Pharmacology and Toxicology

Degrees Offered
Doctor of Philosophy

Program Admissions Requirements
In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Admission to the Pharmacology and Toxicology Graduate Program can be sought in two ways:

• Through the Interdisciplinary Program in Biomedical Sciences (IDP) or the Neurosciences Doctoral Program. After completion of the first-year curriculum of these programs, students can choose to complete their dissertation work with faculty in the Pharmacology and Toxicology Department.
• Through direct admission into Pharmacology and Toxicology.

Fields of Research
Research opportunities in the department are available in five general areas:

Biochemical and Molecular Pharmacology
• Fundamentals of molecular biology and biochemistry are applied to mechanisms of drug action
• Ongoing projects include studies of the effects of drugs on signal transduction processes, including receptors and intracellular signaling molecules (cyclic nucleotides, G proteins, ion channels, eicosanoids and calcium); structure/activity relationships
• Studies of processes by which drugs are metabolized

Cancer Biology
• Study of cellular signaling pathways that promote malignancy and metastasis
• Identification of genes and genetic mutations that increase susceptibility to cancer
• Discovery of agents that prevent the development of cancer

Cardiovascular Pharmacology
• Mechanism of action of drugs that affect the cardiovascular system
• Cellular pharmacology of vascular smooth muscle and endothelium
• Molecular biology of cell adhesion molecules and other inflammatory mediators
- Mechanisms of action of anti-hypertensive and anti-ischemic drugs
- Pathophysiology and pharmacology of heart failure

**Neuropharmacology**
- Biochemical and molecular mechanisms of action of centrally acting neurotransmitters and drugs
- Signal transduction mechanisms involving receptors, ion channels and protein trafficking
- Biochemical mechanisms of drugs of abuse
- Use of imaging techniques as a means to study human neuropharmacology

**Toxicology**
- Xenobiotic metabolism, biochemical toxicology, organ toxicology, neurotoxicology, environmental and aquatic toxicology, and toxicity of pesticides and metals
- Molecular biological and biochemical methods are applied to toxicological problems

**Required Courses**
During the first year, the curriculum consists of a core of required courses in biochemistry, cell and molecular biology, genetics, and cellular signal transduction. Additional advance level courses are taken during the second and third years depending on the field of research chosen by the student.

**Overall Course Requirements**
A requirement of this program is to fulfill two credits in Bioethics by completing course (10222) *Ethics and Integrity in Science* and course (10444) *Research Ethics Discussion Series*. For course descriptions of 10222 and 10444 see listing within the [Bioethics Program](#). Students are also required to participate in a Seminar course each year.

**Overall Courses**
**07214 Principles of Drug Action.** *3 credits.* PRINCIPLES OF DRUG ACTION provides students with the fundamental knowledge of basic pharmacological principles and introduces the major classes of drugs used to treat human diseases. Students will gain a comprehensive understanding of pharmacokinetic principles, dose-response relationships, genetic determinants of patient variability in response to drugs and drug metabolism. Major classes of drugs to be discussed include those that impact the autonomic nervous, cardiovascular, immune, and central nervous systems, In addition,
introduction to drugs used to treat microbial and parasitic infections is provided. The course will be taught primarily in the traditional lecture format, with the addition of one 2 hour patient oriented problem solving (POPS) small group session included to demonstrate key principles related to pharmacodynamics and pharmacokinetics. Student will be evaluated through three short answer-essay-type examination spaced approximately equally throughout the course.

**07215 Survey of Principles of Drug Action. 1 credit.**
This course provides students with the fundamental knowledge of basic pharmacological principles. It consists of the first block of the Principles of Drug Action course focused on pharmacokinetic principles, dose-response relationships, genetic determinants of patient variability in response to drugs, and drug metabolism. Introduction to autonomic nervous system pharmacology is included. The course will be taught primarily in the traditional lecture format, with the addition of one 2 hour patient-oriented problem solving small group session included to demonstrate key principles related to pharmacodynamics and pharmacokinetics.

**16275 Understanding Cell Signaling Through Therapeutic Drugs. 2 credits.**
This course provides an in-depth presentation of mechanisms of cellular signaling at a level designed for doctoral students in the biomedical sciences. The emphasis, through discussion of actions of therapeutic drugs currently used to treat human diseases, is on receptors, second messenger systems, G proteins and signal transduction.

**07225 Ion Channels and Signal Transduction. 3 credits.**
This course provides discussion of the function of ion channels in mammalian cells. The course provides in-depth discussions of ion channel structure, function and regulation.

**07237 Modern Drug Discovery and Development. 3 credits.**
Modern Drug Discovery and Development is an interdisciplinary course with an emphasis on state of the art techniques, concepts and advances in drug discovery and development today. The course will provide an understanding of the fundamental concepts of therapeutic target identification and drug design, high throughput screening, preclinical testing, pharmaceutical optimization, human clinical trials, and drug commercialization.

**07226 Current Concepts of Cancer Biology. 3 credits.**
This course provides students with basic knowledge of cancer biology. Topics include signaling pathways that promote malignancy and metastasis, cancer susceptibility genes, and chemoprevention.

**07295 Reading and Research. 1-9 credits.**

**07299 Master’s Thesis. 6 credits.**
07301 Seminar. 1 credit.
07399 Doctoral Dissertation. 9 credits.