

# Pharmaceutical Sciences

## College of Pharmacy

The Graduate Program in Pharmaceutical Sciences is a multidisciplinary program designed to prepare motivated individuals for academic, industrial, or government careers in pharmaceutical and biomedical research. It is a graduate training program that encompasses research in areas of pharmaceutical sciences that range from identifying fundamental mechanisms of human disease, to the design, development and formulation of new medicines, to understanding the impact of drug policies on health care systems. Within this broad scientific framework, students develop individually tailored programs of study to meet their particular research interests and career objectives.

Intense, laboratory-based and data and analysis driven research, using state-of-the-art techniques and instruments, forms the basis of a student's PhD dissertation or Master's thesis. Each student develops the skills and judgment to make a unique, scholarly contribution to our understanding of drugs and how these compounds impact human health and disease. These breakthroughs are published in top pharmaceutical journals and presented at national and international meetings. Students receive the training that will enable them to become independent scientists who can conduct front-line research in pharmaceutical sciences in industrial, academic or governmental settings.

The overall goal of the graduate program is to provide the graduate student with a comprehensive, structured, yet flexible educational experience comprised of both coursework and independent, highly creative, research. This goal is supported by additional components, such as research rotations for first-year students and a program-wide seminar series. The intent is to provide both depth and breadth of expertise in the Pharmaceutical Sciences along with developing the creative and critical approach to research that characterizes a PhD-level or Master's level scientist.

All students in the program will carry out hypothesis-driven laboratory investigations as the basis of a written dissertation or thesis for PharmD/MS students. The quality of the dissertation will be judged by the student's advisory committee, in accord with the requirements and regulations set forth by the Graduate School. It is expected that the dissertation or thesis work will be recognized as high quality by also being published in national and international scientific journals and presented in forums at national and international scientific meetings.

### **Admission Requirements**

Admission to the graduate program is competitive and is based upon academic background, professional recommendations, performance on the Graduate Record Examination (GRE), experience and interviews. Students should have completed an undergraduate degree in biology, biochemistry, biomedical engineering, chemical engineering, chemistry, neurosciences, or pharmacy with a mastery of mathematics through calculus.

### **Training Options**

Doctoral degrees in Pharmaceutical Sciences at the College of Pharmacy are obtained through one of five Tracks. The Traditional Pharmaceutical Science Tracks provide training that is based on advanced coursework in contemporary basic pharmaceutical sciences plus independent laboratory or computational research under the direction of a faculty mentor. In the Traditional Pharmaceutical Science Tracks the many research opportunities available are organized into three broad disciplinary areas: Medicinal, Bioorganic and Computational Chemistry, Pharmaceutical Chemistry and Engineering, and Pharmacology

and Experimental Therapeutics. The Clinical and Experimental Therapeutics Track requires a prior degree in an area of professional health care, and focuses on training in translational research at the interface between basic and clinical studies. The Pharmaceutical Outcomes and Policy Track trains scientists to conduct research on the safe, efficient, and effective use of pharmaceuticals to improve the health of individuals and populations.

### **Traditional Pharmaceutical Science Tracks**

The goal of the Pharmaceutical Science Tracks is to develop scientists who possess a blend of contemporary basic science skills and an understanding of their role in the development of new drugs. Training begins with advanced coursework that is tailored to give each student a solid foundation across the breadth of pharmaceutical sciences, yet is individualized based on the student's academic background, and the research project that will be the basis for their dissertation. The many research opportunities available are organized into three broad disciplinary areas, built around the three Divisions within the Department of Pharmaceutical Sciences—the Medicinal, Bioorganic, & Computational Chemistry Division, The Pharmaceutical Chemistry and Engineering Division, and the Pharmacology & Experimental Therapeutics Division.

### **Medicinal, Bioorganic and Computational Chemistry Track**

The Division of Medicinal, Bioorganic and Computational Chemistry is focused on small molecules as well as new protein and nucleic acid based therapies, and natural product drug discovery platforms and seeks to expand its expertise with interests in synthetic/biosynthetic approaches for drug discovery, development of novel computational tools for drug design, and evolution of biologics for specific therapies or drug delivery.

### **Pharmaceutical Chemistry and Engineering Track**

The Division of Pharmaceutical Chemistry and Engineering focuses on drug formulation, development and delivery. Areas of emphasis include the application of physical, physical organic, and analytical chemistry to solve pharmaceutical problems; the design, development, and optimization of dosage forms for small and large molecules; and fundamental research into materials science and nanotechnology to advance drug delivery systems design. Collaborations with faculty in the UK College of Engineering provide additional opportunities for a combined pharmaceutical and engineering research program. In addition, faculty participate in preclinical and/or clinical projects through collaborative relationships within the College of Pharmacy and with investigators across the UK Medical Center Complex.

### **Pharmacology and Experimental Therapeutics Track**

The Division of Pharmacology and Experimental Therapeutics draws upon campus-wide strengths in neurobiology, cardiovascular disease, oncology and infectious diseases. Strong collaborations exist with the Sanders-Brown Center on Aging, addiction/abuse consortia, and the Markey Cancer Center, which recently received NCI Cancer Center designation. Division faculty are skilled in pharmacokinetic and pharmacodynamics, systems biology, neurochemistry and neurophysiology. Translational research programs bridging preclinical and/or clinical projects through collaborative relationships within the College of Pharmacy and with investigators across the UK Medical Center Complex also exist.

### **Clinical and Experimental Therapeutics Track (CET)**

The completion of a Pharm.D., D.D.S., D.V.M. or other professional health degree is required for admission into this training Track. The focus of the CET Track is translational research, and involves training in how to conduct studies that occur at the interface of basic and clinical research. Since all students admitted to the program will already have a clinical/health profession degree, the emphasis of the program will be training in the basic sciences. This breadth and balance of skills will improve the graduate's ability to successfully compete for extramural funding and job opportunities. There are required clinical components to assure competency in the foundations, principle and processes of clinical research.

The keystone of the training is the conduct of an integrated, combined laboratory-based and clinical dissertation.

### **Pharmaceutical Outcomes and Policy Track (POP)**

The goal of the Pharmaceutical Outcomes and Policy Track is to train scientists to conduct research on the safe, efficient, and effective use of pharmaceuticals to improve the health of individuals and populations. The emphasis of the program will be on building a core set of analytical skills and tools to evaluate the impact of clinical interventions and clinical outcomes. Students complete core classes in five areas: pharmacoepidemiology, pharmacoconomics, statistics, biomedical informatics, and pharmaceutical policy. This breadth and balance of skills will improve the graduate's ability to successfully compete for extramural funding and contribute to the scholarly literature on pharmaceutical outcomes. Most students within the Pharmaceutical Outcomes & Policy Track have a prior professional health related degree (Pharm.D., B.S. Pharm.) Exceptional students without a pharmacy related degree may be admitted with the consent of the admissions committee. Students without appropriate prerequisite training may be required to complete additional course work.

### **Doctoral Program Core Coursework**

Each Track has a distinct set of courses. These courses may be offered in the Graduate Program of Pharmaceutical Sciences, or available outside of the Program. The mentor and the Dissertation Advisory Committee are empowered to select those courses that fit best into the educational and career goals of the student and the scientific goals of the dissertation. The Track Coordinator (for first-year students) or mentor and the Dissertation Advisory Committee are empowered to petition the DGS, in writing, to waive courses of the Graduate Program Core if the student has demonstrated sufficient academic mastery of material in courses taken in other programs. The DGS will monitor the coursework of students and keep the Advisory Committee members apprised as to the student's grades and completion of courses. Coursework and grades are reviewed by the Advisory committee at each yearly meeting.

The student's Dissertation Advisory Committee is responsible for coursework recommendations that are in addition to the common coursework of the program and courses recommended by the Track faculty. Full descriptions of available graduate courses are described in the Bulletin of the University of Kentucky Graduate School (<http://www.uky.edu/Registrar/Bulletin.htm>).

### **Medicinal, Bioorganic, and Computational Chemistry Track**

#### *Core Courses*

Students should complete these courses over 4-6 semesters

IBS/CHE 601/550	Biomolecules and Metabolism or Biological Chemistry I	(3)
IBS/CHE 602/552	Molecular Biology and Genetics Biological Chemistry II	(3)
PHS 760 00x	Introduction to Pharmaceutical Sciences	(1)
PHS 760 00x	Drug Discovery, Development, Commercialization, Outcomes	(3)
PHS 711	Fundamentals of Bioethics	(2)
PHS 778	Seminar (attendance required each semester until defense; officially register only until passing the qualifying exam)	(1)

Additional courses to be taken by an individual student depend on:

1. The lab and dissertation project the student selects
2. The academic preparation of the student (areas that need strengthening)

#### *Elective courses*

PHS 510	Modern Methods in Pharmaceutical Analysis	(5)
PHS 662	Bioorganic Mechanisms	(3)

PHS 660	Biosynthesis of Natural Products	(3)
BCH 401G	Fundamentals of Biochemistry	(3)
CHE 440G	Introductory Physical Chemistry	(4)
CHE 538	Principals of Physical Chemistry	(3)
IBS 606	Physiological Communication	(3)
MA 213	Calculus III	(4)
PGY 502	Principles of Systems, Cellular and Molecular Physiology	(5)
STA 570	Basic Statistical Analysis4	(4)

### Pharmaceutical Chemistry and Engineering Track

#### Core Courses

Students should complete these courses over 4-6 semesters

CHE 548	Principles of Physical Chemistry II	(3)
PHS 612	Quantitative PD/PK (Modules I and II listed under PHS 760)	(2)
PHS 630	Pharmaceutical Rate Process	(3)
PHS 631	Equilibrium Phenomena in Pharmaceutical Systems	(3)
PHS 760	Drug Discovery, Development, Commercialization and Outcomes	(3)
PHS 711	Fundamentals of Bioethics	(2)
PHS 778	Seminar (attendance required each semester until defense; officially register only until passing the qualifying exam)	(1)

Additional courses to be taken by an individual student depend on:

1. The lab and dissertation project the student selects
2. The academic preparation of the student (areas that need strengthening)

#### Highly Recommended Courses

Students must select 5 courses from this list

CHE 538	Principles of Organic Chemistry	(3)
CME 505	Analysis of Chemical Engineering Problems	(3)
CME 630	Transport I	(3)
IBS 601	Biomolecules and Metabolism (or CHE 550)	(3)
PGY 206 or 502	Elementary Physiology (no graduate credit) or Principles of Systems, Cellular and Molecular Physiology	(3-5)
PHS 76x	Drug Delivery Systems	(3)
PHS 76x	Solid State Stability and Formulation	(3)
PHS 76x	Techniques in Pharmaceutical Analysis	(3)

#### Elective Courses

These courses may require additional prerequisites

CHE 532	Spectroscopic Identification of Organic Molecules	(2)
CHE/IBS 552/602	Biological Chemistry II or Molecular Biology and Genetics	(3)
CHE/ABT 553/495	Chemistry and Molecular Biotechnology or Experimental Methods in Biotechnology	(3-4)
MED 616	Biology and Therapy of Cancer	(3)
STA 673	Distribution-Free Statistical Inference and Analysis of Categorical Data	(2)
STA 677	Applied Multivariate Methods	(3)
STA 679	Design and Analysis of Experiments II	(3)

## Pharmacology and Experimental Therapeutics

### Core Courses

Students should complete these courses over 4-6 semesters

IBS/CHE 601/550	Biomolecules and Metabolism or Biological Chemistry I	(3)
IBS/CHE 602/603/552	Molecular Biology and Genetics/Cell Biology and Cell Signaling/ Biological Chemistry II	(3)
STA/IBS 570/580/611	Basic Statistical Analysis	(4)
	Biostatistics	(3)
	Practical Statistics	(1-4)
PHS 760 00x	Introduction to Pharmaceutical Sciences	(1)
PHS 760 00x	Drug Discovery, Development, Commercialization, Out-comes	(3)
PHS 711	Fundamentals of Bioethics	(2)
PHS 778	Seminar (attendance required each semester until de-fense; officially register only until passing the qualifying exam)	(1)

## Clinical and Experimental Therapeutics

### Core Courses

Students should complete these courses over 4-6 semesters

IBS 601	Biomolecules and Metabolism	(3)
IBS 602	Molecular Biology and Genetics	(3)
PHS 612	Quantitative Pharmacodynamics: Pharmacokinetics	(3)
PHS 711	Fundamentals of Bioethics	(2)
PHS 750	Journal Club (choice of journal club topic)	(1)
PHS 760 00x	Introduction to Pharmaceutical Sciences	(1)
PHS 760 00x	Drug Discovery, Development, Commercialization, Out-comes	(3)
PHS 760 00x	CET track lab rotations	Varies
PHS 778	Seminar (attendance required each semester until de-fense; officially register only until passing the qualifying exam)	(1)
PPS 764	Drug Development Regulation & Clinical Research	(3)

All students must become IRB and HIPPA certified

### Strongly Recommended Courses

STA 671	Statistics: Regression and Correlation	(2)
STA 672	Statistics: Design and Analysis of Experiments	(2)

### Possible Electives

PHS 760 00x	Techniques in Pharmaceutical Analysis	(3)
BIO 520	Bioinformatics	(3)
BIO 615	Molecular Biology	(3)
IBS 603	Cell Biology and Signaling	(3)
PGY 502	Principles of Systems, Cellular and Molecular Physiology	(5)
PGY 617	Physiological Genomics	(2)
PHA 621	Principles of Drug Action	(3)

## Pharmaceutical Outcomes and Policy

The Doctor of Philosophy track focusing on Pharmaceutical Outcomes & Policy requires a minimum of 50 credit hours: including a 29 credit hour core curriculum, 12 hours in a specialization area de-signed by the Advisory Committee, and 9 hours of dissertation work. Students without appropriate pre-requisite training may be required to complete additional course work. Generally, students without a Master level degree will

be required to complete appropriate level courses designed to meet pre-requisite requirements to begin doctoral coursework. The student Advisory Committee may also require additional coursework to satisfy appropriate depth and breadth of training.

PPS 700	Introduction to Pharmaceutical Outcomes and Policy	(3)
PPS 701	Pharmacoepidemiology	(3)
PPS 704	Pharmacy Informatics	(3)
PPS 706	Intermediate Pharmacoeconomics and Decision Analysis	(3)
PPS 710	Techniques in Secondary Data Research	(3)
PPS 750	Pharmaceutical Outcomes and Policy Journal Club (attendance is required each semester until defense)	(1)
PPS 760	Special Topics in Pharmacy Practice & Science: Behavioral Economics in Pharmaceutical Outcomes & Policy (will be created as new course PPS 703)	(3)
PPS 778	Seminars in Pharmacy Practice & Science (attendance is required each semester until defense)	(1)
PHS 760	Topics in Pharmaceutical Sciences: Introduction to Pharmaceutical Sciences	(1)
PHS 760	Topics in Pharmaceutical Sciences: Drug Discovery, Development & Translation	(3)
PHS 711	Fundamentals of Bioethics	(2)
ECO 603*	Research Methods and Procedures in Economics OR (Alt. Statistics)	(3)
ECO 703*	Introduction to Econometrics I OR (Alt. Statistics)	(3)

All students must complete IRB and HIPAA training

\* Prerequisites are required, including 6 hours of statistics or biostatistics, and introductory epidemiology and health economics.

In addition to the core courses, the student's Advisory Committee may recommend additional elective courses. A student's completion of these course requirements must be assured by the student's Mentor(s), Advisory Committee and PPS Track Coordinator. In addition, some students may need to complete prerequisite courses before beginning core class course work. Note at least 75% of the courses must be 600 level or higher and prerequisites for core courses cannot count as specialty electives.

#### *Partial List of Elective Courses*

These courses may require additional prerequisites.

PPS 605	Pharmacoeconomics and Decision Analysis	(2)
PPS 620	Substance Use Disorders: Health Implication, Policies, & Prevention Strategies	(3)
PPS 702	Pharmaceutical Health Policy	(2-3)
PPS 764	Drug Development Regulation and Clinical Research	(3)
BMI 633	Introduction to Bioinformatics	(3)
BMI 730	Principles of Clinical Informatics	(3)
BMI 732	Biomedical Ontologies and Semantic Web Techniques	(3)
BMI 734	Introduction to Biomedical Image Analysis	(3)
BMI 738	Big Data for Healthcare	(3)
BST 682	Generalized Linear Models	(3)
BST 761	Time to Event Analysis	(3)
BST 762	Longitudinal Data Analysis	(3)
CPH 664	Design and Analysis of Clinical Trials	(3)
CPH 711	Chronic Disease Epidemiology	(3)
CPH 712	Advanced Epidemiology	(3)

CS 405G	Introduction to Database Systems	(3)
CS 460G	Machine Learning	(3)
CS 515	Algorithm Design	(3)
ECO 751	Public Economics	(3)
PA 751	Public Policy Formulation & Implementation	(3)
PA 752	The Economics of Policy Analysis	(3)
PPA 784	Next Generation Sequencing and Bioinformatics	
STA 671	Regression and Correlation	(2)
STA 672	Design and Analysis of Experiments	(2)
STA 673	Distribution-Free Statistical Inference and Analysis of Categorical Data	(2)
STA 677	Applied Multivariate Methods	(3)

### Course Descriptions

#### PHS 510 MODERN METHODS IN PHARMACEUTICAL ANALYSIS. (5)

A course which deals with the application of modern analytical methods, primarily instrumental methods, in the determination of the strength, purity, and quality of drugs and pharmaceuticals. Laboratory exercises include analysis of raw materials and finished dosage forms. Lecture, three hours; laboratory, four hours. Prereq: CHE 226.

#### PHS 530 RADIOPHARMACEUTICS. (3)

Basics of radioactive decay and detection. Labelling of molecules and cells with radionuclides. Imaging systems and clinical aspects of radiopharmaceuticals. Radioanalytical applications in pharmaceutical sciences, including positron tomography and gamma scintigraphy. Development of new radiopharmaceuticals and absorbed dose calculations. The principles of radiation safety and radiobiology. Prereq: Consent of instructor.

#### PHS 545 STERILE PARENTERALS AND DEVICES. (2-3)

The course will describe the fundamental concepts, principles and techniques involved in the characterization, development, evaluation and preparation of sterile products. Lecture, two credits; lecture with laboratory, three credits. Prereq: Consent of instructor.

#### PHS 556 PRINCIPLES OF DRUG DESIGN. (3)

Introduction to medicinal chemistry will be explored through rational biochemical and physical organic chemical approaches to drug design, action and development. Structural features, physical properties, mechanism of action and metabolism of drug like molecules, forces that govern interaction of drug-like molecules with their targets, enzyme mechanisms and inhibition and xenobiotic metabolism will be illustrated with specific examples showing how drugs function at the molecular level. Prereq: CHE 230, CHE 232, BIO 148, BIO 152. (Same as BCH 556.)

#### PHS 612 QUANTITATIVE PHARMACODYNAMICS: PHARMACOKINETICS. (3)

Quantitative treatment of dynamics of drug absorption, distribution, metabolism and excretion, including development of both mathematical models and model-independent approaches for describing these processes. Prereq: MA 114 and consent of instructor. (Same as PHA 612.)

#### PHS 630 PHARMACEUTICAL RATE PROCESSES. (3)

Kinetics of reactions of pharmaceutical interest; mechanisms of drug decomposition and theoretical approaches to stabilization and preservation; accelerated stability analysis. Prereq: MA 213, CHE 538, CHE 548 and PHR 631.

**PHS 631 EQUILIBRIUM PHENOMENA IN PHARMACEUTICAL SYSTEMS. (3)**

An advanced study in special topics of a physical chemical nature which are applicable to pharmacy, with special emphasis on physical properties and molecular structure, solubility, complexation and equilibria in solution. Prereq: Physical chemistry.

**PHS 632 THE PRACTICE OF DRUG METABOLISM. (3)**

The purpose of this course is to teach students about practical aspects of drug metabolism research. This includes addressing the function and purpose of drug metabolism studies, how those studies are carried out, why and how they are done, how metabolites are characterized, and some discussion of the limits and utility of the various approaches used in drug metabolism research.

**PHS 649 ADVANCED MOLECULAR PHARMACOLOGY. (2)**

This course will provide in-depth coverage of the molecular pharmacology of growth factors, transcription factors, receptors, and ion channels. Emphasis will be placed on both the normal functions of these cell-signaling molecules and perturbations that result in several prevalent human diseases, including cancer, Alzheimer's, diabetes, osteoporosis, and inherited human illnesses. Students will be introduced to experimental approaches to diagnosing and treating these illnesses in the light of our evolving knowledge of molecular pharmacology. Prereq: IBS 601-606 or consent of instructor. (Same as PHA/TOX 649.)

**PHS 660 BIOSYNTHESIS OF NATURAL PRODUCTS. (3)**

An overview of the biochemical pathways leading to compounds called natural products/secondary metabolites. Prereq: Two semesters of organic chemistry. (Same as BCH 620/PLS 642.)

**PHS 662 BIOORGANIC MECHANISMS. (3)**

An in-depth discussion on the bioorganic chemistry aspects of the active sites of enzymes and drug receptors, the molecular basis of drug design, and principles of drug metabolism. Within these topics, the mode of action of some of the major coenzymes and drugs will be discussed from a mechanistic chemistry point of view. Prereq: CHE 538, CHE 633, BCH 501 or consent of instructor.

**PHS 663 MOLECULAR NEUROBIOLOGY OF ABUSED DRUGS. (3)**

This course is designed to review major topics, concepts and issues pertinent to the molecular neurobiology of drug abuse and dependence. The proposed course of study will provide a strong background in neuroscience and students will be informed about current trends in our understanding of the molecular neurobiology of drug abuse research. Prereq: IBS 601 or consent of instructor.

**PHS 711 RESPONSIBLE CONDUCT OF RESEARCH. (2)**

Research scientists require an understanding of the fundamental principles guiding the ethical and responsible conduct and reporting of their research. Through case studies and reviews of the current literature, students will gain a greater understanding of the ethical and regulatory considerations in research design, conduct, and publication as well as the regulatory landscape governing fiscal compliance, scientific misconduct, research involving vulnerable populations, tissue banking, genetics/genomics, intellectual property, privacy, and data security. The importance of inclusion and diversity of individuals from underrepresented groups, those with disabilities, and individuals from economically disadvantaged backgrounds as investigators is also discussed. Students engage in didactic lectures, small-group breakout discussion sessions, and out of class learning activities to facilitate in-depth training and greater understanding of the relevant issues. Prereq: Consent of instructor.

**PHS 748 MASTER'S THESIS RESEARCH. (0)**

Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.



**PHS 749 DISSERTATION RESEARCH. (0)**

Half-time to full-time work on dissertation. May be repeated to a maximum of six semesters. Prereq: Registration for two full-time semesters of 769 residence credit following the successful completion of the qualifying exams.

**PHS 750 PHARMACEUTICAL SCIENCES JOURNAL CLUBS. (1)**

Discussion and presentations of foundation or current literature and emerging topics in pharmaceutical sciences. Topics vary by section. May be repeated to a maximum of 5 credit hours. Prereq: Consent of instructor.

**PHS 760 TOPICS IN PHARMACEUTICAL SCIENCES. (1-4)**

Pharmaceutical sciences which are not being covered in other courses. May be repeated to a maximum of 24 hours. Prereq: Consent of instructor.

**PHS 767 DISSERTATION RESIDENCY CREDIT.(2)**

Residency credit for dissertation research after the qualifying examination. Students may register for this course in the semester of the qualifying examination. A minimum of two semesters are required as well as continuous enrollment (Fall and Spring) until the dissertation is completed and defended. Reports and discussion of pertinent research and literature in a disciplinary area of the pharmaceutical sciences. May be repeated to a maximum of eight credits. Prereq: Graduate standing.

**PHS 780 SPECIAL PROBLEMS IN PHARMACEUTICAL SCIENCES. (1-6)**

Selected problems of laboratory or literature nature in which a student pursues a topic of interest to him under the supervision of a faculty member particularly qualified in that area. May be repeated once. Prereq: Consent of instructor.

**PHS 790 RESEARCH IN PHARMACEUTICAL SCIENCES. (1-12)**

Research work to be conducted in selected areas of pharmaceutical sciences. May be repeated indefinitely. Prereq: Approval of student's special committee and consent of instructor.

**PHS 911 PHYSIOLOGICAL BASIS FOR THERAPEUTICS I. (4)**

Integrated concepts of human organ system functions with particular emphasis on the physiology of the central and autonomic nervous system, the cellular and molecular mechanisms of neurotransmission and transduction and the response of target tissues. The course includes an introduction to the pathophysiology of each system and the pharmacodynamics of therapeutic agents as a framework for discussion. Variable mixtures of lecture, group discussion and independent study. Prereq: Admission to the first year, College of Pharmacy.

**PHS 912 PHYSIOLOGICAL CHEMISTRY AND MOLECULAR BIOLOGY I. (3)**

The first of a two course sequence covering integrated concepts of human biochemistry from a physiological viewpoint, functional group chemistry essential to biology, key structural and functional relationships of the biomolecules in living systems, energy metabolism emphasizing inter organ relationships and an in depth discussion of information storage and transfer. The course includes an introduction to common metabolic diseases and the therapeutic agents used in those diseases as a framework for discussion. Variable mixture of lecture, group discussion and independent study. Prereq: Admission to the first year, College of Pharmacy

**PHS 914 BASIC PRINCIPLES OF PHARMACEUTICAL SCIENCE: PHARMACEUTICS AND BIOPHARMACEUTICS I. (3)**

The first of a two course sequence in basic principles of Pharmaceutical Science concentrating on

absorption, distribution, metabolism, excretion and bioavailability of drugs; and an introduction to dosage forms, oral drug delivery systems, drug solutions and drug solids, bioequivalence determinations and ratings, and official compendia. Variable mixtures of lectures, discussions and independent study. Prereq: Admission to the first year, College of Pharmacy.

#### PHS 921 PHYSIOLOGICAL BASIS FOR THERAPEUTICS II. (4)

A continuation of PHS 911 covering integrated concepts of human organ system functions with particular emphasis on the physiology of the cardiovascular, renal, pulmonary and endocrine systems. The course includes an introduction to the pathophysiology of each system and the pharmacodynamics of prototype therapeutic agents as a framework for discussion. Variable mixture of lecture, group discussions and independent study. Prereq: PHS 911 and admission to the first year, College of Pharmacy.

#### PHS 922 PHYSIOLOGICAL CHEMISTRY AND MOLECULAR BIOLOGY II. (3)

A continuation of PHS 912. Variable mixture of lectures, group discussion and independent study. Prereq: Admission to the first year, College of Pharmacy and PHS 912.

#### PHS 924 BASIC PRINCIPLES OF PHARMACEUTICAL SCIENCE: PHARMACEUTICS AND BIOPHARMACEUTICS II. (3)

The second of a two course sequence in the basic principles of Pharmaceutical Science concentrating on modified release oral dosage forms; modified release parenteral dosage forms; nasal, buccal, rectal, vaginal and ophthalmic delivery systems; aerosols and pulmonary delivery systems, and the drug development process. Variable mixture of lecture, group discussion and independent study. Prereq: Admission to the first year, College of Pharmacy.

#### PHS 931 PHARMACOLOGICAL BASIS FOR THERAPEUTICS: NERVOUS SYSTEM.(5)

A study of human disease processes and rational pharmacotherapeutics relating to the autonomic, central and peripheral nervous system including a discussion of the factors influencing the development of substance dependence and the strategies for risk reduction. Emphasis is placed on the principles of pathophysiology, pharmacology, toxicology and therapeutics, the incorporation of these principles in the clinical application of modern drug therapy, and how these principles can be utilized in pharmacy practice. Variable mixture of lecture, group discussion and independent study. Prereq: Admission to the second year, College of Pharmacy.

#### PHS 932 PHARMACOLOGICAL BASIS FOR THERAPEUTICS: IMMUNOLOGY AND BIOTECHNOLOGY. (3)

A study of the immune system, immunopathologies and select autoimmune diseases and their treatment. Includes a discussion of immunizations, immunology of cancer, neoplasias and an introduction to antineoplastic therapy. The course concludes with a discussion of biotechnology and its application to the production and use of pharmaceuticals, diagnostic agents and advanced therapies. Variable mixture of lecture, group discussion and independent study. Prereq: Admission to the second year, College of Pharmacy.

#### PHS 933 PHARMACOLOGICAL BASIS FOR THERAPEUTICS: ENDOCRINE SYSTEMS. (3)

A study of the pathophysiology of the major disorders affecting the endocrine system concentrating on the pharmacology of the therapeutic agents used to treat those disorders, including discussions of the rational use of endocrine agents and their congeners in the treatment of non-endocrine diseases. Variable mixture of lecture, group discussion and independent study. Prereq: Admission to the second year, College of Pharmacy.

**PHS 944 BASIC PRINCIPLES OF MEDICINAL CHEMISTRY. (3)**

The rational design of molecules to produce safe and effective therapeutic responses in humans; molecular changes in drug molecules that affect affinity and activity at drug receptors and influence the absorption, distribution, metabolism, excretion and stability of drugs; and the properties of drug molecules which are important in their formulation into drug products. Variable mixture of lecture, group discussion and independent study. Prereq: Admission to the second year, College of Pharmacy.

**PHS 947 APPLIED BIOPHARMACEUTICS AND PHARMACOKINETICS. (4)**

The theoretical and practical considerations of the processes of drug absorption (including dosage formulation), distribution, metabolism and excretion and the mathematical models that describe these events including the calculation of dosage regimens for patients with problems ranging from simple to complex. A variable mixture of computer-assisted learning, formal lecture, interactive lecture and problem-based learning laboratory experiences. Prereq: Admission to the second year, College of Pharmacy.

**PHS 951 PHARMACOLOGICAL BASIS FOR THERAPEUTICS: CARDIOPULMONARY AND RENAL SYSTEMS. (5)**

A study of the pathophysiology of the major disorders affecting the cardiovascular, renal and respiratory system concentrating on the pharmacology of the therapeutic agents used to treat those disorders. Variable mixture of lecture, group discussion and independent study. Prereq: Admission to the third year, College of Pharmacy.