Department of Chemistry

UMKC 2007-08 Graduate and Professional Catalog (1.0)

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Contents

Department of Chemistry

Spencer Chemistry Building, Room 205
5009 Rockhill Road
(816) 235-**2272**
Fax: (816) 235-**5502**
umkc-chemdept@umkc.edu
http://cas.umkc.edu/chem

Mailing Address
University of Missouri-Kansas City
Department of Chemistry
SCB 205
5100 Rockhill Road
Kansas City, MO 64110-2499

Department Chair:
Kathleen V. Kilway

Professors Emeriti:
Kuang L. Cheng, John W. Connolly, Wesley Dale, Henry A. Droll, Eckhard W. Hellmuth, Peter F. Lott, Layton L. McCoy, Timothy F. Thomas

Curators' Professors:
James R. Durig (chemistry and geosciences), Y.C. Jerry Jean (chemistry and physics), Charles J. Wurrey (Curators' Teaching and associate dean, arts and sciences)

Professors:
Jerry R. Dias, Andrew J. Holder, Zhonghua Peng (principal graduate adviser), Thomas C. Sandreczki (associate dean, arts and sciences), Kenneth S. Schmitz

Associate Professors:
Keith R. Buszek, Peter Groner (director of laboratories), Kathleen V. Kilway (chair, principal undergraduate adviser)

Assistant Professors:
Todor K. Gounev (program director), Ekaterina N. Kadnikova, Nathan A. Oyler, J. David Van Horn, Andrea Drew Gounev (coordinator, organic chemistry laboratories)

Department Description

The Department of Chemistry offers programs of study leading to the bachelor of arts, bachelor of science, and master of science degree. The Department also participates in UMKC's Interdisciplinary Ph.D. program. To the extent that each program is flexible (see degree requirements), it is possible to specialize at the graduate level in the areas of analytical, inorganic, organic, physical or polymer chemistry.

Graduate Study in Chemistry

The Chemistry Department offers the master of science degree, with an emphasis in analytical, inorganic, organic, physical, or polymer chemistry.

Doctor of philosophy (Ph.D.) programs at UMKC are interdisciplinary. Students desiring to study at the doctoral level in the discipline of chemistry (as the coordinating unit) must apply to the School of Graduate Studies. Detailed information on the general and discipline-specific admission requirements for the doctoral degree may be found in the General Graduate Academic Regulations and Information section of this catalog.

Students pursuing an Interdisciplinary Ph.D. degree, who have selected chemistry as one of their disciplines, should consult the School of Graduate Studies section of this catalog for degree requirements, and other academic regulations applicable to their degree programs.

General Nature of the Graduate Program
Both the master of science degree and interdisciplinary Ph.D. degree with chemistry as the coordinating discipline have the basic aim of training students to work independently in chemistry. Both programs train the student through a broad but flexible base of coursework for further education, but the interdisciplinary Ph.D. places a greater emphasis on original research.

There are two programs or tracks that lead to the master of science in chemistry: the research and the non-thesis tracks. The interdisciplinary Ph.D. with chemistry as the coordinating unit is only research track. (For further information on the Interdisciplinary Ph.D. Program, see the chemistry discipline within the School of Graduate Studies section of this catalog.)

Student Learning Outcomes

The Department of Chemistry offers two master of science degrees. The non-thesis M.S. program has an emphasis on coursework, while the thesis-based degree has an emphasis on both coursework and original research. Graduating chemistry M.S. students will be exposed to the most recent advances in chemical sciences. In addition, thesis-based M.S. students will experience the excitement of performing guided research.

The following student learning outcomes are expected for our educational process:

Non-Thesis Master of Science in Chemistry
At the end of their studies, students will:

- Have an extensive knowledge of the basic areas of chemistry (inorganic, organic, physical, analytical, and biochemistry).
- Be familiar with the recent advances in the basic areas of chemistry.
- Have the ability to communicate scientific information clearly and precisely, both written and oral forms.
- Have the ability to read, understand, and use scientific literature.
- Have had the opportunity to work with others as part of a team to solve scientific problems.

Thesis-Based Master of Science in Chemistry
At the end of their studies, students will:

- Have an extensive knowledge of the basic areas of chemistry (inorganic, organic, physical, analytical, and biochemistry) with an extensive knowledge in at least one area.
- Have done extensive research through a project.
- Have the ability to recognize scientific problems, formulate questions and answers, and carry out strategies for solving them.
- Have the ability to read, understand, and use scientific literature.
- Have the ability to communicate scientific information clearly and precisely, both written and oral forms.
- Have some understanding of the principles and applications of modern instrumentation, computation, experimental design, and data analysis.

Master of Science Program

Requirements for Admission

Applicants should have the equivalent of an American Chemical Society (ACS)-approved bachelor's degree in chemistry. This degree includes the equivalent of: one year of general chemistry, quantitative analysis, one year of organic chemistry, one year of physical chemistry, physical chemistry laboratory, instrumental analysis, inorganic chemistry, one year of physics, and three semesters of calculus, and the ACS-recommended distribution of advanced courses and course credits. (For example, see UMKC's B.S. program in chemistry in the undergraduate catalog.) Applicants should take particular note of the physical chemistry requirement.

They may be admitted as provisional students if they have a limited number of undergraduate deficiencies. At the time that admission is offered, applicants will be notified of any requirements to be met for reclassification as fully admitted. Undergraduate courses included in these requirements must be completed with grades of C- or higher.

Applicants from foreign countries, who have an official language other than English, must achieve scores of at least 550 (paper-based), 213 (computer-based), or 80 (internet-based)on the Test of English as a Foreign Language (TOEFL) to be considered for admission.

Placement Examinations

Incoming students must take placement examinations in analytical, inorganic, organic, and physical chemistry. Placement examinations are typically administered the week before the first week of classes of the fall and spring semesters. Students scoring below the 50th percentile in the organic and/or physical chemistry exams are required to enroll in CHEM 5520R and/or CHEM 5530, respectively. Enrollment in other graduate organic or physical chemistry courses is not permitted until CHEM 5520R or CHEM 5530, respectively, is (are) successfully completed. CHEM 5530 is currently offered concurrently with 431 or 432. A student is required to take either 5530/431 or 5530/432 or both, depending on his/her performances in the various sub-disciplines of the physical chemistry placement exam. Should a student be required to take both 5530/431 and 5530/432, the average grade of the two 5530 courses will be considered for the fulfillment of the physical chemistry deficiency. Two grades of C+ (2.3 out of 4.0) or lower, or one grade of less than C- (1.7 out of 4.0) in CHEM 5520R or CHEM 5530, will result in termination from the degree program. These courses may not be counted toward the M.S. coursework requirements listed below. Students must complete all additional coursework required as a result of the placement exams by the end of their first three regular semesters.

Graduate Program Committee

Upon admission to M.S. program in chemistry, students will be advised by the department's principal graduate adviser, acting on behalf of the chemistry graduate program committee. Based on the committee's evaluation of the students' transcripts and placement exam scores, the principal graduate adviser will inform students of any deficiencies and how they should be removed. The principal graduate adviser also will advise students on course curriculum. For the thesis degree, the curriculum advising is performed by the research adviser(once they have been selected). The graduate program committee serves as the supervisory committee for non-thesis M.S. students.

Seminar Attendance

Full-time M.S. students are required to attend all regularly scheduled and special departmental seminars and colloquia. Part-time students are also required to attend these seminars but may petition the Chair of the Department of Chemistry to waive this requirement all but one semester. Such students will be required either to attend and participate fully during one semester, including the presentation of a one-hour seminar (see details below), or to present two one-hour seminars in lieu of full participation.

Minimum Requirements for Master of Science Degree

In addition to the requirements listed here, all M.S. students are subject to the all general M.S. requirements of the University. See the School of Graduate Studies section of this catalog for a complete listing.

Research M.S. Program

Time Constraints and Financial Assistance

Full-time thesis M.S. students are required to complete all of the requirements for their degree within four years. In compelling circumstances, and on the written recommendation of a majority of the Supervisory Committee, a single extension for up to one year may be requested for approval by the Chair of the Department of Chemistry. Part-time thesis M.S. students are required to complete all of their requirements for their degree within seven years.

Full-time thesis M.S. students may receive financial support from the Department of Chemistry for a maximum of two-and-one-half years. Students from countries having an official language other than English, and who wish to be supported as GTAs, must take the SPEAK test before the end of their first semester on campus if necessary. Part-time thesis M.S. students are not eligible for financial support from the Department of Chemistry.

Research Adviser and Supervisory Committee

Full-time students must select a research adviser from the graduate faculty of the Department of Chemistry and a supervisory committee by the end of their first regular (i.e., fall or spring) semester on campus. Part-time students must select their research adviser and supervisory committee by the end of their third year after enrollment in their first course as an M.S. student at UMKC.

The research adviser becomes the chairperson of the supervisory committee, which includes at least two additional members of the graduate faculty. Students and their supervisory committee shall plan a program of study which, when met, will qualify students for the M.S. degree. This program of study must be approved by the supervisory committee, the department chair, and the principal graduate adviser prior to the completion of 15 hours of coursework applicable to the degree. The supervisory committee is responsible for conducting the final thesis examination for students in the thesis program.

Coursework

The emphasis of this program is research. A minimum of 31 credit hours (including research and thesis) is required. Full-time, research M.S. students should be able to complete the formal coursework requirement no later than the end of their second year. Thesis M.S. students are required to complete:

1. Three credit hours in one of the following Physical Chemistry courses: CHEM 5531, CHEM 5532, CHEM 5533, CHEM 5534, or CHEM 5535.
2. Three credit hours in Organic Chemistry: CHEM 5521R or CHEM 5522.
3. Six credit hours from graduate level chemistry courses numbered from CHEM 5541 to CHEM 5589.
4. Two additional graduate-level courses for a minimum of 6 credit hours.
5. One credit hour seminar presentation (CHEM 5611).
6. In addition to the formal coursework requirements, a minimum of 6 credit hours of research and thesis (CHEM 5599) are required. Research and thesis (CHEM 5599) work must be done under the direction of the student's research adviser.
7. Up to 6 credit hours of directed studies (CHEM 5590) may be applied toward the degree requirements. Additional coursework may be substituted for part or all of (CHEM 5590) on approval of the student's supervisory committee.

The selected courses must be approved by the student's supervisory committee. Students who receive a grade of C+

(2.3) or lower in more than two courses applicable to the M.S. program or who have a GPA lower than 3.0 on courses (not including CHEM 5590, CHEM 5599 or any undergraduate courses) applicable toward the M.S. degree after completing 18 or more credit hours of such courses, will be terminated from the degree program.

Students, who have received a grade of B- (2.7) or better in graduate coursework taken as part of a degree program at another institution, may transfer up to 6 credit hours of this work on approval of a majority of the student's committee. A written request for this approval must be submitted within one year of full admission to the program.

Seminar Presentation (CHEM 5611)
Students must present a one-hour seminar based on their thesis research project. This seminar will include an exhaustive review of the literature pertinent to their project, a description of the objectives, the proposed methodology, and the significance of this research. Students must register for CHEM 5611 and present this seminar during the semester following selection of their research adviser and committee.

Thesis Defense
The candidate's thesis must be prepared following all of the guidelines required by the UMKC School of Graduate Studies. All supervisory committee members must receive a final draft of the thesis for approval of form and content at least two weeks before submission to the Dean of the School of Graduate Studies. Candidates should submit preliminary drafts of their thesis to their supervisory committee well in advance of this deadline. After the thesis is certified for acceptance by the Dean of the School of Graduate Studies, the student must present an oral defense of his/her research in the form of a thesis seminar. The supervisory committee will make a final determination of the acceptability of the thesis immediately following this presentation. Only minor changes may be made to the thesis at this point.

Non-Thesis M.S. Program

Time Constraints and Financial Assistance

The non-thesis M.S. degree program is intended primarily for students currently employed in a chemically related industry. Full-time, non-thesis M.S. students are required to complete all of the requirements for their degree within four years. Part-time non-thesis M.S. students are required to complete all requirements for their degree within seven years. Non-thesis M.S. students are not eligible for financial support from the Department of Chemistry.

Coursework

The emphasis of this program is coursework. Non-thesis M.S. students are required to complete a minimum of 31 credit hours of graduate-level coursework. Non-thesis M.S. Students are required to complete:

1. Three credit hours must be from Organic Chemistry courses: CHEM 5521R or CHEM 5522.
2. Three credit hours from Physical Chemistry courses: CHEM 5531, CHEM 5532, CHEM 5533, CHEM 5534, or CHEM 5535.
3. Nine hours from Analytical, Inorganic, Polymer, Bioorganic, and Environmental Chemistry courses: CHEM 5541R, CHEM 5551R, CHEM 5571R, CHEM 5567, or CHEM 5587.
4. One credit hour seminar presentation (CHEM 5611).
5. The remaining 15 credit hours may be taken from courses approved by the graduate program committee.

Students who receive a grade of C+ (2.3) or less in more than two courses applicable to the M.S. program, or who have a cumulative grade-point average of less than 3.0 on courses applicable toward the M.S. degree after completing 18 or more credit hours of such courses, will be terminated from the degree program. Grades received for CHEM 5590 and any undergraduate-level courses are not included in the minimum GPA calculation.

Students who have received a grade of B- (2.7) or better in graduate chemistry coursework taken as part of a degree program at another institution may have up to 6 credit hours of equivalent required coursework waived upon approval of a majority of the graduate program committee. A written request for this approval must be submitted within one year of full admission to the M.S. program.

Seminars

Students must present a one-hour literature seminar based on a topic of their choice which has been approved by the Department of Chemistry Chair (or a designee). Students must register for CHEM 5611 the semester of this presentation. This seminar will include an exhaustive review of the pertinent literature and discussion of both present and future implications of research in this area. An abstract is to be posted and distributed one week prior to the presentation date.

Research Facilities

Major Instrumentation:

- Varian Inova 400 MHz NMR spectrometer.
- Bruker 250 MHz NMR spectrometer with solid state probe.
- IBM 200 Electron Spin Resonance Spectrometer.
- AA and ICP-AA spectrophotometers.
- CARY-1 UV-Visible dual beam spectrophotometer.
- Cambridge Structural Database Subscription (Van Horn).
- Raman and Infrared Spectroscopy Lab (Durig).
- Positron Annihilation and Gamma-ray Spectroscopy Lab (Jean).
- ABI Pioneer peptide synthesizer.
- Sprint BioCad liquid chromatography system.
- Finnigan MAT Double Focusing mass spectrometer.

Research Instrumentation:

- Ocean Optics UV-Vis-NIR and other UV-Visible spectrophotometers.
- Metrohm Titrando system with "PC Control" software.
- BAS Epsilon electrochemistry apparatus (Peng).
- Shimadzu HPLC (Van Horn).
- Shimadzu RF-5301PC Fluorescence spectrophotometer.
- Perkin Elmer Polarimeter (Buszek).

Support Facilities:

- Computer and Electronics Shop.
- Chemical Stores.

On Campus Resources:

- Jasco J-710 Circular Dichroism Spectropolarimeter (School of Biological Sciences).
- Varian 600 MHz NMR Spectrometer (School of Biological Sciences, Laity).
- ESI-mass spectrometer and Triple-Quad LC-ESI MS with nanospray adaptor (School of Pharmaceutical Sciences).
- Machine Shop (Department of Physics).

Computer facilities include UMKC's Academic Research servers using HP's Itanium technology and numerous personal computers located in the Spencer Chemistry Building and Flarsheim Hall for teaching and research purposes. A computational research laboratory is also housed in the department with a number of high-speed workstations and modern software.

Emphasis Areas

Analytical
Research in analytical chemistry is focused on:

- Gas chromatography.
- Mass spectrometry.
- Fourier transform infrared, Raman and positron annihilation spectroscopy techniques.

Inorganic
Research in inorganic chemistry is focused on:

- Bioinorganic chemistry, including synthetic and mechanistic coordination chemistry of essential and toxic metal ions.
- Inorganic reactions including thermodynamic and kinetic aspects of metal-ligand interactions in aqueous and other media.
- Correlation of electronic structure calculations with experimental measurements.
- Bioinorganic chemistry of the heaviest metals.
- Development of new synthetic methodology to novel organic-inorganic hybrids.
- Polymer-silicate composites.

Organic
Research in organic chemistry is focused on:

- Synthesis and molecular architecture of bile acids and benzenoid hydrocarbons.
- Synthesis and physical studies of novel host-guest systems.
- Total synthesis of complex natural products.
- Development of new synthetic methods.
- Development of new scaffolds and reagents for combinatorial chemistry.
- Medicinal chemistry.
- Chemical biology.
- Synthesis and elucidation of natural products and antitumor agents.
- Biomimetic materials chemistry of cyclodextrin derivatives.
- Immobilized enzymes for “green” enantioselective catalysis.

Physical
Research in physical chemistry is focused on:

- Using infrared and Raman spectroscopy to determine molecular conformations.
- Developing infrared spectroscopic techniques for the analysis of environmental pollutants.
- Using *ab initio* and semiempirical computational methods to predict chemical and physical properties of interesting chemical species.
- Quantitative structure activity relationships.
- Physical and biological properties of dental materials.
- Characterization of electronic and free-volume properties in materials.
- Positron and positronium chemistry.
- Organic conductivity and superconductivity.
- Brownie dynamic simulation.
- Developing and using solid-state NMR methods for structural and dynamical studies of proteins and peptides.

Polymer
Research in polymer chemistry is focused on:

- Synthesis of novel organic and organometallic polymers.
- Novel dendrimers and their applications.
- Core-shell nanoparticles as functional materials.
- Hybrid polymers for molecular electronics.
- Characterization of electronic/optical/photophysical properties of polymers.
- Study of free volume, phase transition, relaxation phenomena, and gas diffusion of polymers and polymer blends.
- Semiconducting polymers.

Chemistry (CHEM) Courses

5511 Laboratory Safety And Health I (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.

5520R Survey Of Organic Chemistry (3). An intensive advanced survey of the structure, synthesis and reactions of organic compounds. Three hours lecture a week.

5521R Mechanisms Of Organic Reactions (3). A comprehensive course in which the mechanisms of organic reactions are discussed in light of modern chemical principles. Prerequisites: Chemistry 322R and 432. Three hours lecture a week.

5522 Synthetic Organic Chemistry (3). A critical approach to the synthesis and modification of organic molecules; newer methods will be emphasized. Prerequisites: Chemistry 322R and 432. Three hours lecture a week.

5529 Selected Topics In Organic Chemistry (3). Selected topics from the chemistry and theories of organic structures with particular attention to recent developments. Three hours lecture a week.

5530 Systematic Physical Chemistry (3). An intensive and comprehensive review of the principles of physical chemistry. This course may either emphasize thermodynamics with an introduction to principes of quantum mechanics or emphasize quantum mechanical description of atoms and molecules, molecular spectroscopy, statistical mechanics and kinetics. Three hours lecture a week.

5531 Classical Thermodynamics (3). A rigorous treatment of the laws of thermodynamics and their application to ideal and non-ideal equilibrium systems. Three hours lecture a week.

5532 Chemical Kinetics (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. Three hours lecture a week.

5533 Quantum Chemistry (3). Application of quantum mechanical methods to the study of systems of chemical interest. Exact solutions and approximate methods will be discussed. Three hours lecture per week.

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

5535 Statistical Thermodynamics (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.

5539 Selected Topics In Physical Chemistry (3). Selected topics and recent developments in physical chemistry. Prerequisite: Chemistry 5530 or consent of instructor. Three hours lecture a week.

5541R Advanced Analytical Chemistry (3). An intensive review of modern concepts of analytical chemistry. Prerequisite: Chemistry 432. Three hours lecture a week.

5549R Selected Topics In Analytical Chemistry (3). Selected topics and recent developments in analytical chemistry, including modern instrumental methods, electrochemical methods and separation methods. Topics vary from year to year. Prerequisite: Chemistry 442 or Chemistry 5541R.

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

5553R Organometallic Chemistry (3). A survey of the synthesis, structure and reactions of organometallic compounds. Prerequisite: Chemistry 5551R or consent of instructor. Three lecture hours each week.

5559 Selected Topics In Inorganic Chemistry (3). Various special topics in the inorganic area to be offered in different semesters. Prerequisite: Chemistry 5551R or consent of instructor. Three hours lecture a week.

5567 Advanced Bioorganic Chemistry (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.

5571R Introduction To Polymer Chemistry (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. Prerequisite: Chemistry 432. Three lecture hours a week.

5579R Selected Topics In Polymer Chemistry (3). Selected topics and recent developments in specialized fields of polymer chemistry. Presented at intervals, topics vary from year to year.

5580R Computer Applications To Chemical Problems (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.

5587 Environmental Chemistry I (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.

5588 Environmental Chemistry II (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.

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

5598 Research Methodology Conference (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.

5599 Research And Thesis (1-9). Research for thesis.

5611 Chemistry Seminar (1). Presentation and discussion of topics currently appearing in United States and foreign literature. One hour each week.

5699 Research And Dissertation (1-16). Research for dissertation.

5899 Required Graduate Enrollment (1).