 and CHEM 517 Analytical Chemistry and Laboratory (5) (fall only)

Elective Group II (3-4 hours). Choose one of the following: 3-4

CHEM 640 Biological Physical Chemistry (3) **or**
 CHEM 646 Physical Chemistry I (3)
 CHEM 516 Analytical Chemistry (3) (fall only)
 CHEM 667 Systematic Inorganic Chemistry (3) (spring only)
 CHEM 690 Environmental Chemistry (3) (offered at irregular intervals)

Honors. Students may apply for admission to the departmental honors program after completion of an analytical, organic, and physical chemistry course but no sooner than the beginning of the junior year. Highly motivated and superior B.A. and B.S. students are admitted to the honors program. Honors in chemistry are awarded to students who have been admitted to the program and who have completed the following requirements with superior performance.

1. CHEM 184 or CHEM 185, CHEM 188 or CHEM 189, CHEM 516, CHEM 517, CHEM 624 or CHEM 628, CHEM 625, CHEM 626 or CHEM 630, CHEM 627, CHEM 646, CHEM 648, CHEM 647, and at least 3 hours of courses in chemistry at the 700 level or CHEM 667.
2. At least two semesters of CHEM 699 (4-8 hours total) resulting in a written thesis.
3. Evaluation and approval of the thesis by a faculty advisory committee.
4. Oral presentation of the thesis results at a special departmental seminar or other approved forum.

For an application form and further information, consult the department office.

■ Chemistry Courses

CHEM 124 College Chemistry (3). NP N This course is a non-laboratory version of CHEM 125 and is a general treatment of basic concepts of general and organic chemistry as well as the role and significance of chemistry in the modern world. It is designed to fulfill the science requirement for non-science students, and should not be taken by students whose major requires a laboratory course in chemistry or more than one semester of chemistry. Meets with CHEM 125 for three lecture periods per week, with optional discussion sessions. LEC

CHEM 125 College Chemistry (5). NP N A general treatment of the basic concepts of general and organic chemistry as well as the role and significance of chemistry in the modern world. The course is designed to fulfill the science requirement for non-science majors, and should not be taken by students who require more than one semester of chemistry. Three class periods, one three-hour laboratory, and optional discussion sessions. LEC

CHEM 184 Foundations of Chemistry I (5). NP N This course seeks to develop a working knowledge of the conceptual foundation and the quantitative chemical relationships on which subsequent chemistry courses are built. Atomic structure, chemical bonding, properties of gases, liquids, and solids, acid-base chemistry, and chemical equilibria are emphasized. The class meets each week for three one-hour lectures, a one-hour tutorial period, and a three-hour laboratory. Students with credit in CHEM 125 will have two hours added on to their total number of hours required for graduation. Prerequisite: Must be eligible for MATH 115. LEC

CHEM 185 Foundations of Chemistry I Honors (5). NP N A course designed for qualified and motivated students with a strong interest in chemistry to provide a more thorough treatment of the concepts and topics of general chemistry. It is anticipated that students in CHEM 185 have had chemistry at the high-school level and plan to take more than one year of chemistry at the college level. Class meets each week for three one-hour lectures, a one-hour tutorial period, and a three-hour lab. Students with credit in CHEM 125 will have two hours added on to their total number of hours required for graduation. Prerequisite: Eligibility for CHEM 184, a satisfactory score on a qualifying examination administered by the Department of Chemistry, and at least one of the following: (a) acceptance into the KU Honors Program, (b) an AP score in chemistry of 3 or higher, (c) a mathematics ACT score of 28 or higher. LEC

CHEM 188 Foundations of Chemistry II (5). N This course is a continuation of CHEM 184 and provides an introduction to inorganic chemistry and qualitative and quantitative analysis. Electrochemistry, thermodynamics, chemical kinetics, and coordination chemistry are stressed. The class meets each week for three one-hour lectures, an optional tutorial period, and a five-hour laboratory. Prerequisite: CHEM 184. LEC

CHEM 189 Foundations of Chemistry II, Honors (5). N A course designed for qualified and motivated students with strong interest in chemistry to provide a more thorough treatment of the concepts and topics of advanced general chemistry. It is anticipated that the students in CHEM 189 have completed CHEM 185 or excelled in CHEM 184. Prerequisite: Membership in the University Honors Program, CHEM 184, CHEM 185, or consent of the department. LEC

CHEM 309 History of Chemistry (3). H Birth of modern chemical science from roots in Greek natural philosophy, alchemy, Renaissance medicine and technology. The Chemical Revolution of Lavoisier and Dalton. Maturity of chemistry in the 19th and 20th centuries, along with an examination of growth of chemical institutions and the rise of chemical industry. Emphasis on developments from the 18th century to the present. (Same as HIST 309.) LEC

CHEM 450 Directed Readings/Laboratory in Chemistry (1-3). N Individual and supervised study or laboratory work on special topics or problems in chemistry. Prerequisite: Ten hours of chemistry and a minimum overall grade-point average of 2.0 or consent of department. IND

CHEM 516 Analytical Chemistry (3). N Principles of analytical chemistry with emphasis on the fundamental reactions used for chemical analysis. Topics include chemical equilibria in acid/base, complexation, separations, and redox systems, data analysis, and potentiometry. Three class periods per week. Prerequisite: CHEM 188, CHEM 622 or CHEM 624, CHEM 625, and concurrent enrollment in CHEM 517. LEC

CHEM 517 Analytical Chemistry Laboratory (2). N Experiments illustrate fundamental principles of chemical analysis methods. The course serves as an introduction to advanced instrumental methods of analysis. One five-hour laboratory and one fifty minute lecture each week. Prerequisite: CHEM 188, CHEM 622 or CHEM 624, CHEM 625, and concurrent enrollment in CHEM 516. LAB

CHEM 598 Research Methods (3). N An introduction for pre-service teachers to the tools used by scientists to solve scientific problems. Topics include design of experiments and interpretation of their results, use of statistics, mathematical modeling, laboratory safety, ethical treatment of human subjects, writing scientific papers, giving oral presentations, and obtaining data from the scientific literature. Open only to students in the UKanTeach program. LEC

CHEM 622 Fundamentals of Organic Chemistry (3). N A study of the structures and reactions of important classes of organic compounds. Along with the organic laboratory, CHEM 625, this course will fulfill the needs of students requiring a sin-

gle semester of organic chemistry. Students requiring more than one semester of organic chemistry should enroll in CHEM 624. Prerequisite: CHEM 188. LEC

CHEM 624 Organic Chemistry I (3). N Three class periods each week. A study of the structure and reactivity of selected classes of organic compounds. CHEM 624 is the first course of a two-semester sequence. Students who require only one semester of organic chemistry should enroll in CHEM 622. Students with credit in CHEM 622 will have two hours added on to their total number of hours required for graduation. Prerequisite: CHEM 188. LEC

CHEM 625 Organic Chemistry I Laboratory (2). U One five-hour laboratory and one one-hour lecture each week. Emphasis on basic techniques for the preparation, separation, and purification of organic compounds. Required for a major in chemistry and by those departments and programs specifying a complete undergraduate organic chemistry course. Prerequisite: CHEM 622 or CHEM 624, or concurrently. LAB

CHEM 626 Organic Chemistry II (3). N Three class periods each week. A continuation of CHEM 624, intended for students who want further training in organic chemistry. Prerequisite: CHEM 624. LEC

CHEM 627 Organic Chemistry II Laboratory (2). U One five-hour laboratory period and one one-hour lecture each week. More advanced organic laboratory techniques with emphasis on modern spectroscopic methods for determining the structure and purity of organic compounds. Required by all programs which specify a full year of organic chemistry. Prerequisite: CHEM 625 and CHEM 626 or CHEM 626 concurrently. LAB

CHEM 628 Organic Chemistry I, Honors (3). N Three class periods and one tutorial period each week. This is the first half of a two-semester sequence in organic chemistry for students with strong records in previous chemistry courses and who are planning or considering a major in a chemistry-related field. The content is similar to that of CHEM 624 but with coverage in greater depth and more emphasis on developing problem-solving skills. Students requiring only one semester of organic chemistry should not enroll in this course but take CHEM 622. Students with credit in CHEM 622 who take and complete CHEM 628 will have two hours added to their total number of credit hours required for graduation. Prerequisite: CHEM 188 or CHEM 189 and membership in the University Honors Program or consent of instructor. LEC

CHEM 630 Organic Chemistry II, Honors (3). N Three class periods and one tutorial period each week. This is the second course in a two-semester sequence in organic chemistry for students with strong records in previous chemistry courses and who are planning or considering a major in chemistry or in a chemistry-related field. The content is similar to that of CHEM 626 but with coverage in greater depth and more emphasis on developing problem-solving skills. Prerequisite: CHEM 624 or CHEM 628 and membership in the University Honors Program, or consent of instructor. LEC

CHEM 635 Instrumental Methods of Analysis (2). U Theory and application of instrumental methods to modern analytical problems. Topics covered include atomic and molecular spectroscopy, electrochemistry, mass spectrometry, and separations. Two class periods per week. Students must be enrolled concurrently in CHEM 636. Prerequisite: CHEM 516 and CHEM 517. CHEM 640 or CHEM 646 strongly recommended. Corequisite: CHEM 636. LEC

CHEM 636 Instrumental Methods of Analysis Laboratory (2). U Theory and application of instrumental methods to modern analysis problems. Experiments covered include atomic and molecular spectroscopy, electrochemistry, and separation methods. One five-hour laboratory each week. Students must be enrolled concurrently in CHEM 635. Prerequisite: CHEM 516 and CHEM 517. A course in physical chemistry is strongly recommended. Corequisite: CHEM 635. LAB

CHEM 640 Biological Physical Chemistry (3). N A one semester course, designed particularly for biology, biochemistry, and premedical students, which surveys the fundamentals of physical chemistry. The basic principles of thermodynamics, chemical kinetics, quantum chemistry, and spectroscopy will be introduced, and their application to aqueous solutions and biochemical systems will be emphasized. Prerequisite: One semester of organic chemistry, two semesters of calculus, and two semesters of physics. LEC

CHEM 641 Biological Physical Chemistry Laboratory (2). U A course particularly for biology, biochemistry, and premedical students. Experiments in physical chemistry illustrating the fundamental principles of quantum mechanics, spectroscopy, thermodynamics, and kinetics as applied to chemical systems. Prerequisite: CHEM 640. LAB

CHEM 646 Physical Chemistry I (3). N An introduction to the basic principles of quantum mechanics, atomic and molecular structure, molecular rotations and vibrations, group theory, spectroscopy, and statistical mechanics. Prerequisite: CHEM 188; PHSX 211 and PHSX 212; and MATH 121 and MATH 122; and completion of, or concurrent enrollment in MATH 290 or consent of instructor. LEC

CHEM 647 Physical Chemistry I Laboratory (2). U Experiments in physical chemistry, with emphasis on the fundamental principles of quantum mechanics and spectroscopy as applied to chemical systems. Prerequisite: CHEM 646. LAB

CHEM 648 Physical Chemistry II (4). N Emphasizes the thermodynamics of molecular systems with application to the structure and properties of gases, liquids, solids, materials, statistical thermodynamics, chemical kinetics, and reaction dynamics. Prerequisite: CHEM 646; MATH 223 and MATH 290 or consent of instructor. LEC



Course descriptions and degree requirements are subject to change. Consult your department or dean's office.

The Wilcox Classical Museum in Lippincott Hall houses original red-figure vases, Greek and Roman coins, inscriptions, and full-sized plaster casts of the Apollo Belvedere, the Parthenon frieze, and other antiquities.

CHEM 649 Physical Chemistry II Laboratory (2). U One four-hour laboratory and one one-hour lecture per week. Experiments in physical chemistry, with emphasis on the fundamental principles of chemical thermodynamics and kinetics. Prerequisite: CHEM 648 or consent of instructor. LAB

CHEM 667 Systematic Inorganic Chemistry (3). N A systematic study of the elements and their compounds, emphasizing the relationship between properties of substances and their atomic and molecular structures and the positions of the elements in the periodic systems. Prerequisite: CHEM 640 or CHEM 646 or CHEM 648, or CHEM 648 concurrently. LEC

CHEM 668 Advanced Inorganic Laboratory (2). U Experiments concerning the synthesis and characterization of inorganic compounds. Prerequisite: CHEM 667 or concurrent enrollment in CHEM 667. LAB

CHEM 680 Topics in Chemistry: _____ (1-5). N Courses on special topics in chemistry, given as the need arises. Course may be repeated for different topics. Prerequisite: 20 hours of Chemistry. Each section may have additional prerequisites to be determined by the instructor. LEC

CHEM 690 Environmental Chemistry (3). N The chemical nature of the biosphere; this course explores the fundamental chemistry underlying selected problems in air and water pollution. This class will meet for three 50 minute lectures each week. Prerequisite: CHEM 184, CHEM 188, and CHEM 622 and CHEM 624 or their equivalents. LEC

CHEM 696 Junior/Senior Seminar (1). U Special topics and presentations by students and faculty in areas of current interest such as recent developments in chemistry, societal issues facing chemists, career and professional perspectives, and reports of ongoing research. Meets once a week for one to one and one-half hours. May be repeated to accumulate a maximum of two credit hours. Prerequisite: Junior or senior standing, a declared major in chemistry and at least eighteen semester hours of chemistry. LEC

CHEM 698 Undergraduate Research Problems (1-6). N May be repeated to accumulate a maximum of 10 credit hours. An undergraduate research course, in any of the fields of chemistry, consisting of either experimental work or the preparation of an extensive paper based on library investigation of a selected topic. A final report must be submitted to the department at the end of the semester. Open by permission of the department to those with at least 20 hours of chemistry. IND

CHEM 699 Undergraduate Honors Research (2-6). N To be taken two semesters for a total of no more than 8 hours. An undergraduate research course, in any of the fields of chemistry. At the completion of the research, a written thesis, and an oral presentation will be required. Prerequisite: Admission to Chemistry Honors Program. IND

CHEM 711 Applied Electronics for Scientists (4).

CHEM 716 Practicum in Facilitating Learning in the Chemistry Laboratory (1).

CHEM 718 Mathematical Methods in Physical Sciences (3).

CHEM 720 Bibliography of Chemistry (1).

CHEM 731 Fundamentals and Methods of Analytical Chemistry (3).

CHEM 737 Coordination and Organometallic Chemistry (3).

CHEM 740 Principles of Organic Reactions (3).

CHEM 742 Physical Organic Chemistry I (3).

CHEM 750 Quantum Chemistry and Spectroscopy (3).

CHEM 752 Statistical Thermodynamics (3).

CHEM 754 Chemical Kinetics and Dynamics (3).

CHEM 763 Organic Synthesis I (3).

CHEM 766 Spectroscopic Identification of Organic Compounds (3).

CHEM 767 Advanced Laboratory Techniques for the Preparation and Purification of Compounds (3).

CHEM 775 Chemistry of the Nervous System (3).

Chinese

See East Asian Languages and Cultures in this chapter of the catalog.

Cherokee

See Liberal Arts and Sciences courses in this chapter of the catalog.

Classics

Chair: Pamela Gordon

Wescoe Hall, 1445 Jayhawk Blvd., Room 2104

Lawrence, KS 66045-7590, www2.ku.edu/~classics, (785) 864-3153

Degrees offered: B.A., B.G.S., M.A.

Why study classics? Because knowledge of Greek and Roman antiquity is fundamental to understanding the modern world.

Classics is the integrated study of Greek and Roman civilization through its languages, its literature, and its artistic and archaeological remains.

Courses for Nonmajors

All courses are open to nonmajors. The department offers a range of courses in ancient art, archaeology, language, and literature, including the principal course CLSX 148 Greek and Roman Mythology. No knowledge of Latin or Greek is needed for courses labeled CLSX.

Language Proficiency

The CLAS language requirement may be fulfilled by taking either Latin or Greek. To meet the language requirement in Latin, a student should complete LAT 104, LAT 108, and LAT 112 followed by LAT 200 (or their equivalents). To meet the language requirement in Greek, a student should complete GRK 104, GRK 108 and two more courses (6 hours) at the GRK 300 level. The number of hours required may be reduced if a student has high school or transfer hours.

Placement in Latin. Students who wish to enroll in Latin after studying Latin in high school or elsewhere should seek advice from the classics faculty about appropriate placement in Latin courses at KU. Whenever possible, make an advising appointment in advance by calling the Department of Classics at (785) 864-3153 or by contacting an adviser at www2.ku.edu/~classics/undergraduateadvisors.html.

Retroactive Credit in Latin. In cooperation with the University Registrar, the Department of Classics awards retroactive university credit for work in Latin at the high school level. To qualify for retroactive credit, the student's initial university-level enrollment in Latin must be in a KU course. The student qualifies for retroactive credit only after completing the KU Latin course with a grade of C or higher.

After completing such a course with a qualifying grade, the student must bring his or her ARTS form and high school transcript to the Department of Classics office for verification. The department then notifies the Office of the University Registrar of the number of credit hours to be awarded. The student's transcript shows the number of hours awarded but no letter grade. The hours count toward graduation. Guidelines are as follows:

Two Years of High School Latin: A student must enroll initially at KU in LAT 112 or LAT 113 and receive a grade of C or higher. Three hours of retroactive credit will be awarded.

Three Years of High School Latin: A student who initially enrolls in LAT 200 or LAT 201 and receives a grade of C or higher will receive 6 hours of retroactive credit. A student who enrolls in LAT 112 or LAT 113 and receives a grade of C or higher will receive 3 hours of retroactive credit.

Four Years of High School Latin: A student who initially enrolls in a Latin course higher than LAT 200 or LAT 201 (e.g., any 300-level Latin course) and receives a grade of C or higher will receive 9 hours of retroactive credit. A student who enrolls in LAT 200 or LAT 201 and receives a grade of C or higher will receive 6 hours of retroactive credit.

Note: If a student initially enrolls in a course below the specified level (e.g., a student with four years of high school Latin enrolls in LAT 112 or LAT 113), he or she receives no retroactive credit. If a student initially enrolls in a course above the specified level (e.g., a student with two years of high school Latin enrolls in LAT 200 or LAT 201, or a student with three years of high-school Latin enrolls in a Latin course higher than LAT 200 or LAT 201) and receives a grade of C or higher, he or she is eligible for the full retroactive credit allowed for that course.

Majors

The Department of Classics offers two majors. Both provide students of diverse career goals a broad humane education and afford a solid foundation for those who wish to pursue graduate work in classics. The Classical Antiquity major provides inclusive, interdisciplinary training in ancient Greek and Roman cultures and prepares you for graduate study in ancient archaeology, art, or history. The Classical Languages major trains you to read the great authors of classical antiquity (e.g., Homer, Plato, Vergil, Sappho, Saint Augustine) in the original language and prepares you for graduate study in classics and for teaching in some private schools. You might also combine your classical language interest with a