

## CHEMISTRY (CHEM)

Bayly Foundation

PROFESSORS FRANCE, PLEVA  
ASSOCIATE PROFESSORS **ALTY**, DESJARDINS,  
TUCHLER, UFFELMAN  
ASSISTANT PROFESSOR LaRIVIERE  
INSTRUCTOR ABRY  
VISITING PROFESSOR SETTLE

### MAJORS

**A student may complete only one of the majors listed in the Department of Chemistry.**

The major in **chemistry** leading to a Bachelor of Arts degree requires completion of 44 credits as follows:

1. Chemistry 111, 112, 242, 243, 250, 341; Physics 111, 112, 113, 114
2. One course from each of the following three groups:  
Chemistry 241 or 241S  
Chemistry 252 or 254  
Chemistry 260 or 261
3. Six additional credits chosen from biology, chemistry (numbered 200 or above), geology or physics (numbered 200 or above).
4. Completion of the Major Field Test in Chemistry.

Additional courses required as prerequisites for completion of the above include Mathematics 101 and 102, or their equivalents.

The major in **chemistry** leading to a Bachelor of Science degree requires completion of at least 52 credits in the sciences and mathematics including the following:

1. Chemistry 111 and 112, 242, 243, 250, 262, 266, 341; Mathematics 221; Physics 111, 112, 113, 114
2. One course from each of the following three groups:  
Chemistry 241 or 241S  
Chemistry 252 or 254  
Chemistry 260 or 261
3. Two courses chosen from Chemistry 311, 347, 350, and 365.
4. Completion of the Major Field Test in Chemistry.

Mathematics 221 must be completed by the end of the sophomore year; Chemistry 262 must be completed by the end of the junior year. Chemistry 254 and Mathematics 222 are recommended. Additional courses required as prerequisites for completion of the above include Mathematics 101 and 102, or their equivalents.

The major in **biochemistry** leading to a Bachelor of Science degree requires completion of 57 credits as follows:

1. Biology 111 and 113; Chemistry 111 and 112, 241 or 241S, 242, 243, 250, 254, 260, 341, 342, 343, 344; Mathematics 101 and 102; Physics 111, 112, 113, 114

2. Two additional courses totaling at least four credits chosen from the following. Only one 400-level course may count toward the major.  
Biology 220, 221, 225, 301, 310, 320, 350, and when the topic is appropriate and approved by the chemistry department head, Biology 295, 395, 396, 422 or 423  
Chemistry 262, 311, and when the topic is appropriate and approved by the chemistry department head, Chemistry 295, 297, 298, 421, 422 or 423  
Neuroscience 395, 422 or 423, when the topic is appropriate and approved by the chemistry department head.
3. Completion of the Major Field Test in Chemistry.

The major in **chemistry** leading to a specialized Bachelor of Science with Special Attainments in Chemistry degree certified by the American Chemical Society requires completion of 60 credits as follows:

1. Chemistry 111 and 112, 241 or 241S, 242, 243, 250, 252, 261, 262, 266, 267, 311, 341, 350, 471. These courses must be completed with a 2.000 grade-point average or higher.
2. Mathematics 221, 222
3. Physics 111, 112, 113, 114.
4. Completion of the Major Field Test in Chemistry.

Students pursuing this degree must complete six credits in English (usually covered by the general education requirements in composition and literature). Mathematics 221 and Physics 112 and 114 must be completed by the end of the sophomore year; Chemistry 262 must be completed by the end of the junior year. Additional advanced courses in chemistry and Mathematics 332 are highly recommended in preparation for graduate school. Additional courses required as prerequisites for completion of the above include Mathematics 101 and 102, or their equivalents.

The majors in **chemistry-engineering** and **chemistry-engineering 3-2** leading to a Bachelor of Science degree are designed for students interested in the field of chemical engineering. The requirements are described under Engineering (p. 167-168).

*HONORS: An Honors Program in chemistry is offered for qualified students; see department head for details.*

### **Chemistry 100 (4)—Modern Descriptive Chemistry**

*Prerequisite: Permission of the department. Enrollment limited. Not open to students with previous credit in 200-level chemistry.* An elementary study of the structure and reactions of molecules. Laboratory work illustrates some fundamental procedures in chemistry. Designed for non-science students fulfilling general education requirements or desiring a science elective. Laboratory course with fee. (SL, GE5a) *Pleva.*

*Fall*

**Chemistry 106 (4)—Disorder and Chaos**

An interdisciplinary introduction for the non-specialist to the concepts underlying non-linear dynamics (chaos theory), statistical thermodynamics and fractal geometry. Emphasis is placed on the computer modeling of physical and social systems using deterministic and stochastic methods. Visual interpretation of computer simulation is the primary method employed for the analysis of model systems. No mathematics beyond high school algebra is assumed. The laboratory component of the course consists of a series of projects from diverse areas of the natural sciences, including pendulum motion, oscillating chemical reactions, geological formations and the growth patterns of biological systems. Laboratory course. (SL, GE5a) *Desjardins, Pleva, Abry.*

*Spring*

**Chemistry 111 (4)—General Chemistry**

The fundamental principles of general chemistry, with emphasis on atomic and molecular structure, phases of matter, and spectroscopic methods. Laboratory work includes model building, qualitative inorganic analysis and a brief introduction to GC-MS, NMR and UV-VIS spectroscopies. No previous knowledge of chemistry is required, though it is advantageous. Laboratory course with fee. (SL, GE5a) *Tuchler, Uffelman, Abry.*

*Fall*

**Chemistry 112 (4)—Aqueous Inorganic Quantitative Chemistry**

*Prerequisite: Chemistry 111.* A continuation of Chemistry 111, with emphasis on inorganic systems exhibiting aqueous solution equilibria. Topics covered include acid/base reactions, redox reactions, complexation, precipitation reactions, introductory thermodynamics and kinetics, and solution equilibrium. Laboratory work emphasizes techniques of chemical quantitative analysis and data handling. Designed for students planning to continue with more advanced science courses. Laboratory course with fee. (SC, GE5c) *Desjardins, Pleva, Abry.*

*Winter*

**Chemistry 120 (Biology 120) (4)—Atmospheric Science from the Ground Up**

One of the most complex and important physical systems that scientists must understand is the climate. Predictions regarding climate change and the impact of human activity on that change are made based on our understanding of the complex interactions that drive atmospheric composition and the interaction of the atmosphere with the biosphere and the geosphere. Society asks critical questions - both global and local in reach - regarding the impact of climate change and the drivers behind that change. Answers to these questions may have significant impact on the world economy and choices we make locally, statewide, and nationally. Washington and Lee is located three miles from I-81, a major trucking route for interstate commerce. The atmospheric pollutants generated by the traffic on I-81 have an impact on the atmosphere, watersheds (including Chesapeake Bay), plants, and soils. In this course, field and laboratory exercises include the analysis of atmospheric inputs from I-81 and their impacts on soil and plant concentrations of contaminants. Lectures

provide background so that informed hypotheses may be made relating to the influences of highways on local and regional atmospheres and environmental contamination are tested. Laboratory course. (SL, GE5a) *Hamilton, Tuchler.*

*Spring 2010 and alternate years*

**Chemistry 133 (3)—Describing Nature**

This writing-based seminar considers how scientists describe natural phenomena and express scientific theories in terms of mathematics, graphical representations, and prose. Students examine a collection of topics from physics, chemistry and biology and examine how accepted explanations of these phenomena in terms of mathematical models are verified by experiment and then translated to concepts using ordinary language. In essence, if a scientific theory is expressed as an equation, how can we understand it in terms of pictures and words? Topics include entropy, the uncertainty principle, and definitions of life. (SC, GE5c) *Desjardins.*

*Fall*

**Chemistry 175 (3)—Developing Outreach Activities for Local Schools**

*Prerequisite: Chemistry 100, Chemistry 106, or Chemistry 111.* This Spring Term service-learning laboratory course teaches the development of hands-on laboratory activities to fulfill physical science goals required by the Science Standards of Learning for Virginia's Public Schools. Students create instructional science experiments for chosen age levels to explore, and implement activities with school children in Lexington City and Rockbridge County School classrooms. Students visit at least two different classrooms. Primarily a laboratory course. *LaRiviere.*

*Spring 2009 and alternate years*

**Chemistry 195 (3)—The Nuclear Age**

This seminar initially reviews the science and technology leading to the development and production of the first nuclear weapons. It then examines the decision to use the atomic bomb against Japan. The final portion of the course addresses the political, social, and environmental legacies of these weapons. Students write a series of short papers, based on their reading of primary and secondary sources, that form the basis for group discussions throughout the seminar. A term paper is required. Not a laboratory course. (SC, GE5c) *Settle.*

*Fall*

**Chemistry 196 (3)—Nuclear Power: Energy and the Environment**

This course examines the role of nuclear power as a current and future source of energy. Topics include introduction to science and technology of nuclear reactors, the nuclear fuel cycle and nuclear waste, the history of nuclear power generation in the U.S. and other nations, economic, legal, and environmental issues, the risks associated with proliferation of nuclear weapons and terrorist attacks, and a comparison of nuclear power with other sources of energy. (SC, GE5c) *Settle.*

*Spring*

**Chemistry 241 (4)—Organic Chemistry I**

*Prerequisite:* An average grade of 2.5 or better in Chemistry 111 and 112 or permission of the department. General theory of organic chemistry directed toward the basic functional groups of organic compounds. Laboratory work includes the preparation of typical organic compounds. This is the first course of a sequence which will satisfy the entrance requirements of all medical schools. Laboratory course with fee. *France.*

Fall

**Chemistry 241S (4)—Organic Chemistry I at St. Andrews**

*Prerequisites:* An average grade of 3.0 or better in Chemistry 111 and 112 or the equivalent, a 3.000 cumulative grade-point average, and permission of the International Education Committee. General theory of organic chemistry directed toward the basic functional groups of organic compounds. Laboratory work includes the preparation of typical organic compounds. This is the first course of a sequence which will satisfy the entrance requirements of all medical schools. Taught at the University of St. Andrews in Scotland with final grade assigned by W&L faculty member. Laboratory course. *France.*

Fall

**Chemistry 242 (4)—Organic Chemistry II**

*Prerequisite:* Chemistry 241 or 241S. A continuation of Chemistry 241, including an introduction to organic spectroscopic methods. Laboratory course with fee. *France.*

Winter

**Chemistry 243 (3)—Organic Spectroscopic Methods**

*Prerequisite or corequisite:* Chemistry 242. Introduction to mass spectroscopy, infrared spectroscopy and proton and carbon nuclear magnetic resonance spectroscopy, including two-dimensional techniques. Emphasis is on interpreting spectra to determine structures of organic molecules. Laboratory work uses the instruments to identify unknown organic molecules. Laboratory course with fee. *Alty.*

Winter

**Chemistry 250 (2)—Inorganic Chemistry**

*Prerequisites:* Chemistry 260 or 261; pre- or corequisite: Chemistry 243; corequisite: Chemistry 254, or, by permission of the instructor, Chemistry 252. A survey of main group and transition metal chemistry, as well as fundamentals of point group symmetry. Main group chemistry will be discussed from the perspective of the "classic" compounds from the alkali metals, the alkaline earths, the boron family, the carbon family, the pnictogens, the chalcogens, the halogens, and the noble gases. Transition metal chemistry will be examined from the standpoint of characteristic coordination geometries, kinetics and mechanism, electron transfer (inner and outer sphere), and catalysis. *Uffelman.*

Winter

**Chemistry 252 (2)—Inorganic Chemistry Laboratory**

*Prerequisites:* Chemistry 260 or 261; prerequisite or corequisite: Chemistry 243; corequisite: Chemistry 250. A survey of modern inorganic synthesis and spectroscopy. Topics will include manipulation of air-sensitive compounds; NMR of diamagnetic and paramagnetic complexes; dynamic NMR, IR, and UV-VIS spectroscopies. Laboratory course with fee. *Uffelman.*

Winter

**Chemistry 254 (2)—Bioinorganic Chemistry**

*Prerequisites:* Chemistry 260 or 261; prerequisite or corequisite: Chemistry 243; corequisites: Chemistry 250 and permission of instructor. A survey of the major metalloproteins, metalloenzymes, and medicinal inorganic compounds. *Uffelman.*

Winter

**Chemistry 260 (4)—Physical Chemistry of Biological Systems**

*Prerequisites:* Chemistry 112 and Mathematics 102. *Prerequisite or corequisite:* Physics 111. An introduction to the application of thermodynamics and chemical kinetics of biological systems. Topics include enzyme kinetics, the thermodynamics of metabolic cycles, and the conformational energetics of biomolecules, especially protein folding. *Desjardins.*

Fall

**Chemistry 261 (4)—Physical Chemistry I**

*Prerequisites:* Chemistry 112; prerequisite or corequisite: Mathematics 221. An introduction to classical thermodynamics and chemical kinetics. Examples include biological applications of thermodynamic principles and polymer and enzyme kinetics. *Desjardins.*

Fall

**Chemistry 262 (4)—Physical Chemistry II**

*Prerequisites:* Chemistry 112; prerequisite or corequisite: Mathematics 221 and Physics 112. An introduction to quantum mechanics as it applies to atomic and molecular systems. The emphasis is placed on spectroscopic methods and the modern picture of chemical bonding and molecular structure. Semi-empirical and *ab initio* quantum chemistry is considered. *Tuchler.*

Winter

**Chemistry 266 (1)—Physical Chemical Measurements**

*Prerequisite or corequisite:* Chemistry 261 or permission of the instructor. Laboratory work illustrating the principles and instruments of physical chemistry. Laboratory course. *Tuchler.*

Fall

**Chemistry 267 (1)—Physical Chemical Measurements**

*Prerequisite:* Chemistry 261. Laboratory work illustrating the principles and instruments of physical chemistry. Laboratory course. *Tuchler.*

Winter

**Chemistry 295 (1)—Special Topics in Chemistry**

*Prerequisite or corequisite:* 16 credits in chemistry or departmental permission. One-credit studies of special topics. May be repeated for degree credit with permission and if the topics are different. Possible topics include solid state chemistry, metabolic diseases, culinary chemistry, developments in physical chemistry, data handling, and reaction dynamics. *Staff.*

*Offered when interest is expressed and departmental resources permit.*

**Chemistry 296 (1)—Hazardous Materials**

*Prerequisite or corequisite:* Chemistry 241 or 241S or permission of the instructor. *Pass/Fail only.* Introduction to safe and responsible practices in the laboratory. Evaluation of hazards and risk assessment in the laboratory, management of chemicals, working safely with chemicals and equipment and disposal of waste. *Pleva.*

*Winter*

**Chemistry 297 (2)—Special Topics in Chemistry**

*Prerequisite or corequisite:* 16 credits in chemistry or departmental permission. Two-credit studies of special topics. May be repeated for degree credit with permission and if the topics are different. Possible topics include electrochemistry, medicinal chemistry, atmospheric chemistry and the environment, and the dynamics of photochemistry. *Staff.*

*Offered when interest is expressed and departmental resources permit.*

**Chemistry 298 (3)—Special Topics in Chemistry**

*Prerequisite or corequisite:* 16 credits in chemistry or departmental permission. Three-credit studies of special topics. May be repeated for degree credit with permission and if the topics are different. Possible topics include RNA biochemistry, medicinal chemistry, and atmospheric chemistry and the environment. *Staff.*

*Offered when interest is expressed and departmental resources permit.*

**Chemistry 311 (4)—Advanced Analytical Chemistry**

*Prerequisite:* Chemistry 262. This course deals with the process of experimentation. Topics include: statistics, statistical decision making, sampling, wet-chemical preparation, and measurement of analyte by modern instrumental (spectroscopic, chromatographic), as well as more traditional techniques (with an emphasis on electrochemistry). Laboratory course. *Pleva.*

*Fall 2008 and alternate years*

**Chemistry 341 (3)—Biochemistry I**

*Prerequisite:* Chemistry 242. A study of the structure, function, biosynthesis and breakdown of biomolecules, including amino acids, carbohydrates, and lipids. Enzymes, biological membranes and membrane transport, signal transduction, and regulation of metabolism are studied in greater detail. *Alty, LaRiviere.*

*Fall*

**Chemistry 342 (3)—Biochemistry II**

*Prerequisites:* Chemistry 242 and either Chemistry 341 or Biology 215, and permission of the instructor. A continuation of Chemistry 341 with an emphasis on the structure, function, and metabolism of nucleic acids. Topics covered in detail include gene expression and regulation, DNA replication and repair, RNA transcription and processing, and protein synthesis and degradation. *LaRiviere.*

*Winter*

**Chemistry 343 (1)—Biochemistry I Laboratory**

*Prerequisite or corequisite:* Chemistry 341. Experiments demonstrate the techniques used to study proteins and lipids. Isolation and characterization of proteins and lipids using gel electrophoresis, UV/Vis spectroscopy, chromatographic techniques including GC/MS, and the proper reporting and analysis of experimental data are included. Laboratory course with fee. *Alty, LaRiviere.*

*Fall*

**Chemistry 344 (1)—Biochemistry II Laboratory**

*Prerequisite or corequisite:* Chemistry 342. A laboratory course designed to demonstrate the fundamental techniques used to study nucleic acids. Methods to isolate and characterize DNA and RNA include PCR, gel electrophoresis, hybridization techniques, and UV/Vis spectroscopy. Laboratory course with fee. *LaRiviere.*

*Winter*

**Chemistry 347 (3)—Advanced Organic Chemistry**

*Prerequisite:* Chemistry 242. An introduction to the synthesis of complex organic molecules. Topics include control of stereochemistry, synthetic methodology, modern synthetic reactions, protecting groups, natural products synthesis, and combinatorial chemistry. *France.*

*Spring*

**Chemistry 350 (3)—Advanced Inorganic Chemistry**

*Prerequisites:* Chemistry 250, 252, and 262. An introduction to group theory and its application to inorganic spectroscopy and an introduction to organometallic chemistry, organometallic catalytic processes, and solid state chemistry. *Uffelmann.*

*Spring*

**Chemistry 365 (3)—Advanced Physical Chemistry**

*Prerequisite:* Chemistry 262. A more advanced treatment of the fundamental areas of physical chemistry such as thermodynamics, chemical kinetics, statistical mechanics, and quantum mechanics. Specific topics vary with student interest. *Desjardins, Tuchler.*

*Winter*

**Chemistry 421 (1), 422 (2), 423 (3)—Directed Individual Research**

*Prerequisite:* Chemistry 242 or permission of the instructor. Literature search, conferences, tri-weekly reports and laboratory work on a project supervised by the instructor and designed by the student and instructor. A final written report on the project is required. *Staff.*

**Chemistry 433 (3), 436 (6), 439 (9)—Tutorial**

*Prerequisite:* Honors candidacy or permission of the department. Directed reading, conferences, laboratory experiments, and papers on topics mutually agreeable to the student and the staff. Laboratory course. *Staff.*

**Chemistry 471 (1), 472 (2), 473 (3)—Senior Thesis**

*Prerequisite:* Senior standing in chemistry. Literature search, conferences, reports and laboratory. Maximum of six credits. Laboratory course. *Staff.*

**Chemistry 493 (3-3)—Honors Thesis**

*Prerequisite:* Honors candidacy. Literature search, conferences, reports and laboratory work resulting in a thesis exhibiting a significant understanding of an important problem. *Staff.*

*Fall-Winter*

**Chemistry Seminar**

Regular meetings of the staff, chemistry majors, and outside invited speakers are held throughout the academic year to discuss selected topics. All interested students are invited to attend.

**CHINESE (CHIN)**

*(Department of East Asian Languages and Literatures)*

ASSOCIATE PROFESSOR FU

ASSISTANT PROFESSOR CHANG

**Chinese 100 (6)—Supervised Study Abroad: Beginning Chinese**

*Prerequisites:* Permission of the department and approval of the International Education Committee. This course is designed to introduce Chinese language and culture to students with little or no previous Chinese language background and prepare them for studying first-year Chinese. Combining language study with studies of other aspects of Chinese culture (literature, art, history, economy, etc.) provides students with firsthand experience of the development of contemporary China. Classes and discussions are held at the International College of Chinese Studies at East China Normal University in Shanghai. The program includes field trips to points of historical interests and many cultural activities. Students learn through personal experience about the emergence of modern China and its changing culture.

*Fu.*

*Spring*

**Chinese 101 (3)—Exploring Chinese Language and Culture**

This course is an introduction to Chinese language and culture. Students learn elementary oral and written Chinese and also about the evolution of the Chinese language. Slides, media presentations and film clips are used to demonstrate the impact the language has had on the culture and their interactions in contemporary Chinese society. This course is not a prerequisite for Chinese 111, nor does it allow a student to move to a language course numbered higher than Chinese 111 without permission of the instructor. *Staff.*

*Offered when interest is expressed and departmental resources permit.*

**Chinese 111 (4)—First-Year Chinese I**

An introduction to modern spoken and written Chinese. In addition to classroom drill in speaking and reading, extensive use is made of both the language laboratory and the computer in outside preparation. *Fu.*

*Fall*

**Chinese 112 (4)—First-Year Chinese II**

*Prerequisite:* Chinese 111 or the equivalent.

A continuation of Chinese 111. Further work on modern spoken and written Chinese. *Fu.*

*Winter*

**Chinese 113 (3)—Elementary Conversation**

*Prerequisite:* Chinese 112 or the equivalent. This course is intended to consolidate the material learned in Chinese 112 and to develop fluency in speaking. It includes intensive conversational practice focused upon specific themes with reinforcement through visual aids.

*Fu.*

*Offered in spring when interest is expressed and departmental resources permit.*