Chemistry and Biochemistry (CHBC)

Faculty
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Stefan M. Kilyanek, Assistant Professor
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Jackson Lay Jr., Professor
Matt McIntosh, Professor
Frank Millett, Distinguished Professor
Mahmoud Moradi, Assistant Professor
David W. Paul, Associate Professor
Joshua Sakon, Professor
Wei Shi, Assistant Professor
Julie A. Stenken, Professor, 21st Century Chair of Proteomics
Wesley Stites, Professor
Susanne Striegler, Professor
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Degrees Conferred:
M.S., Ph.D. in Chemistry (CHEM)

Areas of Study: Analytical, inorganic, organic, physical, biophysical, and biochemistry.

Primary Areas of Faculty Research: Specialized centers complement traditional research areas in the Department of Chemistry and Biochemistry. These include the Center for Protein Structure and Function and the State-Wide Mass Spectrometry Facility.

Admission to Graduate Program: In addition to the application for admission to the Graduate School and the transcripts required for Graduate School admission, applicants for admission to the degree programs of the Department of Chemistry and Biochemistry must submit a.) three letters of recommendation from persons familiar with the applicant’s previous academic and professional performance and b.) official scores from the Graduate Record Examination (General Test). Advanced subject GRE tests scores (Chemistry, Biochemistry, etc.) are encouraged but not required.

Basic Program for Advanced Degree Candidates: In addition to the material given below, the student is referred to the general Graduate School requirements mentioned earlier in this catalog and to the bulletin Information for Graduate Students in Chemistry and Biochemistry available from the Department of Chemistry and Biochemistry.

1. An undergraduate program, consisting of courses in general chemistry, analytical chemistry (two semesters), organic chemistry (three semesters), physical chemistry (two semesters), and inorganic chemistry (one semester) provide an adequate foundation for graduate work in chemistry and biochemistry. If a graduate student lacks any part of this introductory program, it must be completed within the first four semesters as a graduate student. If the student has the necessary prerequisites, courses for graduate credit may be taken concurrently. Proficiency in physical chemistry must be demonstrated by satisfactory performance on placement examinations. Inadequate performance may be remedied by enrollment in one or more recommended courses.

2. The department has no foreign language requirement for either the M.S. or Ph.D. degree.

3. Each advanced degree candidate must present a suitable program of advanced courses and research. The specific courses needed to provide a basis for scholarly work beyond the B.S. level will vary with the student’s undergraduate preparation, area of concentration and the degree sought. Individual course enrollments must be approved initially by the graduate adviser and subsequently by the student’s advisory committee.

4. Every student must register for a minimum of one credit hour of CHEM 600V or CHEM 700V in each term during which the student is present and doing thesis or dissertation research. Post-candidacy doctoral students are required to be enrolled in at least one hour of dissertation credit (CHEM 700V) every semester (fall, spring, summer), until the degree is conferred.

Additional Requirement for Master of Science Degree: The Master of Science degree in Chemistry requires a minimum 24 hours of course work plus six hours of thesis. A thesis reporting original research will be required of all candidates for the Master of Science degree in chemistry.

Students should also be aware of Graduate School requirements with regard to master’s degrees (http://catalog.uark.edu/graduatecatalog/ degreerequirements/#mastersdegreetext).

Additional Requirements for the Doctor of Philosophy Degree: A doctoral advisory committee is appointed to evaluate the candidate’s preparation and to draw up a suitable program of study and research. This committee consists of the student’s major professor and at least three other members of the graduate faculty. Under most circumstances, the major professor serves as the chairperson of that committee.

For chemistry students, the candidacy examination is of the cumulative type. Five cumulative examinations are given each semester in each of the areas of concentration mentioned above. To complete the candidacy examination, seven of these cumulative examinations must be passed
within a specified time, usually by the end of the fifth semester of graduate work.

Students should also be aware of Graduate School requirements with regard to doctoral degrees (http://catalog.uark.edu/graduatecatalog/dgrequirements/#phdanddddegreqtext).

Courses
CHEM 405V. Special Topics in Chemistry (Irregular). 1-4 Hour.
Potential topics include: advanced spectroscopic methods, bioanalytical chemistry, bioinorganic chemistry, biochemical instrumentation, biophysical chemistry, chemical sensors, drug discovery and design, nanomaterials, pharmaceutical chemistry, process analytical chemistry, and protein folding and design. Prerequisite: Instructor consent.

CHEM 4123. Advanced Inorganic Chemistry I (Fa). 3 Hours.
Reactions and properties of inorganic compounds from the standpoint of electronic structure and the periodic table. Emphasis on recent developments. Prerequisite: CHEM 3514.

CHEM 4211L. Instrumental Analysis Laboratory (Sp). 1 Hour.
Provides laboratory experience in parallel with the lecture material in CHEM 4213. Laboratory 3 hours per week. Pre- or Corequisite: CHEM 4213.

CHEM 4213. Instrumental Analysis (Sp). 3 Hours.
Provides students, especially those in the agricultural, biological, and physical sciences, with an understanding of the role of modern instrumental analysis. Lecture 3 hours per week. Prerequisite: (CHEM 2263 and CHEM 2261L) and ((CHEM 3613 and CHEM 3611L) or (CHEM 3713 and CHEM 3712L)).

CHEM 4723. Experimental Methods in Organic Chemistry (Fa). 3 Hours.
Introduction to the application of synthetic and spectroscopic methods in organic chemistry, including mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance spectrometry. Other laboratory techniques applicable to chemical research will be included. Lecture 2 hours, laboratory 3 hours per week, and 1 hour drill. Chemistry students may not receive graduate credit for this course and CHEM 5753. Corequisite: Drill and lab components. Prerequisite: CHEM 3613 and CHEM 3611L or CHEM 3713 and CHEM 3712L.

CHEM 4853. Biochemical Techniques (Sp). 3 Hours.
Techniques for handling, purifying and analyzing enzymes, structural proteins, and nucleic acids. Lecture 1 hour, laboratory 6 hours per week. Pre- or Corequisite: CHEM 5813 or CHEM 3813.

CHEM 5101. Introduction to Research (Sp, Fa). 1 Hour.
Introduces new graduate students to research opportunities and skills in chemistry and biochemistry. Meets 1 hour per week during which new students receive information from faculty regarding research programs in the department and training in the use of research support facilities available in the department.

CHEM 5143. Advanced Inorganic Chemistry II (Irregular). 3 Hours.
Chemistry of metallic and non-metallic elements emphasizing molecular structure, bonding and the classification of reactions. Knowledge of inorganic chemistry comparable to material in CHEM 4123 and CHEM 5123 is recommended.

CHEM 5153. Structural Chemistry (Irregular). 3 Hours.
Determination of molecular structure by x-ray analysis, electron density, diffraction, and other techniques. Illustrative examples will be chosen mainly from inorganic chemistry. Pre- or Corequisite: CHEM 3504 and CHEM 4123.

CHEM 5223. Chemical Instrumentation (Odd years, Sp). 3 Hours.
Use and application of operational amplifiers to chemical instrumentation; digital electronic microprocessor interfacing; software development and real-time data acquisition. Prerequisite: CHEM 4213 and PHYS 2074.

CHEM 5233. Chemical Separations (Even years, Fa). 3 Hours.
Modern separation methods including liquid chromatography (adsorption, liquid-liquid partition, ion exchange, exclusion) and gas chromatography. Theory and instrumentation is discussed with emphasis on practical aspects of separation science. Prerequisite: CHEM 4213.

CHEM 5243. Electrochemical Methods of Analysis (Even years, Sp). 3 Hours.
Topics will include: diffusion, electron transfer kinetics, and reversible and irreversible electrode processes; followed by a discussion of chronocoulometry, chronocouloucoulometry, polaro graphy, voltagmetry, and chronopotentiometry. Prerequisite: CHEM 4213 and MATH 2574.

CHEM 5253. Spectrochemical Methods of Analysis (Odd years, Fa). 3 Hours.
Principles and methods of modern spectroscopic analysis. Optics and instrumentation necessary for spectroscopy is also discussed. Topics include atomic and molecular absorption and emission techniques in the ultraviolet, visible, and infrared spectral regions. Prerequisite: CHEM 4213.

CHEM 5253. Nuclear Chemistry (Odd years, Fa). 3 Hours.
Nuclear structure and properties, natural and artificial radioactivity, radioactive decay processes, nuclear reaction and interactions of radiation with matter. Prerequisite: CHEM 3514.

CHEM 5273. Cosmochemistry (Odd years, Sp). 3 Hours.
Laws of distribution of the chemical elements in nature, cosmic and terrestrial abundance of elements; origin and age of the earth, solar system, and the universe. Prerequisite: CHEM 3514.

CHEM 5283. Energy Conversion and Storage (Even years, Fa). 3 Hours.
Fundamental and applied concepts of energy storage and conversion, with sustainability implications. Chemical reactions (kinetics, thermodynamics, mass transfer), emphasizing oxidation-reduction, electrochemical, and interfacial processes, and impact on performance of fuel and biofuel cells, batteries, supercapacitors, and photochemical conversion. Prerequisite or Corequisite: MATH 2564. Prerequisite: CHEM 1103, CHEM 1123, PHYS 2054, PHYS 2074, and MATH 2554.

CHEM 5383. Chemometrics (Even years, Sp). 3 Hours.
Chemometrics is the process of extracting relevant information from chemical data by mathematical and statistical tools. These tools allow for designing optimal experimental procedures, extracting important information from complex chemical systems, and better understanding of complex chemical systems.

CHEM 5453. Quantum Chemistry I (Odd years, Sp). 3 Hours.
Fundamental quantum theory: Hamiltonian formalism in classical mechanics, Schrodinger equation, operators, angular momentum, harmonic oscillator, barrier problems, rigid rotator, hydrogen atom and interaction of matter with radiation. Prerequisite: CHEM 3504. (Recommended: MATH 3404).

CHEM 5473. Chemical Kinetics (Sp). 3 Hours.
Theory and applications of the principles of kinetics to reactions between substances, both in the gaseous state and in solution. Prerequisite: CHEM 3514.

CHEM 5513. Biochemical Evolution (Even years, Sp). 3 Hours.
Abiotic synthesis of biomolecules on Earth, the origin of cells, genetic information, origin of life on Earth and elsewhere, evolution and diversity, ecological niches, bacteria, archaea, eukaryotes, novel metabolic reshaping of the environment, life being reshaped by the environment, molecular data and evolution. Prerequisite: CHEM 5813.

CHEM 5603. Physical Organic Chemistry (Fa). 3 Hours.
Introduction to the theoretical interpretation of reactivity, reaction mechanisms, and molecular structure of organic compounds. Application of theories of electronic structure; emphasis on recent developments. Prerequisite: (CHEM 3514 and CHEM 3713 and CHEM 3712L).
The more important types of organic reactions and their applications to various classes of compounds. Prerequisite: (CHEM 3514 and CHEM 3713 and CHEM 3712L).

CHEM 5753. Methods of Organic Analysis (Fa). 3 Hours.
Interpretation of physical measurements of organic compounds in terms of molecular structure. Emphasis on spectroscopic methods (infrared, ultraviolet, magnet resonance, and mass spectra). Prerequisite: (CHEM 3712L and CHEM 3713 and CHEM 3514).

CHEM 5813. Biochemistry I (Fa). 3 Hours.
The first of a two-course series covering biochemistry for graduate students in biology, agriculture, and chemistry. Topics covered include protein structure and function, enzyme kinetics, enzyme mechanisms, and carbohydrate metabolism. Prerequisite: CHEM 3712L and CHEM 3713 (or CHEM 3613 and CHEM 3611L). This course is cross-listed with CHEM 4813H.

CHEM 5843. Biochemistry II (Sp). 3 Hours.
A continuation of CHEM 5813 covering topics including biological membranes and bioenergetics, photosynthesis, lipids and lipid metabolism, nucleic acid and amino acid metabolism, and molecular biology. Knowledge of organic chemistry comparable to material in CHEM 3613 is recommended. Prerequisite: CHEM 5813.

CHEM 600V. Master's Thesis (Sp, Su, Fa). 1-6 Hour.
Master's Thesis. Chemistry graduate students enroll in this course as needed until all CUMES are passed and the student is officially a doctoral candidate. Prerequisite: Chemistry graduate student. May be repeated for degree credit.

CHEM 6011. Chemistry Seminar (Sp, Fa). 1 Hour.
Members of the faculty, graduate and advanced students meet weekly for discussion of current chemical research. Weekly seminar sections are offered for the Departmental seminar and for divisional seminars in biochemistry and in analytical, inorganic, nuclear, organic, and physical chemistry. Chemistry graduate students register for the Departmental seminar section and one of the divisional seminar sections each semester they are in residence. Seminar credit does not count toward the minimum hourly requirements for any chemistry graduate degree. Prerequisite: (CHEM 3514 and CHEM 3713 and CHEM 3712L) and senior or graduate standing. May be repeated for up to 1 hours of degree credit.

CHEM 619V. Special Topics in Inorganic Chemistry (Irregular). 1-3 Hour.
Topics which have been covered in the past include technique and theory of x-ray diffraction, electronic structure of transition metal complexes, inorganic reaction mechanisms, and physical methods in inorganic chemistry. May be repeated for degree credit.

CHEM 6283. Mass Spectrometry (Odd years, Sp). 3 Hours.
This course is devoted to the fundamental principles and applications of analytical mass spectrometry. Interactions of ions with magnetic and electric fields and the implications with respect to mass spectrometer design are considered, as are the various types of mass spectrometer sources. Representative applications of mass spectrometry in chemical analysis are also discussed. Prerequisite: Graduate standing.

CHEM 629V. Special Topics in Analytical Chemistry (Irregular). 1-3 Hour.
Topics that have been presented in the past include: electroanalytical techniques, kinetics of crystal growth, studies of electrode processes, lasers in chemical analysis, nucleosynthesis and isotopic properties of meteorites, thermoluminescence of geological materials, early solar system chemistry and analytical cosmochemistry. May be repeated for degree credit.

CHEM 649V. Special Topics in Physical Chemistry (Irregular). 1-3 Hour.
Topics which have been covered in the past include advanced kinetics, solution chemistry, molecular spectra, nuclear magnetic resonance spectroscopy, and methods of theoretical chemistry. May be repeated for degree credit.

CHEM 6533. Chemistry of Organic Natural Products (Irregular). 3 Hours.
Selected topics concerned with structure elucidation and synthesis of such compounds as alkaloids, antibiotics, bacterial metabolites, plant pigments, steroids, terpenoids, etc. Prerequisite: CHEM 5603 and CHEM 5633.

CHEM 6643. Organometallic Chemistry (Irregular). 3 Hours.
Theories and principles of organometallic chemistry. Concepts include bonding, stereochemistry, structure and reactivity, stereochemical principles, conformational, steric and stereoelectronic effects. Transition metal catalysis of organic reactions will also be described. Prerequisite: CHEM 3504, and CHEM 3514, and CHEM 3703, and CHEM 3713 or permission of instructor.

A detailed description of the fundamental reactions and mechanisms of organic chemistry. Prerequisite: CHEM 5633.

CHEM 669V. Special Topics in Organic Chemistry (Irregular). 1-3 Hour.
Topics which have been presented in the past include heterogeneous catalysis, isotope effect studies of organic reaction mechanisms, organometallic chemistry, stereochemistry, photochemistry, and carbanion chemistry. May be repeated for degree credit.

CHEM 6823. Physical Biochemistry (Even years, Fa). 3 Hours.
Physical chemistry of proteins, nucleic acids, and biological membranes. Ultracentrifugation, absorption and fluorescent spectrophotometry, nuclear magnetic resonance spectroscopy, x-ray diffraction, and other techniques. Prerequisite: (CHEM 3514 and CHEM 5813) or graduate standing.

CHEM 6863. Enzymes (Odd years, Fa). 3 Hours.
Isolation, characterization, and general chemical and biochemical properties of enzymes. Kinetics, mechanisms, and control of enzyme reactions. Prerequisite: CHEM 5813 and CHEM 5843.

CHEM 6873. Molecular Biochemistry (Odd years, Sp). 3 Hours.
Nucleic acid chemistry in vitro and in vivo, synthesis of DNA and RNA, genetic diseases, cancer biochemistry and genetic engineering. Prerequisite: CHEM 5813 and CHEM 5843.

CHEM 6883. Bioenergetics and Biomembranes (Even years, Sp). 3 Hours.
Cellular energy metabolism, photosynthesis, membrane transport, properties of membrane proteins, and the application of thermodynamics to biological systems. Prerequisite: CHEM 5813 and CHEM 5843.

CHEM 700V. Doctoral Dissertation (Sp, Su, Fa). 1-18 Hour.
Doctoral Dissertation. Prerequisite: Graduate standing. May be repeated for degree credit.