Department of Chemistry

Chair

- Jiwoong Park

Associate Chair

- John Anderson

Professors

- Paul Alivisatos
- John Anderson
- Bryan Dickinson
- Aaron Dinner
- Guangbin Dong
- Gregory Engel
- Andrew Ferguson
- Laura Gagliardi
- Giulia Galli, Molecular Engineering - Associate Appointment
- Philippe M. Guyot Sionnest
- Chuan He
- Michael D. Hopkins
- Yamuna Krishnan
- Ka Yee Christina Lee
- Hening Lin
- Wenbin Lin
- David Mazziotti
- Raymond Moellering
- Jiwoong Park
- Joseph Piccirilli, Biochemistry & Molecular Biology
- Viresh Rawal
- Benoit Roux, Biochemistry & Molecular Biology
- Stuart Rowan, Molecular Engineering - Associate Appointment
- Norbert F. Scherer
- Elena Shevchenko, Professor Part-Time
- Steven J. Sibener
- Scott Snyder
- Jack Szostak
- Dmitri Talapin
- Bozhi Tian
- Andrei Tokmakoff
- Surinarayanan Vaikuntanathan
- Gregory Voth

Associate Professors

- Mark Levin

Assistant Professors

- Dipti Jasrasaria
- Sarah King
- Weixin Tang
- Anna Wuttig
- Jie Zhou

Senior Instructional Professors

- Vera Dragisich
- Valerie Keller
- Britni Ratliff
- Meishan Zhao

Assistant Instructional Professor

- Shaunna McLeod
- Hannah Lant

Emeritus Faculty

- Laurie Jeanne Butler
- Karl Freed
- Robert Haselkorn, MGCB
- Richard F. Jordan
- Stephen Kent, Biochemistry & Molecular Biology
- Donald H. Levy
- James R. Norris, Jr.
- Takeshi Oka
- Stuart A. Rice
- James Skinner, Molecular Engineering - Associate Appointment
- Hisashi Yamamoto

The Ph.D. program in the Department of Chemistry offers wide opportunity and unusual flexibility for advanced study and research, and is designed to encourage individuality, independence, and excellence in students. Most students select their research advisor by winter quarter of their first year and are engaged in research by the spring quarter. The department has neither a system of cumulative examinations nor a written major examination. There are relatively few course requirements and great flexibility as to which courses may be taken.

In the Division of the Physical Sciences barriers between departments are low. Students in the Department of Chemistry often take courses in other departments and can even earn the degree in chemistry for research that has been done under the supervision of a member of another department. Students are encouraged to fashion special programs of study under the guidance of the faculty.

Application

A completed application will include undergraduate transcripts and three letters of recommendation. All applicants must meet the Proof of English Proficiency requirements. Applicants who do not meet the waiver criteria here (https://grad.uchicago.edu/admissions/apply/english-language-requirements/) will need to submit verified TOEFL or IELTS scores as part of their application.

Students are normally admitted beginning with the Autumn Quarter of each year. The sequential nature of some of our courses make Autumn Quarter the best time to begin graduate studies. The deadline for the application may vary slightly from year to year, but it normally falls during the first week of December or the last week of November. Our website will list the current cycle's deadline.

A well-defined Master of Science (M.S.) program of appropriate rigor is maintained, but the Department of Chemistry does not offer financial support to students whose degree goal is the master's degree. This degree is neither a prerequisite for, nor a forerunner of, the Ph.D. degree, although it may be acquired along the way if a student so desires.

The Department of Chemistry participates actively in the Medical Scientist Training Program (MSTP) administered by the Pritzker School of Medicine at the University of Chicago. MSTP is a structured six-year program leading to both the M.D. degree and the Ph.D. in Chemistry. Full tuition and a stipend are awarded for the six-year period. MSTP is funded by the National Institute of General Medical Sciences and is open only to U.S. citizens.

Financial Support

All students admitted to the Ph.D. program are offered financial support. Generally this takes the form of a first-year teaching assistantship which provides a complete merit tuition scholarship and pays a competitive monthly stipend. The Department requires that all Ph.D. candidates acquire experience in teaching. Most students satisfy this requirement by serving as Teaching Assistants. Satisfactory performance in teaching is a program requirement. Teaching Assistants are usually assigned to one of the undergraduate laboratory courses. Duties involve supervising one class section (13-18 students) for one afternoon per week, holding a discussion session and office hours, and assisting with grading.

By the end of the third quarter students have usually selected their research supervisor. An appointment as a research assistant (stipend plus tuition) normally continues throughout the period of research.

There are several special supplemental fellowships and scholarships offered by the Department and the University. All students seeking admission are automatically considered in the competition for these awards. No separate application is required. Students are urged to compete for the many national and other external fellowships available.

Advanced Degrees

In the first year, students must satisfactorily complete nine courses selected from the graduate offerings (300, 400, and 500-level) in the Department of Chemistry and in related departments in PME or the Physical and Biological Sciences Divisions. At least six of these courses must be 300-level courses. At least four 300-level courses must be taken in Chemistry, and at least two of these four courses must be a Chemistry course designated as foundational (CHEM 30100 Inorganic Chemistry, CHEM 32100 Physical Organic Chemistry I, CHEM 32200 Organic Synthesis and Structure, CHEM 36100 Wave Mechanics and Spectroscopy, CHEM 36300 Statistical Thermodynamics, CHEM 39000 Solids, Materials, Surfaces, CHEM 33300 Chemical Biology II, CHEM 36200 Quantum Mechanics, CHEM 36400 Advanced Statistical Mechanics, CHEM 39100 Polymer Synthesis, CHEM 39300 Electronic and Quantum Materials for Technology) and up to two courses may be taken from a list of pre-approved non-chemistry courses. No undergraduate level courses can be used to satisfy the Ph.D. course requirement. Up to three courses can be taken from CHEM 5000X series, or CHEM 35000 Intro To Research: Chemistry and/or 400-level chemistry research courses.

Students should consider satisfying any or all course requirements by taking proficiency examinations. Application to take a proficiency examination should be made directly to the person who will be teaching the course. Upon agreement of the course instructor, the examinations will be administered at an agreed upon time prior to the class, but no later than the first week of the quarter in which the course is offered. The faculty member will administer a written exam to the student and shall assign a letter grade to the student based on the student's performance on the written exam. No stigma is attached to failing a proficiency examination.

Students who have completed all courses with a 2.7 GPA or higher (P in research courses) can acquire the M.S. Degree. This degree is neither a prerequisite for, nor a forerunner of, the Ph.D. degree, although it may be acquired along the way if a student so desires. The M.S. degree is typically awarded in the Autumn Quarter of the second year.

Each student's overall record will be reviewed at the end of Spring Quarter of the first-year of study. This includes an evaluation of (1) coursework — a 3.0 or better in all 300-level courses (excluding CHEM 35000 Intro To Research: Chemistry) —, (2) teaching, and (3) finding and maintaining a Research Advisor. At this time a student will be advised whether they are qualified to continue studies and to prepare for the Candidacy Examination. The oral examination will cover the student's research progress to-date, their research proposal, and topics from relevant coursework. More information regarding the Candidacy Exam Process can be found in the Department of Chemistry Graduate Student Handbook here (https://live-ucchem.pantheonsite.io/graduate-program/chemistry-graduate-program-policy-guide/).

Following the candidacy exam, the exam committee will provide feedback on the exam performance and the result of the exam. If the case requires additional discussion, a student may not be notified immediately and may instead receive the results of the examination at a later date. The faculty shall review the results of the Candidacy Examination at the November faculty meeting and, after consideration of the student's overall performance, vote on whether or not to recommend that the student be admitted to candidacy for the Ph.D. degree.

Students must select the members of their thesis committee at some point following the successful completion of their Candidacy Exam, but no later than October 1st of their third-year in residence. Each Ph.D. Thesis Committee shall include three, but no more than four faculty members, one of which will be the student's Research Sponsor (and pro forma Advisor if applicable), and three of which must be faculty members at the University of Chicago. If necessary, due to changes in staffing, alterations in research direction, or developing collaborations, the membership of the committee can be changed at any point in time with written notice provided to the Director of Graduate Studies. Once the committee is selected, the student will arrange the scheduling of the defense.

Each Ph.D. candidate shall schedule a final oral examination with his/her dissertation examining committee. This normally occurs after the dissertation is written, but prior to submitting the final copy to the Office of Academic Publications. At the conclusion of the oral examination the examining committee will discuss the student's performance, often in private, before notifying the student of the result. The Research Advisor will then communicate the result of the examination to the appropriate academic personnel in the department on behalf of the examining committee. More information regarding the Thesis Committee selection, Thesis preparation and submission, and final public seminar and oral examination can be found in the Department of Chemistry Graduate Student Handbook here (https://live-ucchem.pantheonsite.io/graduate-program/chemistry-graduate-program-policy-guide/).

Please note that all guidelines, policies, procedures, and requirements contained within the Department of Chemistry Graduate Student Handbook take precedence and supersede any information provided here. For the most accurate, detailed,

and up-to-date information, always refer to the Department of Chemistry Graduate Student Handbook here *(*https://live-ucchem.pantheonsite.io/graduate-program/chemistry-graduate-program-policy-guide/*).*

Chemistry Courses

CHEM 30100. Inorganic Chemistry. 100 Units.
Group theory and its applications in inorganic chemistry are developed. These concepts are used in surveying the chemistry of inorganic compounds from the standpoint of quantum chemistry, chemical bonding principles, and the relationship between structure and reactivity.
Instructor(s): W. Lin Terms Offered: Autumn
Prerequisite(s): CHEM 11100-11200-11300 or equivalent, CHEM 22000 and CHEM 22100, or concurrent enrollment in CHEM 22100 or equivalent.
Equivalent Course(s): CHEM 20100

CHEM 30200. Synthesis and Physical Methods in Inorganic Chemistry. 100 Units.
This course covers theoretical and practical aspects of important physical methods for the characterization of inorganic molecules. Topics may include NMR, IR, RAMAN, EPR, and electronic and photoelectron spectroscopy; electrochemical methods; and single-crystal X-ray diffraction.
Instructor(s): Anderson, John; Shevchenko, Elena Terms Offered: Winter
Prerequisite(s): CHEM 30100

CHEM 30400. Organometallic Chemistry. 100 Units.
This course covers preparation and properties of organometallic compounds (notably those of the transition elements, their reactions, and the concepts of homogeneous catalysis).
Instructor(s): J. Anderson Terms Offered: Spring
Prerequisite(s): CHEM 20100 and CHEM 26100
Equivalent Course(s): CHEM 20200

CHEM 30600. Chemistry Of The Elements and Materials. 100 Units.
This course surveys the descriptive chemistries of the main-group elements and the transition metals from a synthetic perspective, and reaction chemistry of inorganic molecules is systematically developed.
Instructor(s): J. Anderson Terms Offered: Winter
Prerequisite(s): CHEM 20100

CHEM 30900. Bioinorganic Chemistry. 100 Units.
This course covers various roles of metals in biology. Topics include coordination chemistry of bioinorganic units, substrate binding and activation, electron-transfer proteins, atom and group transfer chemistry, metal homeostasis, ion channels, metals in medicine, and model systems.
Instructor(s): C. He Terms Offered: Spring
Prerequisite(s): CHEM 20200 and 22200/23200

CHEM 31300. Machine Learning in Chemistry. 100 Units.
This course introduces theory and practice of machine learning, with an emphasis on methods relevant to chemistry, such as classification, regression, dimensional reduction, convolutional neural networks, graph neural networks, transformers, generative models, and reinforcement learning. Relevant applications include the analysis of experimental and computational data, learning force fields and potential energy surfaces, and sampling molecular conformations. Material will be introduced through lectures, hands-on exercises and projects, and critical reading and discussion of the literature.
Terms Offered: Spring
Prerequisite(s): MATH 18500; CHEM 26200
Equivalent Course(s): CHEM 21300

CHEM 31358. Simulation, Modeling, and Computation in Biophysics. 100 Units.
This course develops skills for modeling biomolecular systems. Fundamental knowledge covers basic statistical mechanics, free energy, and kinetic concepts. Tools include molecular dynamics and Monte Carlo simulations, random walk and diffusion equations, and methods to generate random Gaussian and Poisson distributors. A term project involves writing a small program that simulates a process. Familiarity with a programming language or Mathlab would be valuable.
Instructor(s): B. Roux Terms Offered: Winter
Prerequisite(s): Three quarters of a Biological Sciences Fundamentals sequence, BIOS 20200 or BIOS 20175 and BIOS 26210-26211, or consent from instructor
Note(s): CB
Equivalent Course(s): BCMB 31358, BIOS 21358, CPNS 31358

CHEM 32100. Physical Organic Chemistry I. 100 Units.
This course focuses on the quantitative aspects of structure and reactivity, molecular orbital theory, and the insight it provides into structures and properties of molecules, stereochemistry, thermochemistry, kinetics, substituent and isotope effects, and pericyclic reactions.
Instructor(s): M. Levin Terms Offered: Autumn
Prerequisite(s): CHEM 22200/23200 and 26200, or consent of instructor

CHEM 32200. Organic Synthesis and Structure. 100 Units.
This course seeks to introduce basic but important concepts in organic synthesis. Key coverage for this quarter includes stereoelectronic effects, conformational analysis, olefin reactions and synthesis, and enolate chemistry. By the end of this quarter, students are expected to have a deep understanding of the structure/reactivity relationship of typical organic molecules, to be capable of learning new synthetic reactions and understanding the reaction mechanism on your own, and to master basic skills to design synthesis of complex molecules.
Terms Offered: Autumn
Prerequisite(s): CHEM 22200/23200 or consent of instructor

CHEM 32300. Strategies and Tactics of Organic Synthesis. 100 Units.
This course continues the study of key reaction types used in modern organic synthesis (see CHEM 322), with emphasis on orbital symmetry-controlled processes, reactive intermediates such as radicals and carbenes, and transformations mediated by photochemical and transition-metal catalysis. Students examine examples from the primary literature to see how these reactions are applied in the synthesis of complex target molecules, and are challenged to design effective routes to moderately intricate structures, with attention to chemo-, regio-, and stereo- and enantioselectivity as well as the scope and limitations of each transformation.
Terms Offered: Winter
Prerequisite(s): CHEM 22200/23200 or consent of instructor

CHEM 33200-33300. Chemical Biology I-II.
This course emphasizes the concepts of physical organic chemistry (e.g., mechanism, molecular orbital theory, thermodynamics, kinetics) in a survey of modern research topics in chemical biology. Topics, which are taken from recent literature, include the roles of proteins in signal transduction pathways, the biosynthesis of natural products, strategies to engineer cells with novel functions, the role of spatial and temporal inhomogeneities in cell function, and organic synthesis and protein engineering for the development of molecular tools to characterize cellular activities.

CHEM 33200. Introduction to Chemical Biology. 100 Units.
This course will introduce biomolecules, chemical biology approaches and genomics from chemistry perspectives. The course will be an introduction to genomics and genomics tools in research and medicine, and will provide a well-rounded view of cell structure and function, the main signaling pathways in cells, and modern methods to chemically probe, program and reprogram cells.
Instructor(s): Y. Krishnan. Terms Offered: Autumn
Prerequisite(s): A grade of C or higher in CHEM 22200 or 23200, or consent of instructor
Equivalent Course(s): CHEM 23300

CHEM 33300. Chemical Biology II. 100 Units.
This course will further explore the principles of biochemistry and cell biology from a chemical perspective. Molecular structure, reactivity and functional organization in biological systems - ranging from single molecules to whole organisms will be examined. Chemical concepts and tools will be applied to solve problems at the interface of chemistry, biology, and medicine. This course aims to develop and refine skills on experimental design, data analysis, interpretation and presentation while promoting the critical analysis of recent research in chemical biology. The focus of this course will be on the design, synthesis, validation and application of chemical probes, broadly defined, in modern biological research.
Instructor(s): W. Tang. Y. Krishnan Terms Offered: Winter
Prerequisite(s): CHEM 33200, or consent of instructor

CHEM 33900. Discovery and Translation of Molecular Therapeutics. 100 Units.
The aim of this course is to broadly expose students to emerging classes of molecular therapeutics and diagnostics with a focus on the chemistry and molecular engineering underlying their discovery, development and translation into use by society. This material will be presented through the lens of academic, industrial and clinical experts, which will collectively expose students to the diverse disciplines that come together in the creation of new medicines and diagnostics.
Instructor(s): R. Moellering. Terms Offered: Spring
Prerequisite(s): CHEM 33200

CHEM 35000. Intro To Research: Chemistry. 300.00 Units.
For course description contact Chemistry.

CHEM 36100. Wave Mechanics and Spectroscopy. 100 Units.
This course presents the introductory concepts, general principles, and applications of wave mechanics to spectroscopy.
Instructor(s): A. Dinner Terms Offered: Autumn
Prerequisite(s): CHEM 26300

CHEM 36200. Quantum Mechanics. 100 Units.
This course builds upon the concepts introduced in CHEM 36100 with greater detail provided for the role of quantum mechanics in chemical physics.
Instructor(s): D. Mazziotti Terms Offered: Winter
Prerequisite(s): CHEM 36100

CHEM 36300. Statistical Thermodynamics. 100 Units.
This course covers the thermodynamics and introductory statistical mechanics of systems at equilibrium.
Instructor(s): S. Vaikuntanathan Terms Offered: Autumn
Prerequisite(s): CHEM 26100-26200

CHEM 36400. Advanced Statistical Mechanics. 100 Units.
Topics covered in this course may include statistics of quantum mechanical systems, weakly and strongly interacting classical systems, phase transitions and critical phenomena, systems out of equilibrium, and polymers.
Instructor(s): V. Goth Terms Offered: Winter
Prerequisite(s): CHEM 36300 or equivalent

CHEM 36500. Chemical Dynamics. 100 Units.
This course develops a molecular-level description of chemical kinetics, reaction dynamics, and energy transfer in both gases and liquids. Topics include potential energy surfaces, collision dynamics and scattering theory, reaction rate theory, collisional and radiationless energy transfer, molecule-surface interactions, Brownian motion, time correlation functions, and computer simulations.
Instructor(s): G. Voth Terms Offered: Spring
Prerequisite(s): CHEM 36100 required; 36300 recommended

CHEM 36600. Molecular Spectroscopy. 100 Units.
This course covers key concepts in molecular spectroscopy, focusing on how different spectroscopic techniques are used to study the structure and dynamics of molecules and materials. Topics include light-matter interactions in the gas and condensed phases, linear electronic spectroscopy, infrared (IR) and Raman vibrational spectroscopy in both gas and condensed phases, time-resolved spectroscopy of dynamic processes, nonlinear and multidimensional spectroscopy, and single-molecule measurements. The class emphasizes conceptual understanding rather than laboratory methods and requires prior knowledge of time-dependent quantum mechanics and statistical mechanics.
Instructor(s): Tokmakoff, A. Terms Offered: Spring
Prerequisite(s): CHEM 36200; CHEM 36400

CHEM 36800. Quantum Molecular and Materials Modeling. 100 Units.
Quantum mechanical methods, including quantum chemistry, density functional theory (DFT), and many body perturbation theory, for simulating the properties of molecules and materials will be explored in this course. Numerical algorithms and techniques will be introduced that allow for solution of approximate forms of the Schroedinger and Boltzmann Equations that model structural and transport properties of molecules and materials. The coupling of DFT with molecular dynamics will be detailed for determining finite temperature properties. Coupling of DFT with spin Hamiltonians to study dynamical spin correlations in materials will also be described. Examples of the application of quantum mechanical methods to materials for energy conversion and quantum information technologies will be provided.
Instructor(s): Laura Gagliardi, Giulia Galli Terms Offered: Spring
Prerequisite(s): MENG 26100, PHYS 23510, CHEM 26100, or instructor consent
Equivalent Course(s): CHEM 26800, MENG 35510, MENG 25510

CHEM 37000. Introduction to Laboratory Research. 100 Units.
TBD
Instructor(s): Moellering, R. Terms Offered: Autumn

CHEM 38700. Biophysical Chemistry. 100 Units.
This course develops a physicochemical description of biological systems. Topics include macromolecules, fluid-phase lipid-bilayer structures in aqueous solution, biomembrane mechanics, control of biomolecular assembly, and computer simulations of biomolecular systems.
Instructor(s): R. Benoit Terms Offered: Spring
Prerequisite(s): ONE of the following: CHEM 31358 Simulation, Modeling, and Computation in Biophysics; CHEM 36300 Statistical Thermodynamics; CHEM 36400 Advanced Statistical Mechanics. Knowledge of basic calculus, matrix algebra, statistical mechanics, and kinetics are recommended.

CHEM 39000. Solids, Materials, Surfaces. 100 Units.
This course is an introduction to modern materials chemistry. It covers basic chemistry and physics of condensed systems, such as solids, polymers, and nanomaterials. The electronic structure of metals, semiconductors and magnetically ordered phases will be discussed. We will review optical and electronic properties of different classes of materials using examples of hard and soft condensed matter systems and drawing structure-property relationships for conventional solids, polymers, and nanomaterials. Finally, the course will cover the fundamentals of surface science and material synthesis, applying modern understanding of nucleation and growth phenomena.
Instructor(s): D. Talapin Terms Offered: Autumn
Prerequisite(s): CHEM 26100, CHEM 26200, and CHEM 26300, or equivalent
Equivalent Course(s): MENG 35200

CHEM 39100. Polymer Synthesis. 100 Units.
This course introduces the most important polymerization reactions, focusing on their reaction mechanisms and kinetic aspects. Topics include free radical and ionic chain polymerization, step-growth polymerization, ring-opening, insertion, controlled living polymerization, crosslinking, copolymerization, and chemical modification of preformed polymers.
Instructor(s): Stuart Rowan Terms Offered: Winter
Prerequisite(s): CHEM 22000 and CHEM 22100
Equivalent Course(s): MENG 25110, MENG 35110

CHEM 39300. Electronic and Quantum Materials for Technology. 100 Units.
This is an introductory course on the science and engineering of electronic and quantum materials. The intended audience is upper-level undergraduate students and first-year graduate students in Molecular Engineering and other related fields, including Chemistry and Physics. We will learn the basics of electrical and optical properties of electronic materials, including semiconductors, metals, and insulators starting from a simple band picture, and will discuss how these materials enable modern electronic and optoelectronic devices and circuitry. We will also explore the modern synthesis techniques for these materials and the effects of reduced dimensions and emergent quantum properties.
Instructor(s): Shuolong Yang Terms Offered: Winter
Prerequisite(s): MENG 26100, PHYS 23510, CHEM 26100, or instructor consent
Equivalent Course(s): MENG 26600, MENG 36600

CHEM 40000. Rsch: Related Depts/Institutes. 300.00 Units.
Doctoral research on an original project in Related Depts/Institutes under the supervision of the professor.

CHEM 40100. Research: Chemistry. 300.00 Units.
Doctoral research on an original project in the Department of Chemistry under the supervision of the professor.
Terms Offered: Autumn Spring Summer Winter

CHEM 40200. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 40300. Research: Inorganic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 40500. Rsch: Laser/Surface/Phys Chem. 300.00 Units.
Doctoral research on an original project in Laser/Surface/Physical Chemistry under the supervision of the professor.

CHEM 40600. Research: Bioorganic Chemistry. 300.00 Units.
Doctoral research on an original project in Bioorganic Chemistry under the supervision of the professor.

CHEM 40700. Research: Inorganic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 40800. Research: Organic Chemistry. 300.00 Units.
Doctoral research on an original project in Organic Chemistry under the supervision of the professor.

CHEM 40900. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 41000. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 41100. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 41200. Research: Physical Chemistry. 300.00 Units.
Doctoral research on an original project in Physical Chemistry under the supervision of the professor.

CHEM 41300. Research: Inorganic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 41400. Research: Org/Biological Chem. 300.00 Units.
Readings and Research for working on their PhD

CHEM 41500. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 41600. Research: Biophysical Chem. 300.00 Units.
Doctoral research on an original project in Biophysical Chemistry under the supervision of professor.

CHEM 41700. Research: Geochemistry. 300.00 Units.
Doctoral research on an original project in Geochemistry under the supervision of the professor.

CHEM 41800. Rsch: Org/Phys-Org Chemistry. 300.00 Units.
Doctoral research on an original project in Org/Phys-Org Chemistry under the supervision of the professor.

CHEM 41900. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42000. Research: Physical Chemistry. 300.00 Units.
Doctoral research on an original project in Physical Chemistry under the supervision of the professor.

CHEM 42100. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42200. Research: Inorganic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42300. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42400. Research: Org/Biological Chem. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42500. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42600. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42700. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42800. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 42900. Research: Organic Chemistry. 300.00 Units.

CHEM 43000. Research: Inorganic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 43100. Research: Inorganic Chemistry. 300.00 Units.
Doctoral research on an original project in Inorganic Chemistry under the supervision of the professor.

CHEM 43200. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 43300. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 43400. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 43500. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 43600. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 43800. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 43900. Research: Org/Biotheoretical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44000. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44100. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44200. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44300. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44400. Research: Organic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44500. Research: Inorganic Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44600. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44700. Research: Physical Chemistry. 300.00 Units.
Readings and Research for working on their PhD

CHEM 44800. Research: Organic Chemistry. 100-300 Units.
Readings and Research for working on their PhD

CHEM 44900. Polymer Chemistry. 300.00 Units.
Laboratory Research on an original project in Polymer Chemistry for Ph.D. dissertation.

CHEM 45000. Research: Physical Chemistry. 300.00 Units.
TBD

CHEM 45100. Research: Physical Chemistry. 300.00 Units.
Laboratory research in physical chemistry.
Instructor(s): Sarah King Terms Offered: Autumn Spring Summer Winter. Start in 2018 - 2019 and continue every year/quarter after that

CHEM 45200. Research: Organic Chemistry. 300.00 Units.
Conduct research towards a dissertation research project in Organic Chemistry.
Instructor(s): Prof. Mark Levin Terms Offered: Autumn Spring Summer Winter

CHEM 45300. Research: Organic/Biological Chemistry. 300.00 Units.
Conduct research for Ph.D. dissertation in the laboratory of a Chemistry Department faculty member.
Instructor(s): Prof. Weixing Tang Terms Offered: Autumn Spring Summer Winter. Offered every quarter

CHEM 45400. Research: Physical Chemistry. 300.00 Units.
Research in computational/theoretical/physical chemistry toward a Ph.D. dissertation project.
Instructor(s): Prof. Laura Gagliardi Terms Offered: Autumn Spring Summer Winter

CHEM 45500. Research: Inorganic Chemistry. 300.00 Units.
Ph.D. laboratory research in a faculty research laboratory.
Instructor(s): Anna Wuttig Terms Offered: Autumn Spring Summer Winter

CHEM 45600. Research: Inorganic Chemistry. 300.00 Units.
Laboratory research on a Ph.D. dissertation project in Inorganic Chemistry.
Instructor(s): Alivisatos, Armand P. Terms Offered: Autumn Spring Summer Winter

CHEM 45700. RESEARCH: ORGANIC/BIOLOGICAL CHEMISTRY. 300.00 Units.
Conduct Ph.D.dissertation research in the laboratory of a faculty member in Chemistry.
Instructor(s): Prof. Jack Szostak Terms Offered: Autumn Spring Summer Winter

CHEM 49000. Chemistry External Research/ Professional Development. 300.00 Units.
Off site research internship.
Instructor(s): Dr. Vera Dragisich Terms Offered: Autumn Spring Summer Winter
Prerequisite(s): Approval of dissertation advisor

CHEM 50000-50001-50002. Advanced Training for Teachers and Researchers in Chemistry I-II-III.
This sequence will extend the traditional two-week departmental TA training into a full year, covering both the materials that are critical to becoming an excellent TA and the skills to produce well-rounded PhD candidates. At the end of this sequence, students are expected to develop an enhanced understanding and talent of critical thinking, an enriched knowledge base that is critical in solving real-world problems, an improved ability in the consideration and use of innovative pedagogical tools, the ability to transition into independent research, and effective skills in preparing high-quality written reports and oral presentations, as well as to begin thinking about career development skills.

CHEM 50000. Advanced Training for Teachers and Researchers in Chemistry I. 100 Units.
All organic chemistry TAs should enroll in discussion section 1D01; all general chemistry TAs should enroll in discussion section 1D02.
Instructor(s): Wuttig, A. Terms Offered: Autumn
Note(s): All organic chemistry TAs should enroll in discussion section 1D01; all general chemistry TAs should enroll in discussion section 1D02.

CHEM 50001. Advanced Training for Teachers and Researchers in Chemistry II. 100 Units.
See above.
Instructor(s): Wuttig, A. Terms Offered: Winter

CHEM 50002. Advanced Training for Teachers and Researchers in Chemistry III. 100 Units.
See above.
Instructor(s): Wuttig, A. Terms Offered: Spring

CHEM 70000. Advanced Study: Chemistry. 300.00 Units.
Advanced Study: Chemistry