

Pharmaceutical Sciences/Pharmacodynamics, M.S.

SCHOOL OF PHARMACY

About the Program

The School of Pharmacy offers a graduate program leading to the M.S. and to the Ph.D. in Pharmaceutical Sciences with a concentration in Pharmacodynamics. The program is designed to prepare students for positions in the pharmaceutical industry, government agencies, and faculty positions in departments engaged in biomedical research.

Time Limit for Degree Completion: 5 years

Campus Location: Health Sciences Center, Main

Some courses may be offered at the Fort Washington campus. Research must be carried out at the Health Sciences Center campus under the supervision of an advisor who is a member of the Graduate Faculty.

Full-Time/Part-Time Status: Full-time status is recommended due to the nature of ongoing research.

Interdisciplinary Study: The program encourages interdisciplinary coursework, research, and collaborations among faculty and students with interests in biochemistry, molecular modeling, organic chemistry, and pharmacology.

Areas of Specialization: The Pharmacodynamics concentration involves the study of integrated drug transport and mechanism of drug action research.

Job Prospects: Graduates generally accept employment offers shortly before or after defending their thesis. Job opportunities for graduates include positions as postdoctoral researchers, scientists in the pharmaceutical industry, and faculty members in a variety of departments involved in biomedical research.

Non-Matriculated Student Policy: Non-matriculated students are able to take up to 9 credits before formal application must be made to the program.

Financing Opportunities: Master's-level students are generally not considered for financial support. Financial support in the form of University fellowships, teaching assistantships, and research assistantships is generally available to Ph.D. candidates only. Only under rare circumstances are M.S. students considered for support.

Admission Requirements and Deadlines

Application Deadline:

Fall: December 15

All applications are evaluated together after the deadline.

APPLY ONLINE to this graduate program.

Letters of Reference:

Number Required: 3

From Whom: Letters of recommendation should be obtained from college/university faculty members familiar with the applicant's academic competence and professionals in a supervisory position.

Coursework Required for Admission Consideration: It is recommended that applicants complete the courses (or their equivalent as determined by the School of Pharmacy) taken in obtaining a B.S. degree in Biochemistry, Biology, Pharmacology, Pharmacy, or Psychology.

Bachelor's Degree in Discipline/Related Discipline: A baccalaureate degree in Biochemistry, Biology, Molecular Biology, Pharmacology, Pharmacy, or Psychology is required.

Preferably, official transcripts are forwarded electronically. Transcripts from all post-secondary institutions attended may be sent electronically to tuspgrad@temple.edu. Alternately, unopened official transcripts bearing the school's seal must be sent directly from the Registrar at each institution to the School of Pharmacy's Office of Graduate Studies.

Applicants who earned a degree at a non-U.S. institution must submit an equivalency evaluation of their transcript(s) through a third-party provider, either World Education Services (WES) or Educational Credential Evaluators (ECE).

Statement of Goals: In approximately 500 to 1,000 words, state your specific interest in Temple's program, research goals, future career goals, and academic and research achievements.

Standardized Test Scores:

GRE: Required. Scores should be in the 65th percentile or above.

Applicants who earned their baccalaureate degree from an institution where the language of instruction was other than English, with the exception of those who subsequently earned a master's degree at a U.S. institution, must report scores for a standardized test of English that meet these minimums:

- TOEFL iBT: 85
- IELTS Academic: 6.5
- PTE Academic: 58

Resume: Current resume or CV required.

Transfer Credit: With approval, courses specific to the field of Pharmacodynamics may be transferred into the program. Applicants must present supporting documentation (syllabus, course description, and/or transcript) for transfer consideration at the time of application. The maximum number of credits a student may transfer into the M.S. program is 6.

Program Requirements

General Program Requirements:

Number of Credits Required Beyond the Baccalaureate: 36

Required Courses:

Code	Title	Credit Hours
Core Courses		
PS 8002	Pharmaceutical Analysis	3
PS 8051	Seminar in Pharm Science	1
PS 8121	Department of Pharmaceutical Sciences Seminar Series	1
PS 8127	Pharmacokinetics	3
PS 8128	Principles in Drug Discovery	3
PS 8129	Bioethics in Research	2
PS 8402	Pharmacodynamics	3
PS 8403	Advanced Pharmacogenomics	2
QARA 5451	Statistical Quality Control	3
Concentration-Specific Courses		6
Electives		3
Research Course		
PS 9996	Master's Research	6
Total Credit Hours		36

Culminating Events:

Thesis:

The M.S. thesis is an original, theoretical, and/or empirical study that contributes to the field of Pharmacodynamics. It should expand existing knowledge and demonstrate the student's knowledge of research methods and a mastery of her/his primary area of interest. The thesis should be rigorously investigated; uphold the ethics and standards of the pharmaceutical sciences; demonstrate an understanding of the relationship between the primary area of interest and the broader field of pharmacodynamics; and be prepared for publication in a professional journal.

Students who are preparing to defend their thesis should confirm a time and date with their advisor and register with the Administrative Assistant at least 15 days before the defense is to be scheduled. The Administrative Assistant arranges the time, date, and room within two working days and forwards to the student the appropriate forms. Once approved, the public announcement of the defense is posted.

The Thesis Examining Committee evaluates the student's ability to express verbally her/his research question, methodological approach, primary findings, and implications. This committee is comprised of at least three Graduate Faculty members. Two members, including the Chair, must be members of the Graduate Faculty of the School of Pharmacy. The Thesis Examining Committee votes to pass or fail the thesis and the defense at the conclusion of the public presentation.

Contacts

Program Web Address:

<https://pharmacy.temple.edu/academics/graduate-program>

Department Information:

Dept. of Pharmaceutical Sciences Office of Graduate Studies
School of Pharmacy
3307 N. Broad Street, Suite 528
Philadelphia, PA 19140
tuspgrad@temple.edu
215-707-4972

Submission Address for Application Materials:

https://apply.temple.edu/PHARM_GRAD/Pages/Welcome.aspx

Department Contacts:

Admissions:

Sophon Din
tuspgrad@temple.edu

Program Coordinator:

Daniel J. Canney, Ph.D.
tuspgrad@temple.edu

Graduate Chairperson:

Swati Nagar, Ph.D.
phscgrad@temple.edu

Department Chairperson:

Ellen Walker, Ph.D.
ellen.walker@temple.edu

Courses

PS 5451. Statistical Quality Control. 3 Credit Hours.

An introduction to statistical concepts, this course reviews control charts for variables, probability theory, control charts for attributes, and acceptance sampling systems. Class discussions include application to quality control of pharmaceutical manufacturing. Note: Not open to students who have taken the former PHARMACEUTICS 451.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5471. Biotechnology:Bioprocess Basic. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5477. Good Manufacturing Practices. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5478. High Purity Water System. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5492. Production of Sterile Products. 3 Credit Hours.

This course reviews the theory and practice involved in the preparation of sterile, injectable products, covering formulation, manufacturing, facility requirements, validation and regulatory issues. Upon completion of the course, students will develop an understanding of the routes of administration of injectable drugs and the types of injections, current formulation methods, aseptic manufacturing processes, requirements for sterile manufacturing facilities, and validation, compliance and regulatory issues. Note: Not open to students who have taken the former PHARMACEUTICS 492. Also note that prior to fall 2016, the title of PS 5492 was "Production of Sterile Parenterals."

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5493. Sterilization Processes. 3 Credit Hours.

This course surveys sterilization processes used in the pharmaceutical, medical device, in-vitro diagnostic, and biotech industries. Current methods of sterilization are discussed, including thermal, gaseous, radiation, filtration, and aseptic processing. Students learn basic aspects of sterilization science as well as design, review, and audit sterilization validations and processes according to industry practices. Note: Not open to students who have taken the former PHARMACEUTICS 493.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5499. Pharmaceutical Drug Dosage Forms. 3 Credit Hours.

Through an overview of drug dosage form design and manufacturing technology, principles of pharmaceutical processing and pharmaceutical dosage form design (including preformulation and biopharmaceutics) are discussed, including dosage forms such as tablets, capsules, modified dosage forms, semi-solid products, and transdermal delivery systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5501. Development of Sterile Products. 3 Credit Hours.

A study of the theory and practice in the development of parenteral products; dosage form design, formulation, solubility/physical pharmacy, excipients, assays, stability, physicochemical properties of biomolecules, delivery systems for controlled/sustained release and manufacturing methods. Note: Not open to students who have taken the former PHARMACEUTICS 501. Also note that prior to fall 2016, the title of PS 5501 was Development - Parenterals."

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 5575. Regulatory Sciences. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8000. Topics in Pharmaceutical Sciences. 1 to 3 Credit Hour.

Topics vary; specific topic(s) announced prior to the start of the semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PS 8001. Principles of Drug Action/Pharmacokinetics. 3 Credit Hours.

This course presents the fundamental principles of pharmacology, medicinal chemistry, and pharmacokinetics needed to understand their application in drug discovery and developmental processes. The material, presented in an integrated manner, includes the molecular mechanisms of drug action, structure-activity relationships, and the time-course of drug absorption and disposition.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8002. Pharmaceutical Analysis. 3 Credit Hours.

Application of chemical analysis as it relates to pharmaceuticals and pharmaceutical manufacturing. Classical separation methods including GC, HPLC, and NMR as well as, hyphenated techniques (GC-MS & HPLC-MC) will be explored. The student will also be introduced to immunologic antibody based procedures and emerging technologies.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8003. Pharmaceutical Manufacturing I: Preformulation/Formulation. 3 Credit Hours.

Presents techniques relevant to all aspects of preformulation and formulation phases, as well as principles and mechanisms of incompatibility and stability testing.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8004. Pharmaceutical Manufacturing II. 3 Credit Hours.

Presents processing and principles that apply to solid dosage form design and product development.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8005. Pharmaceutical Biotechnology. 3 Credit Hours.

This course will introduce students to pharmaceutical biotechnology, biophysical and chemical aspects of biotech products, and their pharmaceutical formulations and clinical applications. Amino acids, proteins, peptides, and nucleotides are of particular interest. The principles of pharmaceutical formulations and physicochemical evaluation of formulations will be discussed. Pharmacokinetics of biologics and current analytical methods used in pharmaceutical biotechnology are included. In addition, the course provides an introduction to biopharmaceuticals that encompass a variety of technologies ranging from products derived from natural sources, peptides, therapeutic proteins/monoclonal antibodies, oligonucleotide therapeutics (e.g. antisense, ribozymes, aptamers, siRNA), gene therapy and special issues in drug delivery. The course will begin with a review of the molecular, biochemical, pharmaceutical underpinnings that support each of the technologies and will move into a more detailed discussion of each therapeutic technology. Preclinical and clinical development, safety, efficacy and manufacturing issues will be discussed.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8006. Physical Pharmacy I. 3 Credit Hours.

The emphasis of this course is to form bridge between the concepts of physical pharmacy and the application of pharmaceutical sciences. Students will understand basic aspects of intermolecular forces, physical properties of solutions, ionic equilibria, buffers and isotonic solutions, solubility and partition phenomena, complexation and protein binding, reaction kinetics, mass transport, dissolution phenomena, interfacial phenomena, and rheology. Pharmaceutical applications based on the basic principles will be discussed as well. Students will be expected to be able to apply the basic concepts from this course to typical formulation and stability issues of pharmaceutical dosage forms. A previous course is physical chemistry.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8007. Applied Biopharmaceutics. 3 Credit Hours.

Presents the interrelationships of the physicochemical properties of the drug and the dosage form, to the route of administration and to the rate and extent of systemic absorption. Drug absorption mechanisms, physiological and GIT constraints on dosage form transit and bioavailability, effect of formulation parameters, dissolution methodologies, in-vitro/in-vivo correlation of drug product performance as well as SUPAC, ICH and FDA guidelines on development and approval process will be covered. Formulation strategies for optimum therapeutic outcome via application of pharmaceutical sciences to the design of drug delivery systems is provided.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8008. Advanced Principles of Pharmacokinetics. 3 Credit Hours.

An advanced course in the theory and application of pharmacokinetics and pharmacodynamics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8009. Advanced Medicinal Chemistry I. 3 Credit Hours.

Discussions of the organic chemistry of drug action and drug design. Current topics in the field are discussed using examples from the recent literature. The design, synthesis and structure activity relationships for major therapeutic drug classes are discussed in detail.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8011. Advanced Medicinal Chemistry II. 3 Credit Hours.

Continued discussions of the organic chemistry of drug action and drug design with current topics discussed using examples from the recent literature. Students review the current literature, give presentations and write research proposals based on their readings and class materials.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8012. Radioisotope Methodology. 3 Credit Hours.

Introductory discussion of the characteristics and properties of ionizing radiation, methods of detection (gas ionization, scintillation, both liquid and solid spectroscopy), radiation standards for safety and protection, and basic evaluation of biological hazards and effects.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8051. Seminar in Pharm Science. 1 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PS 8111. Introduction to Toxicology. 3 Credit Hours.

Toxicology is a multi-disciplinary science focused on the adverse effects of chemicals, drugs and environmental agents. In the first part of this course the basic principles of toxicology will be covered, including dose response relationships, mechanisms of toxicity and exposure. In the second part, target organs of toxicity will be presented with an overview of anatomy and physiology of different target organs (e.g. liver, kidney), as well as organ-specific response to toxic insult. In the final segment of the course, students will be exposed to a variety of areas of applied toxicology, including risk assessment, clinical & forensic toxicology, chemical carcinogenesis, reproductive toxicology and the role of toxicology in drug development.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8121. Department of Pharmaceutical Sciences Seminar Series. 1 Credit Hour.

The goal of the course is to expose graduate students in the Department of Pharmaceutical Sciences to the faculty research in our department. Students will be presented with a number of research topics, including pharmaceuticals, pharmacokinetics, medicinal chemistry, biotransformation, pharmacology, and physiology. In addition to the presentations by faculty members, several guest speakers will present their research topics and discuss their opinions on science careers outside of academia (i.e., industry, medical writing, medical science liaison, etc.). Through exposure to these diverse research topics, students will become more well-rounded scientists and become more aware of career opportunities that are available to them.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8122. Writing and Publishing a Review Article. 1 Credit Hour.

The purpose of this course is to research, write and submit a manuscript (review article) in English for publication in a refereed scientific journal.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8123. Bioinformatic Genes Drug. 1 Credit Hour.

The course is a one semester Research project focused on inherited factors that modulate drug response. The use of Web-based computer software for data mining, genetic variability in humans, detection and prediction of pharmacologically relevant genetic polymorphisms will be presented. The course is an introductory level course for students involved in research on Pharmacogenomics and Pharmacogenetics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8125. Journ Club/Pharmacodynam. 1 Credit Hour.

Course aims to keep participants up-to-date on current literature in the field. Participants will present the background, content, and implications of a paper of their choosing to the class. In addition, Temple researchers may present their ongoing research and/or review the current literature in the field. The goals of the course are to: 1) facilitate the sharing of knowledge and discussion of current information and 2) to aid students in the critical interpretation of the literature, and the presentation of the results to their colleagues.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8126. Laboratory Experience in Pharmaceutical Sciences. 1 Credit Hour.

Students enrolled in this course will be mentored by a member of the graduate faculty in the department in order to become familiar with the research area of the instructor and the everyday workings of the laboratory. The techniques, instrumentation, and procedures covered during the semester will vary depending on the concentration of interest and may include medicinal chemistry/drug discovery, pharmaceuticals/pharmacokinetics or pharmacodynamics/pharmacogenomics. Students will be exposed to a wide variety of experimental techniques and analytical instrumentation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PS 8127. Pharmacokinetics. 3 Credit Hours.

The objective of this course is to present the fundamental principles of pharmacokinetics (PK). The topics will include PK data analysis, dosage regimen design, and the determinants of drug absorption, distribution, metabolism, and excretion. Pharmacodynamics, the study of drug concentration - response relationships, will also be presented.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8128. Principles in Drug Discovery. 3 Credit Hours.

In this course, students will receive an introduction to the fundamental principles of drug discovery and development, beginning with an historical overview of drug discovery.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8129. Bioethics in Research. 2 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8131. Principles of Biochemistry. 4 Credit Hours.

The course provides students with information regarding the chemical and physical properties of biomolecules. Moreover, the interrelated roles of these molecules in a functioning biological system are emphasized.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8132. Topics in Pharmaceutical Biotechnology. 2 Credit Hours.

This is a seminar course in which students will research and give oral presentations on topics of their choice within the broad subject of pharmaceutical biotechnology.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8133. Introduction to Translational Molecular Technology. 2 Credit Hours.

This is a survey course that will introduce graduate students to important topics in the area of translational research.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8134. Neuroscience of Pain. 2 Credit Hours.

This is a neuroscience course that covers the anatomical and physiologic basis for different forms of pain.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8402. Pharmacodynamics. 3 Credit Hours.

This course covers the theoretical underpinnings and practical aspects of quantitative pharmacology. A key feature of the course is its concentration on the integrated study of a drug's pharmacokinetics (transport to its site of action: including absorption, distribution, biotransformation, and excretion) and its mechanism of action at the site of action. Emphasis is placed on the mathematical foundations of such topics as drug-receptor theory, Schild analysis, Furchgott's method, radioligand binding studies, PK/PD modeling, and isobolographic analysis of drug combinations.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8403. Advanced Pharmacogenomics. 2 Credit Hours.

The course is a one semester course focused on inherited factors that modulate drug response. Special problems of genetic variability in humans, detection and prediction of pharmacologically relevant genetic polymorphisms will be discussed. The course will integrate current mechanistic knowledge of drugs, human genetics, data mining, and analytical tools to tailor drug administration for a specific genetic background.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

PS 8131|Minimum Grade of C|May not be taken concurrently.

PS 8404. Pharmaceutical Sciences Literature Review. 2 Credit Hours.

This course is to expose graduate students to the current literature in Pharmaceuticals, Pharmacodynamics and Drug Delivery. The goal of the course is to expose the student to a variety of literature articles pertaining to the physical, biologic, and formulation of pharmaceutical dosage forms. At the end of the course the student should be able to compare and critique articles from several journals common to the area of pharmaceuticals, analyze literature articles as to the relevancy the results to the discussion, propose new research based on the current literature article, and be able to write an abstract for a review article based on several publications.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8464. Abuses of Drugs and Chemicals. 3 Credit Hours.

Pharmacology of drugs of abuse and related chemicals, the extent of drug abuse, factors fostering drug abuse, and treatment methods.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8478. Modified Release Dosage Forms. 3 Credit Hours.

The fundamentals involved in various extended release dosage forms and their modification for use in particular dosage formulations. Biopharmaceutical and pharmacokinetic aspects of extended-release dosage forms are discussed as well. Overview of polymeric excipients used in the formulation of extended-release dosage forms. Current commercial products under development will be discussed.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8502. Advanced Pharmacokinetic Modeling I. 2 Credit Hours.

This course will cover drug transport in biological systems and advanced topics in pharmacokinetics and pharmacodynamics. Course will also involve computer methods to derive models and discussion of current literature.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8582. Physical Pharmacy II. 3 Credit Hours.

The rheological behavior of polymer systems will be discussed. The physical chemical properties of proteins and peptides will be presented with formulation applications. This is an advanced course. Physical Pharmacy I is a prerequisite.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8583. Chemical Surfaces & Interfaces. 3 Credit Hours.

Topics: types and structure of surfactant molecules; properties of aqueous and non-aqueous surfactant solutions; foaming; micelle formation and solubilization. Binary systems; ternary systems; surfactant-water-amphiphile. Stabilization of emulsions and of solid/liquid dispersions. Biological applications.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8584. Advanced Drug and Gene Delivery Systems. 3 Credit Hours.

The application of nanometer to micrometer delivery systems for disease management has made tremendous advances in recent years. Products of nanotechnology are expected to revolutionize modern medicine due to their versatility in targeting tissues and controlling the release of drugs. Global initiatives are in place to support nanotechnology and nanomedicine. In this interactive course, students will learn the basic principles of advanced drug and gene delivery and its major biomedical applications. The methods or strategies of preparation and evaluation of the commonly used drug and gene delivery systems will be discussed. In addition, students will present selected focused topics on the novel drug and gene delivery systems under the instructors' guidance.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8592. Food and Drug Law. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8603. Dermatopharmaceutics. 3 Credit Hours.

Study of the physiology, biochemistry, immunology, skin permeability, and penetration enhancers as well as role of growth factors in healing after injuries. Semi-solid products, influence of formulation variables and their overall drug release capacities in-vitro and in-vivo will be evaluated. Transdermal, iontophoresis, sonophoresis topics, and bioequivalence/bioavailability of topical preparation will be discussed.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 8985. Teaching in Higher Educ. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

PS 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.

This course fulfills the continuous enrollment requirement after coursework completion while preparing for the Preliminary examinations.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PS 9996. Master's Research. 1 to 6 Credit Hour.

Master's Research course appropriate for students finished with coursework and working with a faculty member on the thesis.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PS 9998. Pre-Dissertation Research. 1 to 6 Credit Hour.

This course is appropriate for students finished with coursework and working on their dissertation proposal.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

PS 9999. Dissertation Research. 1 to 6 Credit Hour.

This course is limited to, and required of, students who have achieved candidacy and are now doing dissertation research.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.