BACHELOR OF ARTS: CHEMISTRY

University Requirements

General Education
The UMKC General Education Core (http://catalog.umkc.edu/undergraduate-academic-regulations-information/general-education-requirements) is the university-wide curriculum that all undergraduate students will complete. The 30-credit hour core curriculum includes three course types designated as Anchor, Discourse and Focus and is detailed in the General Education (http://catalog.umkc.edu/undergraduate-academic-regulations-information/general-education-requirements) section of the catalog.

Constitution Course
Every undergraduate student must take a course covering the United States Constitution and the Missouri State Constitution before graduation. Course options are included in the program requirements section below.

RooWriter Assessment
Candidates for all baccalaureate degrees must complete the online UMKC RooWriter Writing Assessment after they have passed Discourse 200 (or its equivalent) but before they have attained 90 credit hours. Incoming transfer students with more than 90 credit hours must complete the RooWriter by the end of their first semester of enrollment or within one semester after passing Discourse 200 (or its equivalent). Students who have not completed the RooWriter Writing Assessment within two semesters after passing Discourse 200 (or its equivalent) will be blocked from enrollment until they successfully complete the RooWriter. Additional information is available in the Undergraduate Academic Regulations and Information (http://catalog.umkc.edu/undergraduate-academic-regulations-information/roowriter) section of the catalog.

Exit Examinations
Information on exit examinations and/or major field exams is available in the Undergraduate Academic Regulations and Information (http://catalog.umkc.edu/undergraduate-academic-regulations-information/graduation/exitexams) section of the catalog.

Student Learning Outcomes
Students graduating from this program will:

• Have a functional knowledge of all the basic areas of chemistry including analytical, organic, physical, inorganic and biochemistry.
• Be able to integrate their knowledge in these areas and use their critical thinking skills in order to become problem solvers.
• Be proficient in chemistry laboratories, especially with respect to: Following and understanding general laboratory practice guidelines, especially proper laboratory safety. Performing chemical analyses. Performing simple chemical synthesis. Understanding and using modern chemical instrumentation.
• Be able to articulate clearly scientific information, both in written and oral forms.
• Be able to use effectively the scientific literature.

Students graduating with a baccalaureate degree in chemistry will be prepared for entry into professional schools (e.g., medical, dental, pharmaceutical, or veterinary), graduate programs, or chemical industries.

Program Requirements

Program Specific Recommendations for UMKC General Education Core (http://catalog.umkc.edu/undergraduate-academic-regulations-information/general-education-requirements) Coursework

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor I</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Anchor II</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Anchor III</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>DISC 100</td>
<td>Discourse I: Reasoning and Values (Speech and Writing)</td>
<td>3</td>
</tr>
<tr>
<td>DISC 200</td>
<td>Discourse II: Culture and Diversity (Writing and Speech)</td>
<td>3</td>
</tr>
<tr>
<td>DISC 300</td>
<td>Discourse III: Civic and Community Engagement (Speech and Writing)</td>
<td>3</td>
</tr>
<tr>
<td>Focus A</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Focus B (Satisfied in program requirements below)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focus C (May be satisfied by the Constitution course requirement below)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focus Elective (Satisfied in program requirements below)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
'Total credits' in this section indicates the number of General Education Core credit hours that are not met by the degree specific requirements outlined below.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Constitution Course Requirement
Section 170.011.1 of the Missouri Revised Statutes, 2015, states that all candidates for a degree issued by a college or university in the state of Missouri must have "satisfactorily passed an examination on the provisions and principles of the Constitution of the United States and of the state of Missouri, and in American history and American institutions."

Courses at UMKC that satisfy this state requirement are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CJC 364</td>
<td>The Supreme Court And The Criminal Process</td>
<td></td>
</tr>
<tr>
<td>HISTORY 101</td>
<td>U.S. History to 1877 (Focus C)</td>
<td>1</td>
</tr>
<tr>
<td>HISTORY 102</td>
<td>U.S. History Since 1877 (Focus C)</td>
<td>1</td>
</tr>
<tr>
<td>HISTORY 360R</td>
<td>Constitutional History of the United States</td>
<td></td>
</tr>
<tr>
<td>HONORS 230</td>
<td>Honors American Government (Focus C)</td>
<td>1</td>
</tr>
<tr>
<td>POL-SCI 210</td>
<td>American Government (Focus C)</td>
<td>1</td>
</tr>
</tbody>
</table>

1 Course may satisfy both the UMKC General Education Core (Focus C) and Constitution requirements.

There are a few other ways this requirement can be satisfied for students transferring to UMKC:

- Take an equivalent course from the list above at a regionally accredited institution.
- Earn credit for one of the above courses through AP, IB, or CLEP.
- Take a course that directly satisfies the Missouri Constitution Requirement at another Missouri institution.
- Have a previous bachelors degree (or higher) from a regionally accredited institution.
- Have an Associate of Arts degree from a regionally accredited institution.
- Complete the 42 Hour Core at a Missouri institution and have it listed on the official transcript.

College of Arts & Sciences Degree Requirements
Students pursuing the bachelor of arts and bachelor of science degrees must complete a major. Students pursuing the bachelor of liberal arts degree must complete a minor. Additional details are available in the Student Services (http://catalog.umkc.edu/colleges-schools/arts-sciences/student-services) section of the catalog.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALEKS Math Placement</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Arts and Humanities Division of CAS</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Science and Math Division of CAS (Satisfied in program requirements below)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social and Behavioral Sciences Division of CAS</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Writing Intensive Course (300-level or above; Satisfied in program requirements below)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Language (3rd Semester Level)</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>MATH 110</td>
<td>College Algebra (or any 200-level or above Math/Stat course; Satisfied in program requirements below)</td>
<td></td>
</tr>
<tr>
<td>or MATH 116</td>
<td>Mathematics For Liberal Arts</td>
<td></td>
</tr>
<tr>
<td>or MATH 120</td>
<td>Precalculus</td>
<td></td>
</tr>
<tr>
<td>Laboratory Science Experience (Satisfied in program requirements below)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Credits</th>
<th>21</th>
</tr>
</thead>
</table>

1 ENGLISH 110, ENGLISH 225, COMM-ST 110, and foreign language courses at 211 or below do not fulfill this requirement.

This requirement may be fulfilled by courses from either the UMKC General Education Core or the College of Arts and Sciences Degree Requirements.
**Major Requirements**

Students must take at least 12 credit hours of 300-level or above coursework in the major.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 211 &amp; 211L</td>
<td>General Chemistry I and Experimental General Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 212R &amp; CHEM 212LR</td>
<td>General Chemistry II and Experimental General Chemistry II</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 321 &amp; 321L</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 322R &amp; CHEM 322LR</td>
<td>Organic Chemistry II and Organic Chemistry Laboratory II</td>
<td>4</td>
</tr>
</tbody>
</table>

**Writing Intensive Course**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 341WI</td>
<td>Analytical Chemistry I: Quantitative Analysis</td>
<td>4</td>
</tr>
</tbody>
</table>

**Chemistry Electives**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
</table>

**Physics**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 210</td>
<td>General Physics I</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 220</td>
<td>General Physics II</td>
<td>4</td>
</tr>
</tbody>
</table>

**Math**

Take any MATH or STAT course 200-level or above.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
</table>

|        |                                             | 3       |

**Total Credits**

|        |                                             | 37      |

1. Any combination of 300-level and 400-level chemistry courses to bring the total credit hours to 26. Certain biochemistry courses (offered by the School of Biological Sciences) also may be included in this total. Please confer with the principal undergraduate advisor.

2. No more than three hours total in CHEM 395, CHEM 399, CHEM 495 and CHEM 499 may be used in meeting the major course requirements.

3. CHEM 320 and CHEM 321 may not both be counted toward the required number of credit hours. (CHEM 321 + CHEM 322R and CHEM 320 + CHEM 322R are both acceptable combinations for meeting, in part, the bachelor of arts departmental course requirements, although the CHEM 320 + CHEM 322R combination is not preferred. The combinations CHEM 320 + CHEM 321 and CHEM 320 + CHEM 321 + CHEM 322R are not acceptable.)

4. Similarly, either CHEM 330 or the combination CHEM 431 + CHEM 432 is acceptable, but the combination CHEM 330 + CHEM 431 + CHEM 432 is not acceptable.

**General Electives**

Students must take elective credit hours to meet the minimum credit hour requirement for their degree, including at least 36 credit hours of coursework at the 300-level or above. The minimum required by the university is 120 credit hours, of which at least 30 credit hours must be taken at UMKC, but some degree programs require more.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>38</td>
</tr>
</tbody>
</table>

**Minimum GPA: 2.0**

**Total Credit Hours: 120**

1. All majors must receive a C- or better in all chemistry courses with an overall chemistry GPA of 2.0 for graduation.

2. A minimum grade of C- is required for all prerequisite courses (including physics and mathematics courses). In exceptional cases, students may receive written consent by submitting a petition to the Chemistry Undergraduate Curriculum Committee which has to be approved to waive this requirement.

3. Each chemistry major must be advised by the Chemistry Undergraduate Advisor every semester.

4. In order to meet the College's residency requirement for a major in Chemistry, a minimum of 12 credit hours must be completed in the Department of Chemistry at UMKC, of which 9 of the 12 hours must be at the 300/400 level. While credit as a result of advanced placement (AP) scores and courses in Biochemistry (LS-BIOC 341, LS-BIOC 365, or LS-BIOC 366) may be used towards meeting major requirements, they do not count towards the residency requirement.
Tools for Planning and Fulfilling Academic Requirements

UMKC's Major Maps (https://cf1.umkc.edu/majormaps) are detailed, semester by semester plans that lead a student to complete all degree requirements within four years. Plans include benchmarks and critical courses by term that assist a student's evaluation of progress and major “fit”. In order to ensure that the appropriate courses are taken, students are encouraged to consult with the undergraduate advisor for this major.

UMKC's Degree Audit System (https://www.umkc.edu/registrar/majors-degrees/planmydegree.asp) provides an individual evaluation of all degree requirements (General Education Core, Degree Specific, Major Specific, etc.) for student's officially recorded (Office of Registration and Records) and "what if" plans of study. This evaluation is used to certify all graduation requirements.

Courses

CHEM 111 Physical Basis Of Chemistry Credits: 3
An introductory course in the basic principles applicable to chemistry for students who intend to take but are not adequately prepared to take CHEM 211. The emphasis is on quantitative relationships and problem solving.

CHEM 115 Elements Of Chemistry I Credits: 4
A one-term course in general chemistry with special emphasis on organic chemistry and biochemistry. A terminal course that does not meet requirements as a prerequisite for any higher level chemistry course.

Co-requisites: CHEM 115L.

CHEM 115L Elements Of Chemistry, Laboratory I Credit: 1
A one-term course in general chemistry with special emphasis on organic chemistry and biochemistry. A terminal course that does not meet requirements as a prerequisite for any higher level chemistry course.

Co-requisites: CHEM 115.

CHEM 160 Chemistry, Society, And The Environment Credits: 3
This course is intended to offer a survey of chemical and scientific concepts surrounding current issues. The emphasis will be on the application of fundamental chemical knowledge to allow a full understanding of these issues in the context of currently known facts and theories. Through classroom discussion and application of the scientific method, the ramifications of the issues will be examined. Topics will include pollution, the importance of the chemical industry, its responsibilities to society, and other items of current scientific and environmental interest.

CHEM 160L Laboratory For Chemistry, Society, And The Environment Credit: 1
This course is offered in support of CHEM 160. It will consist of field activities, experiments, and demonstrations to reinforce the concepts and ideas presented in that course.

CHEM 180P Basic Chemistry Credits: 4
A one-semester survey of basic chemistry including: atomic structure, the periodic table, chemical bonding, chemical reactions, and selected topics from organic, polymer and biochemistry. A terminal course that does not meet requirements as a prerequisite for any higher level chemistry course.

Prerequisites: MATH 110 or equivalent.

Corequisite: CHEM 181P.

Cross Listings: CHEM 115.

CHEM 181P Experimental Basic Chemistry Credits: 4
A demonstration/laboratory course designed to support and illustrate the concepts presented in Chemistry 180P. A terminal course that does not meet requirements as a prerequisite for any higher level chemistry course.

Prerequisites: MATH 110 or equivalent.

Co-requisites: CHEM 180P.

Cross Listings: CHEM 115L.

CHEM 182P Special Projects In Chemistry Credits: 4
An independent study course consisting of library work and field work designed to exemplify various applied aspects of chemistry. A terminal course that does not meet requirements as a prerequisite for any higher level chemistry course.

Prerequisites: MATH 110 or equivalent.

Co-requisites: CHEM 180P.

CHEM 206 Human Nutrition Credits: 3
Introduction to nutrition for health and wellness and the use of chemical energy in the breakdown and synthesis of biomolecules. Nutrition as it applies to a variety of life situations from infancy to older adults. Learning encompasses elements of anatomy and physiology related to nutrition and health.
CHEM 211 General Chemistry I Credits: 4
Stoichiometry, gas laws, thermochemistry, atomic structure, molecular shapes and bonding theories.  
**Prerequisites:** Working knowledge of College Algebra.  
**Co-requisites:** CHEM 211L.

CHEM 211L Experimental General Chemistry I Credit: 1
Introduction to the laboratory techniques used in studying the chemical properties of substances. Some quantitative techniques are included.  
**Co-requisites:** CHEM 211.

CHEM 212LR Experimental General Chemistry II Credit: 1
Introduction to analysis and synthesis. Descriptive chemistry of the more common elements.  
**Prerequisites:** CHEM 211 and CHEM 211L (or equivalent; each with a C-or better).  
**Co-requisites:** CHEM 212R.

CHEM 212R General Chemistry II Credits: 4
Liquids and solids, solutions, equilibrium, kinetics, electrochemistry and thermodynamics. Introductory course to all advanced work in chemistry.  
**Prerequisites:** CHEM 211 and CHEM 211L (or equivalent; each with a C-or better).  
**Co-requisites:** CHEM 212LR.

CHEM 2YC Chemistry Elective LE Credits: 99  
Transfer credit

CHEM 311 Laboratory Safety And Health I Credit: 1
An introduction to laboratory safety and health. Topics to be discussed include good laboratory practice; laboratory hazards; safe chemical handling, storage and disposal; first aid; protective equipment; and federal regulations.  
**Prerequisites:** CHEM 320 or CHEM 321 (or equivalent).

CHEM 320 Elementary Organic Chemistry Credits: 4
This one-semester course covers all fundamental principles of organic chemistry, including modern bonding theory, analytical techniques, physical properties, and chemical reactions. This course is designed to satisfy requirements for students in the UMKC Six-Year Medical Program or certain Biology B.A. majors. This course is not recommended for pre-medical, pre-dental, pre-pharmacy or other pre-health students.  
**Prerequisites:** CHEM 211 / CHEM 211L and CHEM 212R / CHEM 212LR (or equivalents; each with a C- or better).  
**Co-requisites:** CHEM 320L.

CHEM 320L Experimental Organic Chemistry Credit: 1
Elementary organic chemistry experiments to teach basic laboratory operations.  
**Prerequisites:** CHEM 211 / CHEM 211L and CHEM 212R / CHEM 212LR (or equivalents; each with a C-or better).  
**Co-requisites:** CHEM 320.

CHEM 321 Organic Chemistry I Credits: 3
The two terms (CHEM 321, CHEM 322R) constitute an integrated unit in which the chemistry of aliphatic, aromatic, and some heterocyclic compounds are studied. The study begins with simple monofunctional compounds and ends with polyfunctional natural products.  
**Prerequisites:** CHEM 211 / CHEM 211L and CHEM 212R / CHEM 212LR (or equivalents; each with a C-or better).  
**Co-requisites:** CHEM 321L.

CHEM 321L Organic Chemistry Laboratory I Credit: 1
CHEM 321L introduces the student to basic techniques and procedures in isolation, purification, and characterization of organic compounds and simple reactions used in the organic chemistry laboratory. The student will also be trained in the proper way to write a scientific laboratory report.  
**Prerequisites:** CHEM 211 / CHEM 211L and CHEM 212R / CHEM 212LR (or their equivalents; each with a C-or better).  
**Co-requisites:** CHEM 321.

CHEM 322L Organic Chemistry Laboratory II Credit: 1
CHEM 322L is an extension of CHEM 321L. CHEM 322L builds from the basic techniques, procedures, and writing to more advanced organic operations.  
**Prerequisites:** CHEM 321 and CHEM 321L (or equivalents; each with a C-or better).  
**Co-requisites:** CHEM 322R.
CHEM 322R Organic Chemistry II Credits: 3
Continuation of CHEM 321.
Prerequisites: CHEM 211 / CHEM 211L, CHEM 212R / CHEM 212LR and CHEM 321 / CHEM 321L (or equivalents; each with a C-or better).

Co-requisites: CHEM 322L.

CHEM 330 Elementary Physical Chemistry Credits: 3
An introductory course in the principles of physical chemistry for students who have not had calculus.
Prerequisites: CHEM 320, CHEM 322R or CHEM H322R, college physics, and a good background in algebra and trigonometry.

CHEM 341 Analytical Chemistry I: Quantitative Analysis Credits: 4
Principles of gravimetric, volumetric, electrolytic, and other methods of analysis.
Prerequisites: CHEM 212R and MATH 120.

CHEM 341WI Analytical Chemistry I: Quantitative Analysis Credits: 4
Principles of gravimetric, volumetric, electrolytic, and other methods of analysis.
Prerequisites: CHEM 211 / CHEM 211L, CHEM 212R / CHEM 212LR, and MATH 120 (or equivalents; each with a C-or better), RooWriter.

CHEM 345R Instrumental Analysis Credits: 3
An introductory course on the use of instruments for chemical analysis with particular reference to applications of interest to medical technologists and other students in the sciences. Emphasis will be placed on optical, electrochemical and separation methods.
Prerequisites: CHEM 320, CHEM 341, (or equivalents).

CHEM 367 Bioorganic Chemistry Credits: 3
An examination into the current topics at the interface between chemistry and biology. Emphasis will be on the current literature and will include such topics as nucleic acid chemistry, protein chemistry, and carbohydrate chemistry.
Prerequisites: CHEM 321 / CHEM 321L and CHEM 322R / CHEM 322L (or equivalents; each with a C-or better).

CHEM 382 Inorganic And Organic Synthesis Credits: 2
A number of inorganic, organic, and organometallic compounds will be prepared using a variety of synthetic techniques.
Prerequisites: CHEM 321 / CHEM 321L and CHEM 322R / CHEM 322L (or equivalents; each with a C-or better).

CHEM 387 Environmental Chemistry I Credits: 3
A survey of how chemical principles can be applied to the environment. Included will be topics in aquatic chemistry, atmospheric chemistry and chemistry of the geosphere and soil.
Prerequisites: CHEM 320 or CHEM 322R.

CHEM 390 Special Topics In Chemistry Credits: 1-3
This course will focus on an area of chemistry of contemporary significance. The amount of credit is to be determined by arrangement with the department. May be repeated for credit when the topic varies but no more than three hours of credit may be applied to major course requirements.
Prerequisites: CHEM 320, CHEM 322R or CHEM H322R.

CHEM 390PT Special Topics In Chemistry Credits: 1-3
CHEM 392 Chemistry Internship/Practical Training Credits: 1-3
Practical work in chemistry in an industrial, academic or other professional setting. Prior to the start of work, the department must approve the internship/practical training.
Prerequisites: CHEM 211, CHEM 211L, CHEM 212R and CHEM 212LR (or equivalents; each with a C- or better).

CHEM 395 Directed Readings In Chemistry Credits: 1-3
Intensive readings in areas of joint interest to the enrolled student and the cooperating faculty member. Readings may not duplicate or substitute for current course offerings.
Prerequisites: CHEM 320 / CHEM 320L or CHEM 321 / CHEM 321L and CHEM 322R / CHEM 322L (or equivalents; each with a C-or better).

CHEM 399 Intro To Research Credits: 1-3
Special problems to introduce undergraduate chemistry majors to research methods. A comprehensive written report is required and a copy of the report is to be retained in the chemistry office.
Prerequisites: CHEM 212R.

CHEM 410 Chemical Literature Credit: 1
A systematic introduction to the efficient use of the chemical literature. Topics will include both classical search methods and computer search methods.
Prerequisites: CHEM 320 / CHEM 320L or CHEM 321 / CHEM 321L and CHEM 322R / CHEM 322L (or equivalents; each with a C-or better).
CHEM 431 Physical Chemistry I Credits: 3
A first course in physical chemistry having a calculus base. This course emphasizes thermodynamics with an introduction to the basic principles of quantum mechanics.

**Prerequisites:** MATH 210, MATH 220, MATH 250; and PHYSICS 220 or PHYSICS 250.

CHEM 432 Physical Chemistry II Credits: 3
A second course in physical chemistry having a calculus base. This course emphasizes the quantum mechanics description of atoms and molecules, molecular spectroscopy, statistical mechanics, and kinetics.

**Prerequisites:** MATH 210, MATH 220, MATH 250; and PHYSICS 220 or PHYSICS 250; and CHEM 431 (each with a C-or better).

**Co-requisites:** CHEM 437WI.

CHEM 434 Molecular Spectroscopy Credits: 3
A theoretical introduction to molecular spectroscopy and its relation to structure. Electronic, vibrational and rotational spectra of chemical systems will be discussed.

**Prerequisites:** CHEM 432.

CHEM 437WI Experimental Physical Chemistry I Credits: 3
Experimental methods in physical chemistry. One hour lecture and six hours laboratory each week. Satisfies writing intensive requirements for the B.A. or B.S. degree.

**Prerequisites:** MATH 210, MATH 220 and MATH 250; and PHYSICS 220 or PHYSICS 250; and CHEM 431 (each with a C-or better), RooWriter.

**Co-requisites:** CHEM 432.

CHEM 442R Analytical Chemistry II: Instrumental Analysis Credits: 3
A continuation of CHEM 341. The experimental and theoretical aspects of optical and electrochemical, chromatographic and other physicochemical methods of analysis.

**Prerequisites:** CHEM 341, CHEM 432.

CHEM 445 Introduction To Principles Of Forensic Investigation Credits: 2
A survey of the physicochemical forensic techniques employed in the detection, examination, processing, preservation and court presentation of evidence.

CHEM 451R Inorganic Chemistry Credits: 3
Modern concepts and theories of inorganic chemistry.

**Prerequisites:** CHEM 432.

CHEM 471 Introduction To Polymer Chemistry Credits: 3
Survey of organic and inorganic monomers and polymers; the occurrence, synthesis, structures and properties of natural and synthetic polymers; discussion of general properties of plastics, elastomers, fibers, resins, and plasticizers.

**Prerequisites:** CHEM 432 (C-or better).

CHEM 480 Computer Applications To Chemical Problems Credits: 3
An intense course in Fortran programming and its uses in chemical problems related to theory and experimentation. Emphasis will be placed on the mathematical structures of chemical problems and the coding of those problems into Fortran. No previous programming experience is required.

**Prerequisites:** CHEM 320 or CHEM 322R.

CHEM 490 Special Topics In Chemistry Credits: 1-3
This course will focus on an area of chemistry of contemporary significance. The amount of credit is to be determined by arrangement with the department. May be repeated for credit when the topic varies but no more than three hours of credit may be applied to major course requirements.

**Prerequisites:** CHEM 431.

CHEM 495 Directed Readings In Chemistry Credits: 1-3
Intensive readings in areas of joint interest to the enrolled student and the cooperating faculty member. Readings may not duplicate or substitute for current course offerings.

**Prerequisites:** CHEM 432.

CHEM 499 Senior Research Credits: 1-9
The student is given an original research problem and will be held responsible for all previous experience in working toward its solution. A well-written, comprehensive, and well documented research report is required, and a copy of the report is to be retained in the Chemistry department.

**Prerequisites:** CHEM 432.

CHEM 5511 Laboratory Safety And Health I Credit: 1
An introduction to laboratory safety and health. Topics to be discussed include good laboratory practice; laboratory hazards; safe chemical handling; storage and disposal; first aid; protective equipment; and federal regulations.
CHEM 5520R Survey Of Organic Chemistry Credits: 3
An intensive advanced survey of the structure, synthesis and reactions of organic compounds.

CHEM 5521R Mechanisms Of Organic Reactions Credits: 3
A comprehensive course in which the mechanisms of organic reactions are discussed in light of modern chemical principles.
**Prerequisites:** CHEM 322R and CHEM 432.

CHEM 5522 Synthetic Organic Chemistry Credits: 3
A critical approach to the synthesis and modification of organic molecules; newer methods will be emphasized.
**Prerequisites:** CHEM 322R and CHEM 432.

CHEM 5529 Selected Topics In Organic Chemistry Credits: 3
Selected topics from the chemistry and theories of organic structures with particular attention to recent developments.

CHEM 5530 Systematic Physical Chemistry Credits: 3
An intensive and comprehensive review of the principles of physical chemistry. This course may either emphasize thermodynamics with an introduction to principles of quantum mechanics or emphasize quantum mechanical description of atoms and molecules, molecular spectroscopy, statistical mechanics and kinetics.

CHEM 5530A Physical Chemistry I Credits: 3
This graduate course reviews principles of physical chemistry, focusing on thermodynamics, equilibria and electrochemistry.

CHEM 5530B Physical Chemistry II Credits: 3
This graduate course reviews principles of physical chemistry, focusing on quantum chemistry, molecular spectroscopy and structure, and kinetics.

CHEM 5531 Classical Thermodynamics Credits: 3
A rigorous treatment of the laws of thermodynamics and their application to ideal and non-ideal equilibrium systems.

CHEM 5532 Chemical Kinetics Credits: 3
Empirical analysis of chemical reaction rates. Theories of unimolecular and bimolecular reactions, reactions in solution and complex reactions. Review of modern and classical techniques used to study chemical kinetics.

CHEM 5533 Quantum Chemistry Credits: 3
Application of quantum mechanical methods to the study of systems of chemical interest. Exact solutions and approximate methods will be discussed.

CHEM 5534 Molecular Spectroscopy Credits: 3
A theoretical introduction to molecular spectroscopy and its relation to structure. Electronic, vibrational and rotational spectra of chemical systems will be discussed.

CHEM 5535 Statistical Thermodynamics Credits: 3
A rigorous treatment of the fundamental concepts of statistical thermodynamics, with applications to specific systems that reflect the interests of students participating in the course.

CHEM 5539 Selected Topics In Physical Chemistry Credits: 3
Selected topics and recent developments in physical chemistry.
**Prerequisites:** CHEM 5530.

CHEM 5541R Advanced Analytical Chemistry Credits: 3
An intensive review of modern concepts of analytical chemistry.
**Prerequisites:** CHEM 432.

CHEM 5551R Advanced Inorganic Chemistry I Credits: 3
A systematic treatment of bonding, structure, reactions and reaction mechanisms of inorganic compounds, with emphasis on classical transition metal compounds and organometallic compounds.
**Prerequisites:** CHEM 451R or equivalent.

CHEM 5559 Selected Topics In Inorganic Chemistry Credits: 3
Various special topics in the inorganic area to be offered in different semesters.
**Prerequisites:** CHEM 5551R.

CHEM 5567 Advanced Bioorganic Chemistry Credits: 3
This course examines the organic chemistry and laboratory synthesis of the major biopolymers and organic chemistry related to biological systems. Emphasis is on literature and library research and natural product and solid phase organic synthesis, combinatorial synthesis, bioconjugates and applied bioorganic chemistry.

CHEM 5571R Introduction To Polymer Chemistry Credits: 3
Survey of organic and inorganic monomers and polymers; the occurrence, synthesis, structures and properties of natural and synthetic polymers; discussion of general properties of plastics, elastomers, fibers, resins and plasticizers.
**Prerequisites:** CHEM 432.
CHEM 5580R Computer Applications To Chemical Problems Credits: 3
An intense course in FORTRAN programming and its uses in chemical problems related to theory and experimentation. Emphasis will be placed on the mathematical structures of the chemical problems and the coding of these problems into Fortran. No previous programming experience is required.

CHEM 5587 Environmental Chemistry I Credits: 3
A survey of how chemical principles can be applied to the environment. Included will be topics in aquatic chemistry, atmospheric chemistry and chemistry of the geosphere and soil.

CHEM 5588 Environmental Chemistry II Credits: 3
Discussion of selected topics in advanced environmental chemistry, such as environmental toxicology, environmental risk, the chemistry of hazardous wastes and their treatment, and environmental analytical chemistry.

CHEM 5590 Directed Studies Credits: 1-3
Intensive readings and/or research in an area selected by the graduate student in consultation with the instructor.

CHEM 5598 Research Methodology Conference Credits: 3
Student will meet on an individual basis with two faculty members who are involved in research. The student's adviser will coordinate this course.

CHEM 5599 Research And Thesis Credits: 1-9
Research for thesis.

CHEM 5611 Chemistry Seminar Credit: 1
Presentation and discussion of topics currently appearing in United States and foreign literature.

CHEM 5699 Research And Dissertation Credits: 1-16
Research for dissertation.

CHEM 5899 Required Graduate Enrollment Credit: 1

CHEM H206 Human Nutrition Credits: 3
Introduction to nutrition for health and wellness and the use of chemical energy in the breakdown and synthesis of biomolecules. Nutrition as it applies to a variety of life situations from infancy to older adults. Learning encompasses elements of anatomy and physiology related to nutrition and health.

CHEM H212R Honors: Organic Chemistry I Credits: 4

CHEM H321 Honors: Organic Chemistry I Credits: 3

CHEM H321L Organic Chemistry Laboratory I - Honors Credit: 1
A more intense version of CHEM 321L.

CHEM H322L Organic Chemistry Laboratory II Credit: 1
CHEM 322L is an extension of CHEM 321L. CHEM 322L builds from the basic techniques, procedures, and writing to more advanced organic operations.

Prerequisites: CHEM 321 and CHEM 321L (or equivalent; each with a C-or better).

Co-requisites: CHEM 322R.

CHEM H322LR Organic Chemistry Laboratory II-Honors Credits: 2
A more intense version of CHEM 322L. See course description for CHEM 322L.
Prerequisite: CHEM 321L.

CHEM H322R Honors: Organic Chemistry II Credits: 3

CHEM H399 Introduction To Research Credits: 1-3
Special problems to introduce undergraduate chemistry majors to research methods. A comprehensive written report is required and a copy of the report is to be retained in the chemistry office. May be taken only after consultation with a member of the chemistry staff.
Prerequisites: CHEM 212R.

CHEM H499 Senior Research - Honors Credits: 1-9
Course frequency subject to enrollments, staffing and financial exigency.