### PHARMACOLOGY AND TOXICOLOGY PHM

**Department of Pharmacology and Toxicology**  
**College of Veterinary Medicine**

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisites/Restrictions</th>
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<tr>
<td>211</td>
<td>Pharmacology and Toxicology in Society</td>
<td>Introduction for non-science or science students to the field of pharmacology and toxicology. History of pharmacology and toxicology. Present issues and future possibilities. Society and systems of drug development and delivery. Drug abuse and policies.</td>
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<td>321</td>
<td>Common Drugs</td>
<td>Spring, 3(3-0): P (PSL 250) or (PSL 431 and PSL 432) or PSL 310 R: Open to juniors or seniors of approval of department. Introduction to commonly used drugs. Emphasis on over-the-counter medications and frequently prescribed prescription drugs. Selected natural products also will be covered. How commonly used drugs affect the body to treat or cure various conditions and how the body handles drugs. Principles of appropriate drug use and consequences of misuse.</td>
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<td>350</td>
<td>Introductory Human Pharmacology</td>
<td>Fall, Spring, Summer. 3(3-0): P (PSL 250 or PSL 310) or (PSL 431 and PSL 432) R: Not open to freshmen. Not open to students with credit in PHM 430 or PHM 440. General principles of pharmacology. Central nervous system, autonomic nervous system, cardiovascular, renal, cancer, microbial, and endocrine pharmacology.</td>
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<td>351</td>
<td>Fundamentals of Drug Safety</td>
<td>Spring, 2(2-0): P: (BS 161 and BS 162) or (LB 144 and LB 145) or (BS 181H and BS 182H) R: Open to juniors or seniors or approval of department. How and why drugs are tested and monitored for safety. The roles of the FDA, USDA, and EPA to ensure drug safety.</td>
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<td>421</td>
<td>Clinical Toxicology</td>
<td>Fall, 3(3-0): P: [(CEM 251 or CEM 351) and PSL 310] or (PSL 431 and PSL 432) R: Open to seniors or approval of department. Basic methods and procedures commonly employed in clinical toxicology will be introduced and explained. Mechanisms of toxicity, symptoms, diagnostics, and treatment of the most common encountered toxins in clinical exposure will be reviewed in detail.</td>
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<td>422</td>
<td>Fundamentals of Neuropharmacology</td>
<td>Spring, 2(2-0): P: [Departmental with Neuroscience. Administered by Pharmacology and Toxicology. P: NEU 301 or PSL 250 or PSL 310 or PSL 431 R: Open to juniors or seniors or approval of department. Mechanisms and uses of action of drugs on neurons and neuron-controlled activities.</td>
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<td>430</td>
<td>Human Pharmacology</td>
<td>Summer, 3 credits: P (PSL 250 or PSL 310) or (PSL 431 and PSL 432) R: Molecular biology, biochemistry, chemistry, physiology, and/or human biology. R: Open to master's students in the Integrative Pharmacology Major or in the Pharmacology and Toxicology Major and open to undergraduate students. Approval of department. Not open to students with credit in PHM 350 or PPM 440. General principles of pharmacology. Central nervous system and autonomic nervous system, cardiovascular, renal, cancer, microbial, and endocrine pharmacology.</td>
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<td>431</td>
<td>Pharmacology of Drug Addiction</td>
<td>Fall, 3(3-0): Interdepartmental with Neuroscience. Administered by Pharmacology and Toxicology. R: Zoology or Human Biology or Psychology or Biochemistry or Physiology. Introduction to pharmacology and neuropharmacology. Understanding of the biological basis for drug abuse and addiction.</td>
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<td>440</td>
<td>Principles of Drug Action</td>
<td>Summer, 1 credit: R: Chemistry, molecular biology, biochemistry, physiology, and/or human biology. R: Not open to master's students in the Integrative Pharmacology Major or in the Pharmacology and Toxicology Major. Not open to students with credit in PHM 430 or PPM 350. Factors influencing drug action. Absorption, distribution, and elimination. Factors controlling intensity, selectivity and nature of drug action. Mismatches of drug presence and drug action including receptor-effector coupling mechanisms and mechanisms of drug tolerance. Offered first half of semester.</td>
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<td>450</td>
<td>Introduction to Chemical Toxicology</td>
<td>Fall, Spring, Summer. 3(3-0): P: (BS 161 and BS 162 and CEM 251) or (LB 144 and LB 145 and CEM 251) R: Not open to freshmen or sophomores. Mammalian toxicology. Disposition of chemicals in the body, detoxication, elimination, and mechanisms of toxicity in major organ systems. Selected toxic agents.</td>
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<td>454</td>
<td>Leadership and Teams for Scientists and Health Professionals</td>
<td>Fall, Spring, 3(3-0): R: Open to juniors or seniors or approval of department. Engage in self-reflection within the context of relating to others within a team setting; carry out appropriate leadership models suited to given contexts; evaluate change options as a leader in an organizational setting; and continue to grow as a lifelong learner. Not open to students who have completed PHM 854.</td>
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<td>461</td>
<td>Tropical Medicine Pharmacology</td>
<td>Fall, Spring, 2(2-0): P: PHM 350 or concurrently R: Open to juniors or seniors or master's students. Approval of department. Tropical diseases, epidemiologic and clinical features, and pharmacologic treatments. Multidisciplinary and interdisciplinary approaches, especially in poverty settings.</td>
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<td>480</td>
<td>Special Problems</td>
<td>Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Approval of department. Individual work on selected research problems.</td>
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<td>483</td>
<td>Antimicrobial Chemotherapy</td>
<td>Fall, Spring, 3(3-0): P (PHM 350 or concurrently) and (PHM 461 or concurrently) R: Biotechnology and/or biochemistry. Therapeutic drugs and toxins for human or veterinary clinical medicine have generated significant attention in the non scientific news media. Reasons for societal attention, therapeutic breakthroughs, therapeutic needs, drug marketing, and drug regulatory policies.</td>
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<td>487</td>
<td>Current Topics in Pharmacology and Toxicology</td>
<td>Fall, Spring, 2(2-0): R: College level physiology and/or biochemistry. Therapeutic drugs and toxins for human or veterinary clinical medicine have generated significant attention in the non scientific news media. Reasons for societal attention, therapeutic breakthroughs, therapeutic needs, drug marketing, and drug regulatory policies.</td>
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<td>552</td>
<td>Veterinary Pharmacology I: Principles and Neuropharmacology</td>
<td>Spring, 2(2-0): R: Open to graduate-professional students in the College of Veterinary Medicine. SA: PHM 556 Basic principles of pharmacology and mechanisms of action of drugs used to affect nervous system function.</td>
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<td>553</td>
<td>Veterinary Pharmacology II: Systems and Infectious Diseases</td>
<td>Spring, 2(2-0): R: Open to graduate-professional students in the College of Veterinary Medicine. SA: PHM 556 Principles of pharmacology of infectious disease and specific organ systems, including mechanisms of action and adverse effects of drugs.</td>
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<td>557</td>
<td>Veterinary Toxicology</td>
<td>Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open to graduate-professional students in the College of Veterinary Medicine. General principles of pharmacology and toxicology and selected drugs. Rational drug therapy.</td>
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<td>564</td>
<td>Basic Principles of Medical Pharmacology</td>
<td>Fall, 2(2-0): R: Open to graduate-professional students in the College of Osteopathic Medicine. SA: PHM 556 Basic principles of pharmacology and toxicology and selected drugs.</td>
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Case Studies in Clinical Pharmacology
Spring 2(2-0) P: PHM 563 RB: Completion of Year 2 in the College of Osteopathic Medicine or College of Human Medicine. R: Open to graduate-professional students in the College of Osteopathic Medicine or in the College of Human Medicine or approval of department.
Selected case studies emphasizing clinical applications of pharmacological principles. Evaluation of new drugs, drug advertising, and adverse drug reactions.

Research Problems in Pharmacology or Toxicology
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: Completion of Semester 4 of the graduate-professional program in the College of Veterinary Medicine. R: Approval of department.
Selected research problems in pharmacology or toxicology.

Regulatory Affairs and Project Management in Clinical Research
Fall. 3(3-0) RB: Participants are not required but are encouraged to have a basic background in biology, chemistry and mathematics. R: Approval of department. Not open to students with credit in PHM 857 or PHM 858.
Principles and activities involved in drug development, the regulatory process for obtaining marketing authorization, the fundamental aspects of project management including work breakdown structure, scheduling, earned value analysis, and risk management.

Fundamental Principles of Pharmacology and Toxicology
Fall. 3(3-0) R: Open to graduate students in the College of Natural Science or in the Department of Pharmacology and Toxicology or approval of department.
Core principles of pharmacology and toxicology including pharmacokinetics, toxicokinetics (drug-toxicant absorption, distribution, metabolism, elimination, modeling), pharmacodynamics (drug-receptor and drug-enzyme interactions), and drug discovery.

Cellular, Molecular and Integrated Systems Pharmacology
Spring. 3(3-0) P: (BMB 801 or BMB 802) and (PHM 827 or PSL 828 or PSL 829) R: Open to doctoral students or approval of department.
Cellular and molecular mechanisms of drug actions on organ systems of humans and other mammals.

Chemical Disposition in Mammals
Fall. 1(1-0) R: Open to doctoral students. Approval of department. Not open to students with credit in PHM 801 or PHM 819.
Principles of drug/toxicant absorption, distribution, metabolism, elimination, and kinetics in mammalian systems.

Molecular and Developmental Neurobiology
Fall. 3(3-0) Interdepartmental with Integrative Biology and Neuroscience and Pathobiology and Diagnostic Investigation and Psychology. Administered by Neuroscience. RB: Bachelor's degree in a Biological Science or Psychology. R: Open to graduate students in Neuroscience major.
Nervous system specific gene transcription and translation. Maturation, degeneration, plasticity, and repair in the nervous system.

Receptor Pharmacology
Fall. 1(1-0) R: Not open to doctoral students in the Department of Pharmacology and Toxicology. Approval of department.
Fundamental principles and current theories of receptor pharmacology, drug receptor pharmacodynamics and signal transduction mechanisms.

Cardiovascular Pharmacology and Toxicology
Summer. 3(3-0) R: Open to graduate students or approval of department.
Cardiovascular signal transduction and control in normal and pathophysiologic states.

Integrative Toxicology: Mechanisms, Pathology and Regulation
Fall of odd years. 3(3-0) Interdepartmental with Animal Science and Biochemistry and Molecular Biology and Pathobiology and Diagnostic Investigation. Administered by Pharmacology and Toxicology. P: PHM 819.

Neurotoxicology
Spring. 2(2-0) RB: PHM 819 and PHM 450 or equivalent introductory pharmacology and toxicology courses; undergraduate biochemistry and cell biology. R: Open to graduate students. Approval of department.
Biochemical, molecular, physiological mechanisms and assessment of neurotoxicity. Factors predisposing the nervous system to selective toxicants. Pathophysiology and models of toxicant-induced neurodegenerative diseases.

Principles of Drug-Tissue Interactions
Fall, Summer. 2(2-0) R: Open to graduate students and open to lifelong graduate students. Not open to students with credit in PHM 801.
General principles relevant to the interaction of chemicals with biological systems. Topics include pharmacokinetics and/or pharmacodynamics.

Academic and Research Integrity
Fall, Spring. 1(1-0) Guidelines for research and academic integrity focusing on issues pertinent to biomedical graduate students and scientists.

Physiology and Pharmacology of Excitable Cells
Fall. 4(4-0) Interdepartmental with Integrative Biology and Neuroscience and Pharmacology. Administered by Pharmacology and Toxicology. R: Open to graduate students in the College of Natural Science or in the Department of Pharmacology and Toxicology or approval of department.
Function of neurons and muscle at the cellular level: membrane biophysics and potentials, synaptic transmission, sensory nervous system function.

Concepts in Carcinogenesis
Fall. 2 credits. P: (BLD 830 or BMB 801 or approval of department) and (PHM 819 or BLD 830) R: Open to master's students or doctoral students or lifelong graduate students. Approval of department.
Mechanisms underlying malignant transformation of a cell. Carcinogenic potential of chemicals.

Neuropharmacology
Fall. 2(2-0) P: PHM 819 RB: Some background in pharmacology. R: Open to master's students or doctoral students or lifelong graduate students.
Mechanisms of action of drugs on the central nervous systems, targets, clinical use and side effects.

Experimental Design and Data Analysis
Fall, Summer. 3(3-0) RB: Undergraduate degree in biology, chemistry or related field. Practical application of statistical principles to the design of experiments and analysis of experimental data in pharmacology, toxicology, and related biomedical sciences.

Endocrine Pharmacology and Toxicology
Fall, Spring, Summer. 3(3-0) RB: Participants are not required but are encouraged to have a basic background in biology, chemistry and mathematics. R: Approval of department.
Pharmacology, pharmacology, and toxicology of the endocrine system. Endocrine diseases, pharmacological intervention, hormone therapy, endocrine disruptors, role of hormones in normal metabolism and metabolic disorders, and animal models of endocrine and metabolic disorders.

Applied Integrative Pharmacology Laboratory
Summer. 3(3-0) P: (PHM 813 or concurrently) and PHM 819 and PHM 830 RB: Undergraduate degree in biology, chemistry or related field. Prior biomedical lab experience helpful. R: Not open to undergraduate students. Approval of department.
Research methods using virtual simulation for studying integrative physiology and pharmacology.

Gastro-Intestinal and Liver Pharmacology and Toxicology
Spring. 2(2-0) P: (PHM 350 or PHM 819) or Some pharmacology background. Specific drugs and their mechanisms of action in the treatment of gastrointestinal and liver diseases. Toxic effects of drugs and other xenobiotics on the gastrointestinal tract, including the liver.
834 Respiratory Pharmacology
Spring. 2(2-0) RB: Some prior course work in physiology or pharmacology.
Integrative study of drugs, their mechanism of action, and their side effects in the treatment of major diseases and pathologies of the respiratory system.

835 Biopharmaceuticals: From Development to Manufacturing
Fall. 3(3-0) P: PHM 819 RB: Undergraduate degree in biology, chemistry, or related field is recommended. R: Not open to undergraduate students.
Biopharmaceutical development and manufacturing processes for recombinant proteins, monoclonal antibodies, vaccines and cell-based therapeutics (stem cells). Emphasis on real-world case studies and group projects.

837 Autonomic Pharmacology
Effects of drugs having therapeutic potential and potential for adverse side effects within the autonomic nervous system and organs controlled by this system. Comparison with drugs having therapeutic potential and potential adverse side effects on muscle function.

839 Systems Neuroscience
Spring. 4(4-0) Interdepartmental with Human Anatomy and Integrative Biology and Neuroscience and Psychology. Administered by Neuroscience. R: Open to graduate students or human medicine students or osteopathic medicine students in the College of Natural Science or in the College of Agriculture and Natural Resources or in the College of Human Medicine or in the College of Osteopathic Medicine or in the College of Social Science or in the College of Veterinary Medicine. SA: ANT 839.
Anatomy, pharmacology, and physiology of multicellular neural systems. Sensory, motor, autonomic, and chemo-regulatory systems in vertebrate brains.

840 Safety Pharmacology
Spring. 2(2-0) RB: Undergraduate degree in biology, chemistry or related area. Prior coursework in physiology useful.
Systems study of current experimental models, risk assessment, and regulatory guidelines for evaluating drug candidates for pharmacologic effects unrelated to therapeutic effects.

841 Cellular and Molecular Toxicology
Fall. 3(3-0) RB: PHM 819 and PHM 450 or equivalent introductory pharmacology and toxicology courses; undergraduate biochemistry and cell biology R: Open to graduate students or approval of department.
Mechanistic concepts and techniques of toxicology at the cellular and molecular levels. Various molecular events and cellular modifications that result from and/or are associated with chemically/environmentally induced toxicity and disease.

850 Communications for Scientists
Fall, Summer. 2(2-0) R: Open to master's students or lifelong graduate students in the College of Osteopathic Medicine or in the Department of Pharmacology and Toxicology or in the Integrative Pharmacology Major or in the Pharmacology and Toxicology Major. Effective research and business communication, including written skills for scientific audiences.

851 Intellectual Property and Patent Law for Biomedical Sciences
Fall. 2(2-0) RB: Strong reading and writing skills helpful.
Fundamentals of intellectual property and patent law encountered by biomedical scientists, including issues of prevention, patent prosecution, and enforcement of patents in a litigation setting.

854 Leadership and Team-Building for Biomedical Research
Spring. 2(2-0) RB: Experience supervising others and/or participation in workplace teams is strongly suggested.
Evaluation of current leadership methods. Models of leadership. Practice of specific skills and development of a plan to increase their influence and extend learning beyond the class.

855 The Business of Biomedical Research Organizations
Spring. 2(2-0) RB: Some prior course work in business as used in biomedical research and development environments.
Theories, methods, terminology, and culture of business.

857 Project Management
Summer. 2(2-0) R: Open to graduate students in Pharmacology and Toxicology and cell biology R: Open to graduate students in Pharmacology and Toxicology.
Formal project management culture, principles, knowledge areas, and terminology. Specific tools and techniques including work breakdown structure, earned value analysis, risk management, and quality control for managing scientific research. Offered first ten weeks of semester.

858 Drug Development Process
Spring. 3(3-0) RB: Some experience working with laboratory or clinical research projects.
Project management standards and best practices in drug development process, including clinical trials.

910 Seminar
Fall, Spring. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to graduate students. Approval of department.
Discussion of recent topics in pharmacology and toxicology by faculty or invited outside speakers. Students research reports.

980 Problems
Fall, Spring, Summer. 1 to 5 credits. A student may earn a maximum of 20 credits in all enrollments for this course. R: Open to doctoral students. Approval of department.
Limited work in selected research projects.

998 Master of Science Capstone Literature Review
Fall, Spring. 1 to 2 credits. A student may earn a maximum of 2 credits in all enrollments for this course. P: PHM 850 RB: Completion of at least 24 credits of MS program R: Open to master's students in the Integrative Pharmacology Major or in the Pharmacology and Toxicology Major. Approval of department.
Advisor-supervised literature research and writing of a 15-20 page fully-referenced critical review paper on a relevant topic in pharmacology and toxicology.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open to doctoral students in the Department of Pharmacology and Toxicology or in the Pharmacology and Toxicology-Environmental Toxicolgy major. Approval of department.
Doctoral dissertation research.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open to doctoral students in the Department of Pharmacology and Toxicology or in the Pharmacology and Toxicology-Environmental Toxicolgy major. Approval of department.
Doctoral dissertation research.