Department of Pharmacology and Toxicology

Pharmacology and Toxicology Graduate Programs

The Department of Pharmacology and Toxicology has research strengths in neuropharmacology — especially in neurodegeneration, psychiatric disorders, and addiction — and the effects of diabetes on the nervous system. The research program is founded on strong Ph.D. and M.S. graduate programs.

Doctoral students are prepared to teach and do research in a university, pharmaceutical, biotechnology, or government laboratory setting. New Ph.D. students can look forward to personal development in an atmosphere that fosters strong collaborative activities as well as independent scholarship. The department recruits 4 to 5 Ph.D. students each year and offers stipends and tuition coverage.

The major aim of the MS degree program is to provide qualified graduates to institutions in academia, industry, and government. The Master of Science in Pharmacology and Toxicology program emphasizes student's research skills in molecular and neuro-pharmacology and toxicology. In addition to the didactic component of our training, we view hands-on training in laboratory research critical to the master's thesis experience.

The Distance Master of Science degree in Pharmacology and Toxicology is a program designed to train individuals in molecular, cellular and organ systems pharmacology and toxicology. The program provides advanced scientific knowledge in pharmacology and toxicology and is designed for individuals who are seeking additional academic qualifications that will facilitate their advancement at their place of employment, or will increase their competitiveness for admission to other graduate or professional degree programs.

The department's research programs and faculty place it at the leading edge of research in the pharmacological and toxicological neurosciences.

Neurosciences Graduate Programs

The graduate program in neurosciences at the University of Kansas is a degree-granting program. Students are admitted directly into the program. The program is coordinated by the Lawrence campus of the university - with strengths in the behavioral, biological, chemical, and pharmaceutical sciences - and the Medical Center campus in Kansas City - with strengths in all the biomedical and clinical sciences. Each student is asked to indicate the campus on which he or she would like to be considered for admission. Students in this program should expect to be admitted to and receive a Ph.D. degree in neurosciences.

The program appeals to students who want to teach and/or do research in a university or do research in a pharmaceutical/ biotechnology company or government laboratory. Students who are interested in this field wish to work out individual programs spanning a great breadth from molecular and cellular neurobiology to organism-based neurophysiology, behavioral neurobiology, and cognitive neuroscience. Students take advantage of the many research and training opportunities available at two campuses of a major research university. Our students can look forward to personal development in an atmosphere that fosters strong collaborative activities as well as independent scholarship. If this type of program fits your professional training expectations, we invite you to join us.

Facilities

Research facilities offer a range of modern instrumentation and many research support services. Major instruments include tissue culture rooms, ultracentrifuges, scintillation counters, high-pressure liquid chromatography systems, a patch-clamp electrophysiology system with Nikon fluorescent microscope, two-photon and multi-photon microscopes, microprocessor-controlled spectrophotometers and fluorometers including a dual excitation wavelength instrument for intracellular measurements and a time-resolved luminescence and fluorescence microplate reader with dual dispensing capabilities, a Seahorse Extracellular Flux Analyzer for measuring cell metabolism and major energy-producing pathways of the cell, a dark room with a film processor, and real-time PCR equipment.

University research support facilities also contribute to the high quality of research and training for graduate students. These facilities are fully staffed by professionals and include the Electron Microscopy Lab with transmission and scanning scopes; the Biochemical Research Services Lab for Illumina RNAseq, protein and DNA sequencing, amino acid analysis, and oligonucleotide and peptide syntheses; a High Throughput Laboratory for screening compounds as potential tools and drug development, and the Molecular Graphics and Modeling Lab with VAX computers, extensive databases for protein structures, and multiple molecular modeling programs an NMR facility; an X-ray Crystallography Laboratory; a Mass Spectrometry Laboratory; and an Instrumentation Design Laboratory. All labs have current computer technology, including hardware and extensive software for imaging, data analysis, data reduction, protein and gene analysis, and statistical tests.

Department of Pharmacology and Toxicology

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Neurosciences Program

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Courses

NURO 799. Neuroscience Seminar Series. 1 Credits.
This course provides an opportunity for graduate students in the Neuroscience program to develop their oral presentation skills by giving annual seminars of their research project and findings. Students are required to attend all presentations and give one seminar within each academic calendar year. Presentations by students are evaluated by other graduate students and faculty at the end of each seminar. (Same as NEUS 799.) Prerequisite: Permission of the course director.

NURO 800. Neuroscience Teaching Principles. 2 Credits.
This course is to be used by graduate students fulfilling the teaching requirements for the Ph.D. in Neuroscience. Students may choose between in-lab or lecture-based instruction for the course. For in-lab, the student will be paired with an underclassman or rotation student and serve as their primary instructor. For lecture-based, the student will function as a discussion leader and lecturer in a limited number of class sessions. For either track, the student will meet with the faculty they are assisting and participate in individual progress meetings and development of research products (in-lab) or preparation of presentation materials and tests (lecture-based). Each student will be evaluated by the faculty mentor and by the students in the lab or class taught. (Same as NEUS 800.) Prerequisite: Graduate standing in Neuroscience.

NURO 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, P&TX 801, PHCH 801 and PHCH 802.)

NURO 803. Neuroscience Literature Review I. 1 Credits.
This course is designed for graduate students and will fulfill the first written exam requirement for the Ph.D. in Neuroscience. The student will research and write a six page literature review by choosing a topic provided by the faculty. Prerequisite: Graduate standing in the Neuroscience Program.

NURO 805. Neuroscience Literature Review. 1 Credits.
This course is designed for graduate students and will fulfill the second written exam requirement for the Ph.D. in Neuroscience. The student will research and write a twelve page literature review by choosing a topic provided by the faculty. Prerequisite: Graduate standing in the Neuroscience Program.

NURO 825. Research in Neuroscience. 1-10 Credits.
Original investigations at an advanced level in the areas of neuroscience. The research by each student will be performed in the laboratory of one of the faculty mentors of the graduate program in Neuroscience. Prerequisite: Graduate standing in the Neuroscience program.

NURO 846. Advanced Neuroscience. 4 Credits.
Team-taught, in-depth neuroscience course focusing on normal and diseased brain function at the molecular, cellular and systems levels. Lectures and discussions will emphasize current issues in neuroscience research. (Same as ANAT 846, PHCL 846, PHSL 846 and NEUS 846.) Prerequisite: Permission of the course director.

NURO 847. Developmental Neurobiology. 2 Credits.
Development of the nervous system from early induction to the development of learning and memory. Topics include: Induction; Cellular Differentiation; Axon Growth and Guidance; Target Selection; Cell Survival and Growth; Synapse Formation; Synapse Elimination; and Development of Behavior. (Same as ANAT 847, PHSL 847, and NEUS 847.) Prerequisite: Advanced Neuroscience (ANAT 846; NURO 846; PHSL 846) or consent of instructor.

NURO 848. Molecular Mechanisms of Neurological Disorders. 3 Credits.
An in-depth coverage of pathogenic mechanisms in neurological diseases; cellular and molecular responses to brain injury and disease, neuroinflammatory diseases (e.g., multiple sclerosis), neurodegenerative diseases (e.g., Alzheimer's, Parkinson's, Huntington's, amyotrophic lateral sclerosis, and prion diseases), neurogenetic diseases (e.g., lysosomal and peroxisomal disorders, Down's syndrome and fragile X), trauma, stroke, and viral diseases (e.g., HIV encephalitis). (Same as ANAT 848, PHCL 848, PHSL 848, and NEUS 848.) Prerequisite: Advanced Neuroscience (ANAT 846, PHCL 846 or PHSL 846) or an equivalent course and consent of instructor.

NURO 850. Sensory Biology. 2 Credits.
A variety of topics associated with sensory biology, including olfaction, vision, audition, equilibrium, and the visceral and somatic senses will be discussed relative to basic functions and in disease settings. Faculty will provide lectures throughout the semester and research article discussions will be woven into the content throughout the course. (Same as NEUS 850.) Prerequisite: Permission of the course director.

NURO 851. Clinical and Biological Basics of Dementia. 1 Credits.
This course will cover the major aspects of dementia research methodology, ranging from basic science to clinical and translational research. There will be a broad introduction to Alzheimer's Disease and Dementia including history, basic science, advanced analysis methods, and social and cultural ramifications. We will further cover topics such as clinical trial design, inclusion and ethical considerations, and translation into clinical practice. The course will include both didactic lectures and journal clubs. (Same as NEUS 851.) Prerequisite: Advanced Neuroscience (NEUS 846; ANAT 846; PHSL 846) or consent of the instructor.

NURO 899. Neuroscience Master's Thesis. 1-11 Credits.
Hours and credit for this course to be arranged with the mentor. Independent investigation of a research problem in neuroscience, but of limited scope. Prerequisite: Graduate standing in the Neuroscience program and consent of mentor/instructor.

NURO 999. Neuroscience Doctoral Dissertation. 1-11 Credits.
Hours and credit for this course to be arranged with the mentor. Conduct of original investigation in neurosciences. Prerequisite: Graduate standing in the Neuroscience program post-oral comprehensive examination and consent of mentor/instructor.

Courses

PTX 630. Pharmacology I. 4 Credits.
The pharmacology series covers the mechanisms by which drugs interact with living organisms. An integrative emphasis will be placed on understanding the molecular basis of drug action with respect

to modifying the pathophysiology of specific disease states. Topics in P&TX 630 include, general principles of pharmacokinetics and pharmacodynamics, pharmacology of the nervous system, biotechnology drugs, pharmacogenomics, and vitamins. Prerequisite: Students must be admitted to the school of Pharmacy to enroll in this course. Students must have successfully completed BIOL 646.

PTX 631. Pharmacology II. 3 Credits.
The pharmacology series covers the mechanisms by which drugs interact with living organisms. An integrative emphasis will be placed on understanding the molecular basis of drug action with respect to modifying the pathophysiology of specific disease states. Prerequisite: Students must have first year professional standing in the School of Pharmacy. Students must have successfully completed P&TX 630.

PTX 632. Pharmacology III. 3 Credits.
The pharmacology series covers the mechanisms by which drugs interact with living organisms. An integrative emphasis will be placed on understanding the molecular basis of drug action with respect to modifying the pathophysiology of specific disease states. Prerequisite: Students must be admitted to the school of Pharmacy to enroll in this course. Students must have successfully completed P&TX 630 and P&TX 631.

PTX 633. Pharmacology IV. 3 Credits.
The pharmacology series covers the basic principles of the immunology, inflammation, and targeted drugs used to regulate the immune response. In addition, basic concepts of infectious diseases and their therapeutics are discussed. Prerequisite: Students must have second year professional standing in the School of Pharmacy. Students must have successfully completed P&TX 630, P&TX 631 and P&TX 632.

PTX 640. Toxicology. 2 Credits.
General principles of toxicology, treatment, and management of accidental poisoning, and current topics of interest. Prerequisite: Students must have third year professional standing in the School of Pharmacy. Students must have successfully completed P&TX 630, P&TX 631, P&TX 632 and P&TX 633.

PTX 642. Obesity, Diabetes, and Metabolic Syndrome: Current Concepts. 1 Credits.
The objective of this course is to provide students with an opportunity to read, examine, and report on a broad array of topics relevant to diabetes and obesity. Students will be given broad latitude to propose topics of interest to them within the area of diabetes and obesity. The format of the course will be group presentations. Groups of 3 students will identify a topic of interest to them in the field of diabetes and obesity, prepare a 30 min presentation and deliver it to the class for discussion. Prerequisite: Students must be admitted to the school of Pharmacy and have successfully completed P&TX 630 to enroll in this course.

PTX 643. Current Concepts of Neurodegenerative Disease. 1 Credits.
Neurodegenerative diseases, such as Alzheimer's and Parkinson's diseases, are associated with older age and/or enhanced oxidative stress. The possible causes for the development and progression of these diseases with relation to current research in the field will be discussed. Additionally, a summary of available and suggested future treatments will be given. Prerequisite: Students must be admitted to the school of Pharmacy and have successfully completed P&TX 630 to enroll in this course.

PTX 645. Neurobiological Basis of Addiction: Physiological, Biochemical, Pharmacological & Treatment Concepts. 1 Credits.
Several addictions will be discussed including addictions to alcohol, cocaine, methamphetamine, gambling, and others as time permits. The physiology, biochemistry, pharmacology and available treatments for these addictions will be reviewed. The role of pharmacotherapies will be discussed, particularly as they relate to the molecular basis of addiction. Behavioral and psychological approaches also will be examined. Prerequisite: Completion of P&TX 632 or special permission from faculty.

PTX 646. Current Concepts of Psychotropic Medication. 1 Credits.

This course provides information regarding commonly used psychotropic medications, or any drug that affects brain activities associated with mental processes and behavior. This includes, but are not limited to, the categories of antipsychotics, mood stabilizers, anti-anxiety (anxiolytics), antidepressants, and stimulants. The range of topics from basic biology to drug-drug interactions will be explored in the course. Groups of three students will identify a topic of interest to them in the field of psychotropic drugs and affect, mood, or behavior, prepare a 30 min presentation, and deliver it to the class for discussion. Prerequisite: P&TX 630.

PTX 647. Gut Microbiota in Health and Disease. 1 Credits.
The human gut is home to about 100 trillion microorganisms (bacteria, archaea, viruses, fungi, and protozoa) that form a complex and dynamic ecosystem – the gut microbiota. This course will explore host-gut microbe interactions across the lifespan, the role of the gut microbiota in health (e.g., immune system development, resistance to opportunistic pathogens, metabolism, gut-brain axis, behavior), the association between a disrupted microbiota (dysbiosis) and numerous diseases (e.g., inflammatory bowel disease, asthma and allergy, obesity, diabetes, cardiovascular and kidney disorders, depression, and neurodegeneration), and the bidirectional interactions between gut microbes and drugs and other chemicals. The profound effects of diet on microbial diversity will be examined in depth. Approaches to maintaining or restoring a healthy gut microbiota will be considered. Prerequisite: Students must have second-year professional standing in the School of Pharmacy.

PTX 650. Medicinal Chemistry & Pharmacology I. 4 Credits.
This course will integrate fundamental principles of medicinal chemistry, pathophysiology and pharmacology in the development and treatment of diseases of the central, autonomic and peripheral nervous systems as well as sections on respiratory and gastrointestinal disease. (Same as MDCM 650.) Prerequisites: Medicinal Biochemistry or BIOL 636.

PTX 651. Medicinal Chemistry & Pharmacology II. 4 Credits.
This course will integrate fundamental principles of medicinal chemistry, pathophysiology and pharmacology in the development and treatment of diseases of the central, autonomic and peripheral nervous systems as well as sections on respiratory and gastrointestinal disease. (Same as MDCM 651.) Prerequisite: MDCM 650 or P&TX 650.

PTX 652. Immunotherapies. 3 Credits.
This course will cover fundamental principles of immunology and the development and use of immunotherapeutics to treat cancer, autoimmune and inflammatory diseases. (Same as MDCM 652.) Prerequisite: MDCM 650 or P&TX 650.

PTX 694. Undergraduate Laboratory: Research in Pharmacology and Toxicology. 1-5 Credits.
Original research on a laboratory problem of limited scope. This course cannot count toward pharmacology and toxicology requirements in the School of Pharmacy. Prerequisite: Consent of instructor.

PTX 698. Library Problems in Pharmacology and Toxicology. 1-5 Credits.
Original library review of a limited special topic in pharmacology and toxicology. The student will write a review in his or her report. This course

may count toward pharmacology and toxicology requirements in the School of Pharmacy. Prerequisite: P&TX 635 and consent of instructor.

PTX 700. Professional Issues in the Biomedical Sciences. 2 Credits.
A course designed to assist doctoral students in the biomedical sciences in their professional development by providing presentations, discussions, and practical experiences related to career planning. Topics include diverse career opportunities and expectations of each, preparation of vitae/resumes and other elements of a successful job search, writing scientific papers and dealing with editors, developing programmatic research programs, balancing professional obligations, advancing through promotions, and related topics. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 705. Current Concepts in Biochemical Pharmacology and Toxicology. 3 Credits.
A detailed study of the foundational concepts and leading-edge discoveries in biochemistry and molecular biology that underlie the actions and effects of drugs and toxicants with particular relevance to human disease and new therapeutic strategies. The interconnectedness and integration of seemingly disparate pathways and regulatory mechanisms will be emphasized. The technologies and experimental approaches used in biochemical pharmacology and toxicology will be illustrated. Topics may vary from year to year depending on recent advances in the field. The course will involve a combination of lectures and discussions with an emphasis on critically reading and analyzing primary research papers. Students will be evaluated on the basis of oral presentations and take-home problem sets. Prerequisite: Graduate standing in Pharmacology and Toxicology Program. Two semesters of undergraduate biochemistry with molecular biology.

PTX 730. Advanced Pharmacology I - CNS and ANS. 2 Credits.
A detailed study of the fundamentals of autonomic nervous system, central nervous system, and their pharmacology. Prerequisite: Permission of the course director.

PTX 731. Advanced Pharmacology II - Cardiovascular and Renal System. 2 Credits.
A detailed study of the fundamentals of cardiovascular system, renal system and their pharmacology. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 732. Advanced Pharmacology III - Immunology and Inflammatory Diseases. 2 Credits.
A detailed study of the fundamentals of inflammation, treatment for infectious disease and gastrointestinal pharmacology. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 733. Advanced Pharmacology IV - Endocrinology. 2 Credits.
A detailed study of the fundamentals of endocrinology and associated pharmacology. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 742. Experimental Pharmacology. 3 Credits.
Experimental approaches to understanding mechanism of drug action. Use of drugs as tools to understand functioning of biological systems will also be stressed. The focus is on the different types of receptor systems and signaling pathways. Topics will include: pharmacokinetics, pharmacodynamics, G-protein linked receptors, ion channels, nuclear receptors and kinase signaling cascades. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 747. Molecular Toxicology. 2 Credits.
A detailed study of the fundamentals of the experimental methods used in a modern toxicology laboratory. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 750. Pharmacology I- Introduction to Pharmacology and Biotechnology. 3 Credits.
An introduction to the basic principles of biochemistry and molecular biology as well as pharmacokinetics and pharmacodynamics of drug action. Additional lectures will introduce students to principles of genomics, transgenic technologies and microscopy. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology.

PTX 751. Pharmacology II - Endocrine Pharmacology. 2 Credits.
A detailed study of the fundamental concepts of endocrinology with an emphasis on the pathophysiologic details of diabetes and the pharmacology of treatment. Brief discussions on hypothalamic/pituitary, reproductive, thyroid and adrenal endocrinology and pharmacology will be presented. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of P&TX 750.

PTX 752. Pharmacology III- Central Nervous System and Autonomic Nervous System. 4 Credits.
A detailed study of the fundamental concepts of the autonomic nervous system, central nervous system, and select diseases of the CNS and their pharmacology. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of P&TX 750.

PTX 753. Pharmacology IV- Cardiovascular and Renal System. 2 Credits.
A detailed study of the fundamental principles of the cardiovascular system, renal system and their associated pharmacology. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of P&TX 750.

PTX 754. Pharmacology V - Immunopharmacology, Infectious Diseases and Gastrointestinal Pharmacology. 2 Credits.
This course is a detailed study of the fundamental concepts of immunology, inflammatory-related diseases and immunopharmacology, infectious diseases and gastrointestinal pharmacology. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of P&TX 750.

PTX 755. Molecular Toxicology. 2 Credits.
A detailed study of the fundamentals of the toxicology, drug transformations and the mode of toxicity of various drug classes. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of P&TX 750.

PTX 756. Receptor Pharmacology and Cell Signaling. 2 Credits.
A detailed study of the fundamental concepts of receptor pharmacology with an emphasis on the structures, functions, and pharmacology of G-protein signaling, ion channels, nuclear receptors and kinase signaling. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of P&TX 750.

PTX 758. Pharmacogenomics. 2 Credits.
A detailed study of fundamental concepts of pharmacogenomics - how genes and genetic variation determine interindividual differences in drug response - experimental approaches, select gene-drug examples, translation from research to clinical use, and ethical, legal and social implications. Prerequisites: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology.

PTX 759. Communication in Biomedical Sciences. 2 Credits.
Lectures and practical experience in written and oral communication skills, featuring various types of scientific writing. Prerequisite: Graduate

standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of at least 4 courses from the P&TX 750 – P&TX 755 series.

PTX 760. Optogenetic, Two Photon Imaging and Microscopy and Image Analysis Techniques in Neuropharmacology. 2 Credits.
An in-depth presentation of the use of optogenetics and two photon imaging in exploring synaptic plasticity in the CNS. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of at least 4 courses from the P&TX 750 – P&TX 755 series.

PTX 761. Journal Club. 1 Credits.
Students will participate in student-lead journal club discussions and lead one journal club discussion under the mentorship of a faculty member. This is a synchronous course that online students join via video conferencing so students must be available during the regularly scheduled departmental journal club class. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of at least 4 courses from the P&TX 750 – P&TX 755 series.

PTX 785. Research Proposal. 2 Credits.
To satisfy the research requirement for the Distance M.S. program in Pharmacology and Toxicology, the aspiring student must define a research project and prepare a written proposal describing the nature and goals of the project. It is suggested that the student in conjunction with their distance research mentor collaborate in the selection of and the definition of the proposed research. The proposal should be 4 pages (0.5 in margins, 11-12 point Arial, Times Roman or Calibri font) that states the overall goal of the project, the hypothesis to be tested, 2-3 specific aims, a statement of significance and impact of the research and research approach. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology, and completion of P&TX 750.

PTX 799. Pharmacology and Toxicology Seminar. 1-2 Credits.
A review of current literature and research in pharmacology and toxicology. Required of all graduate students in the department every fall and spring semester. Graded on a satisfactory/unsatisfactory basis. Prerequisite: Graduate standing in P&TX.

PTX 800. Pharmacology and Toxicology Teaching Principles. 2 Credits.
This course is to be used by graduate students fulfilling the teaching requirements for the Ph.D. in pharmacology and toxicology. The student will function as a discussion leader and lecturer in a limited number of class sessions. Each student will meet with the faculty whom he or she is assisting. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 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, PHCH 801 and PHCH 802.)

PTX 803. Pharmacology Literature Review I. 1 Credits.
This course is designed for graduate students and will fulfill the first written exam requirement for the Ph.D. in pharmacology and Toxicology. The student will research and write a six page literature review by choosing a topic provided by the faculty. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 805. Pharmacology Literature Review II. 1 Credits.
This course is designed for graduate students and will fulfill the second written exam requirement for the Ph.D. in pharmacology and Toxicology. The student will research and write a twelve page literature review by choosing a topic provided by the faculty. Prerequisite: Graduate standing in Pharmacology and Toxicology Program.

PTX 806. Literature MS Thesis. 4 Credits.
This course is intended to be the final course in the program and will be used to complete the literature-based research proposal. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of at least 26 credit hours.

PTX 825. Research in Pharmacology and Toxicology. 1-10 Credits.

Original investigations at an advanced level in the areas of pharmacology or toxicology or related fields. This research will be performed by graduate students in collaboration with a faculty member. Prerequisite: Graduate standing and consent of instructor.

PTX 826. Online Research in Pharmacology and Toxicology. 8 Credits.
Original investigations at an advanced level in the areas of pharmacology or toxicology or related fields. This research will be performed by graduate students in collaboration at their place of off-site mentoring in collaboration with the faculty mentor. Prerequisite: Graduate standing in the Online M.S. Program in Pharmacology and Toxicology and consent of KU Pharmacology and Toxicology Faculty Mentor.

PTX 885. Distance Master's Research in Pharmacology and Toxicology. 1-12 Credits.
Original investigations at an advanced level in areas of pharmacology or toxicology or related fields. This research will be performed by graduate students in collaboration at their place of off-site mentoring in collaboration with the faculty mentor. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of 12 credits in P&TX 785.

PTX 889. Distance Master's Thesis. 2 Credits.
Independent investigation of a research problem of limited scope, leading to the preparation of a written Master's Degree thesis. Prerequisite: Graduate standing in the Distance M.S. Program in Pharmacology and Toxicology and completion of 12 credits in P&TX 885.

PTX 890. Distance M.S. Thesis. 2 Credits.
Independent investigation of a research problem of limited scope, leading to the preparation of a written Master's Degree thesis. Prerequisite: Graduate standing in the On-line M.S. Program in Pharmacology and Toxicology.

PTX 898. Online Master's Thesis. 1-2 Credits.
Independent investigation of a research problem of limited scope leading to the preparation of a written Master's Degree thesis. Prerequisite: Graduate standing in the Online M.S. Program in Pharmacology and Toxicology.

PTX 899. Master's Thesis. 1-11 Credits.
Hours and credit to be arranged. Independent investigation of a research problem of limited scope. Prerequisite: Graduate standing in Pharmacology and Toxicology Program and consent of instructor.

PTX 999. Doctoral Dissertation. 1-11 Credits.
Hours and credit to be arranged. Original investigation in pharmacology and toxicology. Prerequisite: Consent of instructor.