

# Department of Medicinal Chemistry

## Medicinal Chemistry Graduate Programs

Medicinal chemistry is an interdisciplinary field at the interface of chemistry and biology. It approaches important biological and health-related problems through application of fundamental principles of organic chemistry, biochemistry, natural product chemistry, and molecular pharmacology. Graduates are expected to be thoroughly familiar with the chemistry of organic compounds, including their synthesis and biosynthesis, their reactivity, and their interactions with and alteration by living systems. Research is at the heart of the program, and the department's research activities encompass many areas of modern medicinal chemistry.

Currently, the department has 10 full-time faculty members, 15 - 20 graduate students on an average, about 10-15 postdoctoral associates, numerous undergraduate researchers, and an outstanding technical staff. The department is recognized nationally and internationally, and generally, our graduates pursue successful careers in the pharmaceutical industry and in academia.

## Facilities

The department is well equipped for both chemical and biochemical research and has research facilities for about 50 graduate students, postdoctoral associates, and research technicians. Laboratory space in the department provides research laboratories for chemical synthesis and biochemical research. Faculty are housed in modern research buildings on west campus (Shankel Structural Biology Center) and main campus (Integrated Science Building). The department has an excellent complement of modern spectroscopic, biochemical, and chromatographic instrumentation, and other specialized research instrumentation is available through cooperative arrangements with other departments and core laboratories.

Advanced instrumentation and facilities are available through KU's Molecular Structures Group (<https://msg.ku.edu>) (MSG). MSG laboratories include the Biochemical Research Service Laboratory (BRSL), the Mass Spectrometry Laboratory, the Nuclear Magnetic Resonance Laboratory, the Molecular Graphics and Modeling Laboratory and the X-ray Crystallography Laboratory with more than \$10 million in instrumentation.

The Shankel Structural Biology Center (SBC) offers new research opportunities for medicinal chemists interested in protein and nucleic acid structure and combinatorial synthesis; it also houses a 800-MHz NMR. In the same building, the High Throughput Screening Laboratory (<http://www.hts.ku.edu/>) has integrated and automated robotics equipment for carrying out biochemical and cell-based assays and a chemical library of more than 100,000 compounds with diverse structures and drug-like properties for biological screening. The service laboratories have professional staff that provides training in specialized research techniques in addition to their service functions.

## Department of Medicinal Chemistry

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## Courses

### MDCM 601. Medicinal Biochemistry I. 3 Credits.

A study of the biochemical principles of macromolecular structure and function, molecular communication, and the metabolism of nutrients and xenobiotics as applied to problems of medicinal and pharmacological significance.

### MDCM 603. Medicinal Biochemistry II. 3 Credits.

A study of the biochemical principles of macromolecular structure and function, biosynthesis, molecular communication, and the metabolism of nutrients and xenobiotics as applied to problems of medicinal and pharmacological significance. Prerequisite: Students must have first year professional standing in the School of Pharmacy. Students must have successfully completed MDCM 601.

### MDCM 606. Phytomedicinal Agents. 1 Credits.

This course will acquaint the pharmacy students with the current status of botanical use in the United States. A basic foundation will be provided so that the pharmacist can properly assess the appropriateness and usefulness of various phytomedicines and combinations in managing certain ailments with regard to efficacy, safety, potential toxicity, and potential herb-drug interactions. Prerequisite: Students must be admitted to the school or division of Pharmacy and have successfully completed MDCM 601 to enroll in this course.

### MDCM 608. Medicinal Chemistry of Neurodegenerative Diseases. 1 Credits.

A course designed to acquaint pharmacy students with diseases that affect and deteriorate the central nervous system. Students will learn the (1) pathophysiology of prevalent neurodegenerative disorders, (2) criteria used to diagnose and discriminate the disorder, (3) current treatments available, and (4) new therapeutic strategies (or modalities) being developed and clinically evaluated. Students will familiarize themselves with each disease topic by reading and critically assessing primary scientific literature provided by the instructor(s). Selected manuscripts will provide relevant background on the disorder and detail medicinal chemistry approaches to address its underlying etiology and/or symptomology. Assigned students will lead in class discussions of the reading materials, commenting on topics including, but not limited to, the merits of the research hypothesis, experimental design and protocols, interpretation of results, validity of the conclusions, and prospects for therapeutic translation. Discussions will follow a defined prompt provided by the instructor(s) for each topic. At the conclusion of the course, students will have a working knowledge of the cause, diagnosis, and treatment of pervasive neurodegenerative diseases, and develop skills for comprehending and critiquing scientific literature in the field of medicinal chemistry. Prerequisite: MDCM 625. Consent of Instructor.

### MDCM 625. Medicinal Chemistry I: Neuroeffector and Cardiovascular Agents. 4 Credits.

A study, from the molecular viewpoint, of the organic substances used as medicinal agents, including consideration of their origins, chemical properties, structure-activity relationships, metabolism and mechanisms

of action; this course emphasizes drugs affecting the cardiovascular and central nervous systems. Prerequisite: Students must be admitted to the school or division of Pharmacy and have successfully completed MDCM 603 to enroll in this course.

**MDCM 626. Medicinal Chemistry II: Homeostatic Agents. 4 Credits.**

A continuation of MDCM 625 with special emphasis on anticancer, antiviral, antibacterial, antifungal, antidiabetic, anticholesterol, and steroidal drugs. Prerequisite: Students must have second year professional standing in the School of Pharmacy. Students must have successfully completed MDCM 625.

**MDCM 690. Undergraduate Research. 1-5 Credits.**

Research in medicinal chemistry. Students will be assigned to a laboratory research problem. Prerequisite: Consent of instructor.

**MDCM 692. Problems in Medicinal Chemistry. 1-5 Credits.**

This course encompasses original work on a laboratory problem of limited scope, honors reading assignments from medicinal chemistry literature, or in-depth discussions of assigned topics. Prerequisite: Consent of instructor.

**MDCM 701. Advanced Medicinal Biochemistry I. 3 Credits.**

A study of the principles of macromolecular structure and function, biosignaling, bioenergetics and metabolism, with an emphasis on the relationship between biochemistry and medicine. Prerequisite: Graduate standing or permission of instructor.

**MDCM 710. Chemistry of Drug Action I. 4 Credits.**

This course provides an overview of topics central to the understanding and practice of contemporary medicinal chemistry. It illustrates the interplay of anatomy and physiology with the organic-, bio- and analytical chemistry of drugs in the body. Topics covered include physiological mechanisms and disease processes; cell structure and function; basic intermediary metabolism; basic principles underlying drug action including the physicochemical properties of drugs and how these affect the interaction of drugs with living systems; chemical and biological manipulation of the absorption, distribution, metabolism and excretion of drugs and prodrugs; kinetics and inhibition of enzymes and transporters; quantitation and molecular modeling of drug binding to targets. Prerequisite: One year of organic chemistry, one semester of biochemistry, and one college-level course in biology.

**MDCM 790. Chemistry of Drug Action II. 3 Credits.**

A discussion of the principles of contemporary drug design with specific examples chosen from the original literature. This course covers the organic substances used as medicinal agents, including consideration of their origins, chemical properties, structure-activity relationships, metabolism and mechanisms of action. Prerequisite: Graduate standing or completion of MDCM 625 and MDCM 626.

**MDCM 798. Master's Literature Seminar in Medicinal Chemistry. 1 Credits.**

Literature seminar for graduate students in Spring of their 2nd year. Prerequisite: Graduate students in 2nd year of program.

**MDCM 799. Research Seminar in Medicinal Chemistry. 1 Credits.**

Reports by research students and discussions of developments in the field not covered in formal courses.

**MDCM 801. Issues in Scientific Integrity. 1 Credits.**

Lectures and discussion on ethical issues in the conduct of a scientific career, with emphasis on practical topics of special importance in molecular-level research in the chemical, biological, and pharmaceutical sciences. Topics will include the nature of ethics, the scientist in the laboratory, as author, grantee, reviewer, employer/employee, teacher/

student, and citizen. Discussions will focus on case histories. This course is open only to distance education students. Graded on a satisfactory/unsatisfactory basis. (Same as MDCM 801, NURO 801, P&TX 801, PHCH 801 and PHCH 802.)

**MDCM 817. Rigor, Reproducibility and Responsible Conduct in Research. 3 Credits.**

This class addresses the recognized problems in rigor, reproducibility, and transparency that are plaguing modern science. Students will learn the fundamentals of hypothesis design, avoiding bias, randomization, sampling, and appropriate statistical analyses, reagent validation, among other key topics. This course also introduces principles for being an ethical, responsible, and professional research scientist. Topics include: plagiarism, fabrication and falsification of data, record keeping and data sharing, mentor/mentee and collaborative relationships, among others. The class will include a mixture of lecture, case studies and discussion. (Same as BIOL 817/CHEM 817/PHCH 817.) Prerequisite: Graduate student.

**MDCM 860. Principles and Practice of Chemical Biology. 3 Credits.**

A survey of topics investigated by chemical biology methods including: transcription and translation, cell signaling, genetic and genomics, biochemical pathways, macromolecular structure, and the biosynthesis of peptides, carbohydrates, natural products, and nucleic acids. Concepts of thermodynamics and kinetics, bioconjugations and bioorthogonal chemistry will also be presented. (Same as BIOL 860, CHEM 860 and PHCH 860.) Prerequisite: Permission of instructor.

**MDCM 895. Research in Medicinal Chemistry. 1-12 Credits.**

Hours and credit to be arranged.

**MDCM 899. Master's Thesis. 1-12 Credits.**

Hours and credit to be arranged. Independent investigation of a research problem of limited scope. Prerequisite: Consent of instructor.

**MDCM 980. Proposal Preparation. 2 Credits.**

Presentation of a literature seminar and writing an original NIH-style research proposal concerning contemporary problems in medicinal chemistry. Prerequisite: Consent of instructor.

**MDCM 999. Doctoral Dissertation. 1-12 Credits.**

Hours and credit to be arranged. Original chemical research in the synthesis and development of medicinal agents, elucidation of the chemical mechanisms of drug action, drug metabolism, and drug toxicities.