

The following is a listing of courses offered by the Graduate Program in Pharmaceutical Science. Prerequisites and brief descriptions are included for each course. For more information on a particular course, please consult the Graduate Course Catalog, the Program Director, or the course instructor(s).

## **Graduate Courses:**

### **Advanced Pharmaceutics**

**Prerequisites:** Physical chemistry and associated math requirements

**Course No:** 16:720:507

**Instructor:** Sinko

**Credits:** 3

**Description:** The application of physical-chemical principles to the study and evaluation of pharmaceutical systems: solubility phenomena, equilibria, complexation, phase transitions, and pharmaceutical stability, and the fundamentals of pharmacokinetics.

### **Advanced Pharmacokinetics & Dynamics**

**Prerequisites:** Ordinary differential equations (or equivalent)

**Course No:** 16:720:509

**Instructor:** Kong

**Credits:** 3

**Description:** This course will cover the kinetic aspects of the major subject areas in the pharmaceutical sciences such as chemical kinetics and drug stability, dissolution kinetics, mass transport, pharmacokinetics, and several smaller focused areas.

### **Molecular and Cellular Pharmaceutics**

**Course No:** 16:720:614

**Instructor:** Minko

**Credits:** 3

**Description:** The specific aim of this course is to familiarize the students with modern conception of cellular response to drugs in different dosage forms and drug delivery systems. The course will provide insight into the transport through biological barriers of different drug delivery forms, the main cellular signaling pathways triggered by various drugs and drug formulations, types of cell death induced by various types of modern drugs, cellular adaptation to the drug exposure, cellular mechanisms of multidrug resistance, interaction between drugs and DNA. It also will enable the student to have a basic understanding of the principles of pharmacogenomics and pharmacogenetics.

### **Membrane Transporters in Drug Disposition**

**Course No:** 16:720:609

**Instructor:** You

**Credits:** 3

**Description:** Transporters are membrane proteins that span cellular membranes and are the gatekeepers for all cells and organelles, controlling intake and efflux of crucial endogenous substrates such as sugars, amino acids, nucleotides, and inorganic ions. The specificity of many transporters however is not limited to their physiological substrates, and for some, their physiological substrates remain undiscovered. Xenobiotics (drugs, dietary and environmental compounds) have the potential to be recognized by transporters. These transporters crucially influence the absorption, distribution, and elimination of drugs in the body. This course will provide an overview of the relevant drug transporters, their roles in human physiology and diseases and will present the principles of drug transport and its associated techniques.

### **Dermaceutics**

**Prerequisite:**

**Course No:** 16:720:523

**Instructor:** Michniak

**Credits:** 3

**Description:** Design of topical drug delivery systems; theoretical and practical considerations in development of topical disperse systems; skin permeation of drugs and its optimization; dermatologic and cosmetic applications.

## **Design of Experiments**

**Course No:** 16:960:590

**Credits:** 3

Description: Fundamental principles of experimental design; completely randomized variance component designs; randomized blocks; Latin squares; incomplete blocks; partially hierarchic mixed-model experiments; factorial experiments; fractional factorials; and response surface exploration. **Prerequisite: 01:960:484 or 401 or equivalent.**

## **Ethical Scientific Conduct**

**Course No:** 16:115:556

**Credits:** 1

Description: Introduction to ethical issues of scientific investigation, including intellectual property, plagiarism, conflict of interest, human and animal subjects, and record keeping.

## **Independent Research Proposal**

Enrollment limited to Ph.D. candidates with approval of their adviser.

**Course No:** 16:720:540

**Credits:** 3

**Description:** Develop a written research proposal using the standard HHS/NIH format as part of the Ph.D. degree requirements. Proposal is evaluated as to its originality, scientific merit, and quality.

## **Seminar in Pharmaceutical Science**

**Course No:** 16:720:601,602

**Credits:** 1 per semester as required

**Description:** Presentation and discussion of recent developments in the pharmaceutical sciences.

## **Research in Pharmaceutical Science**

**Course No:** 16:720:701,702

**Credits:** By arrangement

**Description:** Research undertaken with the student's advisor as part of the thesis or dissertation.

## **Additional Graduate Courses**

### **Basic Statistics for Research**

**Course No:** 01:960:401

**Credits:** 3

**Description:**

### **Introduction to Biopharmaceutics and Pharmacokinetics**

**Course No:** 30:721:430

**Credits:** 4

**Description:** This course will introduce students to the basic concepts and principles in biopharmaceutics and pharmacokinetics. Biopharmaceutics describes the role of dosage form in the absorption and disposition of drugs in the body. Pharmacokinetics describes the processes involved in the Absorption of a drug (in part determined by biopharmaceutics) from its site of administration into the blood circulation, Distribution of the drug to its sites of action, Metabolism of the drug, and its subsequent Excretion of the drug from the body (ADME). Processes that influence the pharmacokinetics of drugs, including formulation, physico-chemical, physiological, pharmacological and pathological factors will be discussed. The use of mathematical equations to describe the pharmacokinetic concepts and principles of drug action are introduced and applied to dosage regimen determinations.

### **Independent Study in Pharmaceutical Science**

**Course No:** 16:720:610,611

**Credits:** 1-3

**Description:** Independent library and/or laboratory research into special aspects of pharmaceutical science; arranged under the supervision of a specific faculty member. No more than 3 credits may be taken as part of a student's program.

### **General Toxicology I, II**

**Course No:** 16:963:501,502

**Credits:** 2, 2

**Instructor:** Gallo, Richardson

**Description:** Basic principles of toxicology, organ toxicology, toxicology of specific chemical agents and radiation; overview of environmental and industrial toxicology and safety evaluation. **Prerequisites:** 16:115:503,504, 16:761:501,502, or equivalent.

## **Biochemical Toxicology**

**Course No:** 16:963:505

**Credits:** 4

**Instructor:** Iba, Thomas

**Description:** Metabolism and electrophilic reactions of subsequent toxic metabolites studied with emphasis on kinetics, mutagenesis, carcinogenesis, and organ toxicity. **Prerequisites:** 16:115:503,504, and permission of instructor.

## **Molecular Toxicology**

**Course No:** 16:963:633

**Credits:** 2

**Instructor:** Zhou

**Description:** Laboratory techniques used in toxicological research. Students will analyze research data and evaluate the techniques used.

## **Medicinal Chemistry: Research Techniques and Principles**

**Course No:** 16:663:501

**Credits:** 3

**Instructor:** Rice

**Description:** Basic course for students preparing to do research in medicinal chemistry. Information management, computer methods, basic laboratory techniques and principles of medicinal chemistry. **Prerequisites:** 01:160:305,306, or equivalent.

## **Principles of Drug Design**

**Course No:** 16:663:502

**Credits:** 3

**Instructor:** Hu, Kerrigan

**Description:** Identifying new drug leads, drug absorption and distribution, pharmacomodulation, enzymes and receptors as targets, peptidomimetics, computer-aided drug design, and combinatorial chemistry; **Prerequisites:** 16:160:305,306, or equivalent.

## **Strategies and Tactics in Synthetic Medicinal Chemistry**

**Course No:** 16:663:504

**Credits:** 3

**Instructor:** Rice

**Description:** Design of syntheses for complex organic medicinal agents. Preparation of series of analogs for structure-activity investigations. **Prerequisite:** 16:160:503 or equivalent.

## **Drugs: Structure and Function**

**Course No:** 16:663:505

**Credits:** 3

**Instructor:** LaVoie

**Description:** A survey of the major pharmaceutical agents in clinical use. Emphasis on the influence of chemical structure in the elicitation of pharmacological effects. **Prerequisites:** 01:160:305,306, or equivalent.

## **Introduction to Molecular Modeling**

**Course No:** 16:160:510

**Credits:** 3

**Instructor:**

**Description:** Introduction to the use of computer-assisted molecular modeling techniques for the study of chemical problems; lectures on theoretical principles; instruction in use of modern modeling programs; computer projects involving solution of chemical problems. **Prerequisites:** 01:160:307,308, 323,324; or equivalent.

## **Molecular Biology and Biochemistry**

**Course No:** 16:115:511,512

**Credits:** 3,3

**Instructor:**

**Description:** First term: structure and function of proteins, nucleic acid structure, catalysis of biochemical reactions, glycolysis, oxidative phosphorylation. Recombinant DNA approaches, DNA replication, mutability, recombination, repair, and transposition. Second term: transcription, posttranscriptional processing, translation, gene regulation, photosynthesis, properties of membranes, signal transduction, intermediary metabolism. **Prerequisite: One year organic chemistry. These courses recommended for students outside the program in biochemistry.**

## **Pharmaceutical Process Design II (Unit Operations)**

**Course No:** 16:155:546

**Credits:** 3

**Instructor:**

**Description:** An introduction to the essential operations used in the manufacture of pharmaceutical products. The pharmaceutical product life cycle, variability, testing, and specifications of pharmaceutical ingredients. Unit operations including blending, granulation, fluidized bed operations, milling, capsule filling, compaction, tablet coating, and other processes will be addressed. How the output of one process is the input to the next process, and how deviations can cascade along the production sequence until they cause process failures. Design, scale-up, troubleshooting, and optimization. Prerequisite: Permission of instructor.

## **Pharmaceutical Organic Nanotechnology**

**Course No:** 16:155:544

**Credits:** 3

**Instructor:**

**Description:** An introduction to organic nanotechnology and its application to manufacturing drug products. Industrial pharmaceutical examples, including nanoparticle and nanocomposite synthesis. Prerequisite: Permission of instructor.

## **Advanced Engineering Pharmaceutical Kinetics, Thermodynamics, and Transport Processes**

**Course No:** 16:155:549

**Credits:** 3

**Instructor:**

**Description:** Thermodynamics of pharmaceutical systems, phase diagram, phase equilibrium, and chemical equilibrium; diffusive and convective transport in pharmaceutical processes; chemical and pharmacokinetics and reaction engineering of pharmaceutical systems. Prerequisite: Undergraduate degree in chemical engineering or permission of instructor.

## **Regression Analysis**

**Course No:** 16:960:563

**Credits:** 3

**Instructor:**

**Description:** Review of basic statistical theory and matrix algebra; general regression models; computer application to regression techniques; residual analysis; selection of regression models; response surface methodology; experimental design models; and analysis of covariance. Emphasis on applications. Prerequisite: Level IV statistics.

## **Introduction to Colloid and Interface Science**

**Course No:** 16:400:612

**Credits:** 3

**Instructor:**

**Description:** Analysis and design of various colloidal systems in the context of fundamental physico-chemical interactions between surfaces/phases. Colloidal structures and their stability. Practical use of natural and engineered colloids for food; agricultural and pharmaceutical applications. Prerequisite: Calculus I.

## **Nanotechnology and Its Applications in Biotechnology and Food**

**Course No:** 16:400:613

**Credits:** 3

**Instructor:**

**Description:** Basic concepts, investigation tools, and fundamental issues of nanotechnology, with emphasis on the applications of nanotechnology in agricultural and food systems, health care, food safety, and food packaging. Self-assembly, scanning probe microscopy, micro- and nanoencapsulation, organic/inorganic nanocomposites, DNA, and protein chips. Prerequisites: Physical chemistry or permission of instructor.

## **Cellular and Molecular Pharmacology: Principles of Drug Action and Targeting**

**Course No:** 16:718:680

**Credits:** 3

**Instructor:**

**Description:** Molecular basis of pharmacologic selectivity, drug targets, adaptive responses to drugs, disposition of drugs, and genetic and molecular approaches to drug therapy. Prerequisites: Permission of graduate director and instructor.