Chemistry and Biochemistry (CHBC)

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Department of Chemistry and Biochemistry Website (https://fulbright.uark.edu/departments/chemistry)

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.

Requirements for M.S. in Chemistry

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/#mastersdegreestext).

Requirements for Ph.D. in Chemistry

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/degreerequirements/#phdanddddegreestext).

Graduate Faculty

Adams, Paul D., Ph.D. (Case Western Reserve University), B.S. (Louisiana State University), Associate Professor, 2006.

Allison, Neil T., Ph.D. (University of Florida), B.S. (Georgia College), Associate Professor, 1980.

Beyzavi, M. Hassan, Ph.D. (Freie Universität Berlin, Germany), Assistant Professor, 2017.


Chen, Jingyi, Ph.D. (University of Washington), M.A. (State University College at Buffalo), B.S. (Zhongshan University), Associate Professor, 2010.

Coridan, Robert, Ph.D., M.S. (University of Illinois-Urbana-Champaign), B.S. (The Ohio State University), Assistant Professor, 2015.

Fan, Chenguang, Ph.D. (Iowa State University), B.S. (Nanjing University), Assistant Professor, 2016.

Fritsch, Ingrid, Ph.D. (University of Illinois-Urbana-Champaign), B.S. (University of Utah), Professor, 1992.

Greathouse, Denise A., Ph.D. (University of Arkansas), Research Associate Professor, 1997.
Heyes, Colin David, Ph.D. (Georgia Institute of Technology), B.S. (Loughborough University), Associate Professor, 2008.
Kilyanek, Stefan M., Ph.D., M.S. (University of Chicago), B.S. (Grand Valley State University), Assistant Professor, 2014.
Koepe, Roger E., Ph.D. (California Institute of Technology), A.B. (Haverford College), Distinguished Professor, 1979.
Lay, Jackson, Ph.D. (University of Nebraska-Lincoln), Professor, 2002.
McIntosh, Matt, Ph.D. (Pennsylvania State University), B.A. (Virginia Tech), Professor, 1996.
Millett, Francis, Ph.D. (Columbia University), B.S. (University of Wisconsin), Distinguished Professor, 1972.
Moradi, Mahmoud, Ph.D. (North Carolina State University), M.S., B.S. (Sharif University of Technology), Assistant Professor, 2015.
Paul, David W., Ph.D. (University of Cincinnati), B.S. (Southwestern University), Associate Professor, 1980.
Sakon, Joshua, Ph.D. (University of Wisconsin-Madison), B.S. (Southern Oregon University), Professor, 1997.
Shi, Wei, Ph.D. (University of Alberta), M.S. (East China University of Science and Technology), B.S. (Shanghai Jiao Tong University), Assistant Professor, 2012.
Stenken, Julie A., Ph.D. (University of Kansas), B.S. (University of Akron), Professor, 2007.
Stites, Wesley, Ph.D. (Massachusetts Institute of Technology), M.A., B.A. (Johns Hopkins University), Professor, 1991.
Striegler, Susanne, Ph.D., M.S., B.S. (Ulm University, Germany), Professor, 2012.
Thallapuranam, Suresh, Ph.D. (Osmia University), Professor, 2003.
Tian, Ryan, Ph.D. (University of Connecticut), B.S. (Fudan University, Shanghai), Associate Professor, 2004.
Wang, Feng, Ph.D. (University of Pittsburgh), Ph.D. (Kutztown University of Pennsylvania), Associate Professor, 2012.
Wilkins, Charles L., Ph.D. (University of Oregon), B.S. (Chapman College), Distinguished Professor, 1998.
Xia, Jie, Ph.D. (State University of New York-Binghamton), M.S., B.S. (Wuhan University), Associate Professor, 2016.
Zheng, Nan, Ph.D. (University of Michigan-Ann Arbor), M.S. (University of Rochester), B.S. (University of Science and Technology of China), Associate Professor, 2008.

Courses
CHEM 505V. Special Topics in Chemistry. 1-4 Hour.
(Formerly CHEM 405V.) Potential topics include: advanced spectroscopic methods, bioanalytical chemistry, bioorganic chemistry, biorganic chemistry, biophysical chemistry, chemical sensors, drug discovery and design, nanomaterials, pharmaceutical chemistry, process analytical chemistry, and protein folding and design. Graduate degree credit will not be given for both CHEM 405V and CHEM 505V. Prerequisite: Instructor consent.
CHEM 5101. Introduction to Research. 1 Hour.
This eight week course introduces new graduate students to research opportunities and skills in chemistry and biochemistry. Meets 2 hours per week in the first half of the semester. Safety and ethics in research and scholarship are discussed. Students learn about research programs in the department to aid in choosing an advisor.
CHEM 5123. Advanced Inorganic Chemistry. 3 Hours.
Reactions and properties of inorganic compounds from the standpoint of electronic structure and the periodic table. Emphasis on recent developments. Knowledge comparable to material in CHEM 3453 is recommended.
CHEM 5143. Advanced Inorganic Chemistry II. 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. 3 Hours.
Determination of molecular structure by diffraction, spectroscopic, and other techniques. Illustrative examples will be chosen from inorganic chemistry and biochemistry.
CHEM 5213. Instrumental Analysis. 3 Hours.
Provides students, especially those in the physical, agricultural, and biological sciences, with an understanding of the theory and practice of modern instrumental techniques of analysis. Lecture 3 hours per week. Knowledge comparable to material in CHEM 2263 and CHEM 3603 is recommended.
CHEM 5223. Chemical Instrumentation. 3 Hours.
Use and application of operational amplifiers to chemical instrumentation; digital electronic microprocessor interfacing; software development and real-time data acquisition. Knowledge of analytical chemistry comparable to material in CHEM 4213 is recommended.
CHEM 5233. Chemical Separations. 3 Hours.
Modern separation techniques 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. 3 Hours.
Topics will include diffusion, electron transfer kinetics, and reversible and irreversible electrode processes followed by a discussion of chronocoulometry, chronocoulometry, polaronography, voltammetry, and chronopotentiometry. Knowledge of analytical chemistry comparable to material in CHEM 4213 is recommended.
CHEM 5253. Spectrochemical Methods of Analysis. 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. Knowledge of analytical chemistry comparable to material in CHEM 4213 is recommended.
CHEM 5263. Nuclear Chemistry. 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. 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. 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 photovoltaic conversion.
CHEM 5383. Chemometrics. 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 5443. Physical Chemistry of Materials. 3 Hours.
Physical and chemical characteristics of materials and discussion of the science behind materials engineering and performance. Topics include theory, principles of characterization methods, modeling, and applications in the context of materials. Knowledge comparable to material in CHEM 3514 and CHEM 3504 or CHEM 3453 or CHEG 3713 or MEEG 2403 is recommended.
CHEM 5453. Quantum Chemistry I. 3 Hours.
Fundamental quantum theory: Hamiltonian formalism in classical mechanics, Schrödinger equation, operators, angular momentum, harmonic oscillator, barrier problems, rigid rotor, hydrogen atom, and interaction of matter with radiation. Knowledge of physical chemistry comparable to material in CHEM 3504 is recommended.

CHEM 5473. Chemical Kinetics. 3 Hours.
Theory and applications of the principles of kinetics to reactions between substances, both in the gaseous state and in solution. Knowledge of physical chemistry comparable to material in CHEM 3514 is recommended.

CHEM 5513. Biochemical Evolution. 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 5573. Statistical Thermodynamics. 3 Hours.
Covers fundamentals in thermodynamics, molecular dynamics, Monte Carlo, phase transitions, behavior of gases and liquids and basic concepts in chemical kinetics and physical kinetics. Knowledge comparable to physical chemistry materials in CHEM 3514 is recommended.

CHEM 5603. Physical Organic Chemistry. 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. Knowledge of material comparable to CHEM 3613, CHEM 3613H, CHEM 3713 and CHEM 3514 is recommended.

CHEM 5633. Organic Reactions. 3 Hours.
The more important types of organic reactions and their applications to various classes of compounds. Knowledge of organic chemistry comparable to material in CHEM 3603 is recommended.

CHEM 5723. Experimental Methods in Organic Chemistry. 3 Hours.
Introduction to the application of synthetic and spectroscopic methods in organic chemistry, including mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance spectroscopy. Lecture 3 hours per week. Knowledge comparable to material in CHEM 3613 is recommended.

CHEM 5753. Methods of Organic Analysis. 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). Knowledge of organic chemistry comparable to material in CHEM 3603 is recommended.

CHEM 5813. Biochemistry I. 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 nucleic acid and carbohydrate structures. Knowledge of organic chemistry comparable to material in CHEM 3613 is recommended.

CHEM 5843. Biochemistry II. 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. 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. 1 Hour.
Weekly discussion of current chemical research. Departmental and divisional seminars in analytical chemistry, biochemistry, inorganic, organic, and physical chemistry are held weekly. Seminar credit does not count toward the minimum hourly requirements for any chemistry graduate degree. May be repeated for degree credit.

CHEM 619V. Special Topics in Inorganic Chemistry. 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. 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. 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. 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 6633. Chemistry of Organic Natural Products. 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. 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. Knowledge of material comparable to CHEM 3713 and CHEM 3514 is recommended.

CHEM 6673. Organic Reaction Mechanisms. 3 Hours.
A detailed description of the fundamental reactions and mechanisms of organic chemistry. Prerequisite: CHEM 5633.

CHEM 669V. Special Topics in Organic Chemistry. 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 carbonation chemistry. May be repeated for degree credit.

CHEM 6823. Physical Biochemistry. 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 5813.

CHEM 6863. Enzymes. 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.
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CHEM 6873. Molecular Biochemistry. 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. 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. 1-12 Hour.
Doctoral Dissertation. For chemistry graduate students who have passed all CUMES
and have officially been admitted to doctoral candidacy. Prerequisite: Chemistry
graduate student. May be repeated for degree credit.