

School of Pharmacy and Pharmaceutical Sciences

Jan D. Hirsch, Dean

A. Richard Chamberlin, Department of Pharmaceutical Sciences Chair

Alexandre Chan, Department of Clinical Pharmacy Practice Chair

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The School of Pharmacy and Pharmaceutical Sciences (SPPS) offers innovative and rigorous programs which integrate a diverse plethora of concepts: Bachelor of Science in Pharmaceutical Sciences, Master of Science in Pharmacology, Doctor of Philosophy (Ph.D.) in Pharmacological Sciences, and Doctor of Pharmacy (Pharm.D). Undergraduate and graduate students receive unparalleled training for future careers that improve our society's health and well-being, including biomedical research, pharmacy, medicine, and other positions within the health sciences and pharmaceutical industry. The SPPS has two departments: Pharmaceutical Sciences and Clinical Pharmacy Practice.

The Department of Pharmaceutical Sciences integrates concepts from biology, chemistry, chemical engineering, pharmacology and physiology with opportunities for collaborative interdisciplinary research. Pharmaceutical Scientists are rapidly changing the field of drug discovery and development. Graduates of our program are well qualified to seek employment in the public and private sectors, or pursue graduate degrees such as Ph.D., M.D., or Pharm.D.

The Department of Clinical Pharmacy Practice offers unparalleled training for future careers in pharmacy. Our innovative curriculum focuses on integrative health and putting the patient first, training students in the classroom and in the field. The department houses clinical pharmacy practice faculty, who develop and deliver didactic and experiential curricula for the Doctor of Pharmacy program.

- Department of Clinical Pharmacy Practice
- Department of Pharmaceutical Sciences

- Doctor of Pharmacy (Pharm.D.)
- Pharmaceutical Sciences, B.S.
- Pharmacological Sciences, Ph.D.
- Pharmacology, M.S.

Faculty

Amal Alachkar, Ph.D. University of Manchester, *Associate Professor of Teaching of Pharmaceutical Sciences* (neurotransmitter systems, molecular pharmacology, neuropsychopharmacology)

Kevin T. Beier, Ph.D. Harvard University, *Assistant Professor of Physiology and Biophysics; Biomedical Engineering; Pharmaceutical Sciences*

Claudia Benavente, Ph.D. University of Arizona, *Assistant Professor of Pharmaceutical Sciences; Developmental and Cell Biology* (genetics, epigenetics, cancer, pediatric cancer, retinoblastoma, osteosarcoma)

Bruce Blumberg, Ph.D. University of California, Los Angeles, *Professor of Developmental and Cell Biology; Biomedical Engineering; Environmental Health Sciences; Pharmaceutical Sciences* (gene regulation by nuclear hormone receptors in vertebrate development physiology, endocrine disruption)

Emiliana Borrelli, Ph.D. University of Strasbourg, *Chancellor's Professor of Microbiology and Molecular Genetics; Pharmaceutical Sciences*

Rémi Buisson, Ph.D. Université Laval, *Assistant Professor of Biological Chemistry; Pharmaceutical Sciences*

Christine Cadiz, Pharm.D. University of California, San Diego, *Health Sciences Assistant Professor of Clinical Pharmacy Practice*

A. Richard Chamberlin, Ph.D. University of California, San Diego, *Department Chair and Professor Emeritus of Pharmaceutical Sciences* (chemical biology, organic and synthetic)

Alexandre Chan, Pharm.D. Rutgers University, *Department Chair and Professor of Clinical Pharmacy Practice*

John Charles Chaput, Ph.D. University of California, Riverside, *Professor of Pharmaceutical Sciences; Chemical and Biomolecular Engineering; Chemistry; Molecular Biology and Biochemistry* (chemical and synthetic biology)

Olivier Civelli, Ph.D. Swiss Federal Institute of Technology in Zurich, *Distinguished Professor of Pharmaceutical Sciences; Developmental and Cell Biology* (novel neuroactive molecules, molecular neuropharmacology)

Melanie Cocco, Ph.D. Pennsylvania State University, *Associate Professor of Molecular Biology and Biochemistry; Pharmaceutical Sciences*

Dan M. Cooper, M.D. University of California, San Francisco, *Senior Associate Dean, Clinical Translational Science and Associate Vice Chancellor, Clinical Translational Research and Professor of Pediatrics; Biomedical Engineering; Pharmaceutical Sciences*

Sue P. Duckles, Ph.D. University of California, San Francisco, *Professor Emeritus of Pharmaceutical Sciences*

John P. Fruehauf, M.D. Rush University, *Professor Emeritus of Medicine; Pharmaceutical Sciences*

Kelvin W. Gee, Ph.D. University of California, Davis, *Professor Emeritus of Pharmaceutical Sciences*

Steven A.N. Goldstein, M.D., Ph.D. Harvard University, *Vice Chancellor for Health Affairs and Distinguished Professor of Physiology and Biophysics; Pharmaceutical Sciences*

Celia Goulding, Ph.D. King's College London, *Professor of Molecular Biology and Biochemistry; Pharmaceutical Sciences*

Stephen Hanessian, Ph.D. Ohio State University, *Distinguished Professor of Pharmaceutical Sciences; Chemistry (organic chemistry, medicinal chemistry)*

Jan Hirsch, Ph.D. University of South Carolina, *Dean of the School of Pharmacy and Pharmaceutical Sciences and Professor of Clinical Pharmacy Practice*

Naoto Hoshi, Ph.D. Kanazawa University, *Associate Professor of Pharmaceutical Sciences; Physiology and Biophysics*

Lan Huang, Ph.D. University of Florida, *Professor of Physiology and Biophysics; Biological Chemistry; Biomedical Engineering; Pharmaceutical Sciences*

Keri Hurley-Kim, Pharm.D. Touro University, *Health Sciences Assistant Clinical Professor of Clinical Pharmacy Practice*

Mahtab F. Jafari, Pharm.D. University of California, San Francisco, *Director of the Center for Healthspan Pharmacology and Professor of Pharmaceutical Sciences; Ecology and Evolutionary Biology (anti-aging pharmacology and preventive medicine)*

Diana N. Krause, Ph.D. University of California, Los Angeles, *Adjunct Professor of Pharmaceutical Sciences*

Young Jik Kwon, Ph.D. University of Southern California, *Professor of Pharmaceutical Sciences; Biomedical Engineering; Chemical and Biomolecular Engineering; Molecular Biology and Biochemistry (gene therapy, drug delivery, cancer-targeted therapeutics, artificially-induced cellular vesicles, multi-modal therapies)*

Joyce Lee, Pharm.D. University of California, San Francisco, *Health Sciences Clinical Professor of Clinical Pharmacy Practice*

Frances L. Leslie, Ph.D. University of Aberdeen, *Professor Emeritus of Pharmaceutical Sciences*

Shahrdad Lotfipour, Ph.D. University of California, Irvine, *Assistant Professor of Emergency Medicine; Pharmaceutical Sciences*

Andrej Luptak, Ph.D. Yale University, *Professor of Pharmaceutical Sciences; Chemistry; Molecular Biology and Biochemistry (chemical biology)*

Sarah McBane, Pharm.D. University of North Carolina at Chapel Hill, *Health Sciences Clinical Professor of Clinical Pharmacy Practice*

David L. Mobley, Ph.D. University of California, Davis, *Vice Chair and Professor of Pharmaceutical Sciences; Chemistry (chemical biology, physical chemistry and chemical physics, theoretical and computational)*

Lee Nguyen, Pharm.D. University of California, San Francisco, *Health Sciences Associate Clinical Professor of Clinical Pharmacy Practice*

Megan Nguyen, Pharm.D. Western University of Health Sciences, *Associate Dean of Pharmacy Student Affairs and Health Sciences Associate Clinical Professor of Clinical Pharmacy Practice*

Trina Norden-Krichmar, Ph.D. University of California, San Diego, *Assistant Professor of Epidemiology; Biological Chemistry; Computer Science; Pharmaceutical Sciences*

James S. Nowick, Ph.D. Massachusetts Institute of Technology, *Professor of Chemistry; Pharmaceutical Sciences (chemical biology, organic and synthetic, polymer, materials, nanoscience)*

Brian Paegel, Ph.D. University of California, Berkeley, *Professor of Pharmaceutical Sciences; Biomedical Engineering; Chemistry (chemical biology, drug discovery, drug discovery, miniaturization, evolution)*

Daniele Piomelli, Ph.D. Columbia University, *Louise Turner Arnold Chair in the Neurosciences and Distinguished Professor of Anatomy and Neurobiology; Biological Chemistry; Pharmaceutical Sciences*

Michael Pirrung, Ph.D. University of California, Berkeley, *Professor of Pharmaceutical Sciences (chemical biology, synthesis, and nucleic acids)*

Lawrence Plon, Pharm.D. M.A. University of Southern California, *Assistant Adjunct Professor of Pharmaceutical Sciences*

Thomas L. Poulos, Ph.D. University of California, San Diego, *Distinguished Professor of Molecular Biology and Biochemistry; Chemistry; Pharmaceutical Sciences* (chemical biology)

Jennifer A. Prescher, Ph.D. University of California, Berkeley, *Professor of Chemistry; Molecular Biology and Biochemistry; Pharmaceutical Sciences* (chemical biology, organic and synthetic)

Samuel E. Schriener, Ph.D. University of Washington, *Vice Chair and Associate Professor of Teaching of Pharmaceutical Sciences* (aging, genetics, biochemistry, mitochondria)

Robert Spitale, Ph.D. University of Rochester, *Director of the UCI Transcriptomics Core and Associate Dean of Research and Professor of Pharmaceutical Sciences; Chemistry; Molecular Biology and Biochemistry* (chemistry, chemical biology, RNA biology)

Shiou-Chuan (Sheryl) Tsai, Ph.D. University of California, Berkeley, *Professor of Molecular Biology and Biochemistry; Chemistry; Pharmaceutical Sciences*

Christopher Vanderwal, Ph.D. Scripps Research Institute, *Professor of Chemistry; Pharmaceutical Sciences* (organic and synthetic)

Jonathan Watanabe, Pharm.D. University of Southern California, Ph.D. University of Washington, *Associate Dean of Pharmacy Assessment and Quality and Professor of Clinical Pharmacy Practice*

Gregory A. Weiss, Ph.D. Harvard University, *Department Vice Chair and Professor of Chemistry; Molecular Biology and Biochemistry; Pharmaceutical Sciences* (analytical, chemical biology, organic and synthetic, polymer, materials, nanoscience)

Cheryl Wisseh, Pharm.D. University of North Carolina Chapel Hill, *Health Sciences Assistant Clinical Professor of Clinical Pharmacy Practice*

Weian Zhao, Ph.D. McMaster University, *Associate Professor of Pharmaceutical Sciences; Biological Chemistry; Biomedical Engineering* (stem cell therapy, diagnostics, biosensors, immunotherapy, single-cell analysis)

Qun-Yong Zhou, Ph.D. Oregon Health & Science University, *Professor of Pharmaceutical Sciences*

Xiaolin Zi, Ph.D. Shanghai University, *Associate Professor of Urology; Pharmaceutical Sciences*

Pharmaceutical Sciences Courses

PHRMSCI 1. New Student Seminar. 1 Unit.

Weekly meetings consisting of presentations by faculty, professional staff, and Peer Academic Advisors provide information about the Pharmaceutical Sciences major, campus resources, learning skills, and special programs and opportunities.

Grading Option: Pass/no pass only.

Restriction: Pharmaceutical Sciences Majors only. New students only.

PHRMSCI 3. Professional Development and Careers in the Pharmaceutical Sciences. 1 Workload Unit.

Designed to help Pharmaceutical Science majors select a career track and prepare for graduate program applications and careers in industry.

Grading Option: Workload Credit Letter Grade with P/NP.

Restriction: Juniors only. Pharmaceutical Sciences Majors only.

PHRMSCI 42. Life 101 . 2 Units.

Covers the latest scientific work on the impact of nutrition, exercise, and lifestyle choices on mental and physical health. Motivates students to make positive changes by fostering personal growth.

PHRMSCI 76. Ethical Conduct of Research. 2 Units.

Covers the ethical responsibilities of biomedical scientists. Topics include, as discussions and case studies, the high standards of science, the responsible conduct of research, animal experimentation, and clinical trials as they relate to the pharmaceutical sciences.

PHRMSCI H80. Drugs and Society. 4 Units.

Where drugs come from, how drugs work, how and why people abuse drugs, the costs of drug abuse on society, which drugs are commonly abused, and how drug abuse can be prevented and treated. Course intended for non-science majors.

Prerequisite: Recommended: High school chemistry and biology.

Restriction: Campuswide Honors Collegium students only.

(II)

PHRMSCI 90. Speaking about Science. 4 Units.

Students learn to effectively prepare and present public speeches and slide presentations. Included are storytelling, informative, commemorative, and persuasive speeches, and scientific presentation. Evaluating speeches and strategies to reduce speaker apprehension is also covered.

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

PHRMSCI 120. Human Physiology. 4 Units.

Covers the function of the human body. All major organ systems are discussed. Designed to prepare students for healthcare careers, such as medicine, pharmacy, dentistry, and for research careers which require basic knowledge of how the human body functions.

Corequisite: PHRMSCI 120L

Prerequisite: BIO SCI 99

Overlaps with BIO SCI E109.

PHRMSCI 120L. Human Physiology Lab. 2 Units.

Designed to complement PHRMSCI 120. Computer-based lab simulations are used to study the function of the human body. Class physically meet for review sessions and exams.

Corequisite: PHRMSCI 120

Prerequisite: BIO SCI E109

Overlaps with BIO SCI E112L.

PHRMSCI 122L. Medical Microbiology Laboratory. 3 Units.

An introduction to the structure, metabolism, cultivation, isolation, classification, and identification of the major groups of bacteria. Additional focus on identification of infection and use of antibiotics in diseased patients.

Prerequisite: BIO SCI 99 and CHEM 51C. CHEM 51C with a grade of C- or better

PHRMSCI 142. Healthspan Sciences. 4 Units.

Covers the complex and multi-factorial process of aging and increases the understanding of factors that contribute to enhanced lifespan, including basic principles of health and wellness and scientifically proven interventions, both pharmacological and non-pharmacological.

Prerequisite: BIO SCI 98 and BIO SCI 99 and PHRMSCI 120

Restriction: Upper-division students only.

PHRMSCI 155. Neuropsychopharmacology. 4 Units.

Mechanisms underlying chemical signaling processes in the nervous system. Fundamental knowledge for understanding the cellular and molecular actions of drugs and their mechanisms of action on synaptic transmission. Applied neuropsychopharmacology including major drug classes and therapeutic uses.

Prerequisite: PHRMSCI 170A. PHRMSCI 170A with a grade of C- or better

Restriction: Upper-division students only.

PHRMSCI 163. Pharmacogenomics and Epigenetics. 4 Units.

Survey of the genetic and epigenetic basis of inter-subject variability in response to drugs. Covers drug efficacy, safety, and need for their optimization in pharmacotherapy. Emphasizes genetic mechanisms of polymorphisms in the pharmacokinetics and pharmacodynamics of representative therapeutic drugs.

Prerequisite: BIO SCI 99

Concurrent with PHRMSCI 263.

PHRMSCI 170A. Molecular Pharmacology I. 4 Units.

Molecular basis of drug-receptor action at the molecular and cellular levels. Structure-function of drug targets emphasizing enzymes, ion channels, and membrane transport proteins. Understanding how the drugs' mechanisms of action contribute to the development of more efficacious and safer drugs.

Prerequisite or corequisite: (CHEM 51C or CHEM H52C) and (PHRMSCI 120 or BIO SCI E109)

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

PHRMSCI 170B. Molecular Pharmacology II. 4 Units.

Introductory survey covering the molecular mechanisms of drugs that target the nervous system, such as anxiolytics, antidepressants, antipsychotics, hypnotics, muscle relaxants, and recreational drugs; drugs related to the immune system, including antibiotics, antihistamines, and immunosuppressants; drugs used to treat cancer.

Prerequisite: PHRMSCI 170A

PHRMSCI 171. Physical Biochemistry. 4 Units.

Thermodynamics and kinetic fundamentals as applied to problems relevant to pharmaceutical sciences such as receptor/enzyme-ligand interactions. Fundamentals of biophysical methods used in the pharmaceutical sciences including structure determination and biomolecular spectroscopy.

Prerequisite: MATH 2B and PHYSICS 3C and (CHEM 1C or CHEM H2C) and BIO SCI 99

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

PHRMSCI 172. Topics in Pharmaceutical Sciences. 2 Units.

Presents information about various fields of research, study, careers, and graduate school opportunities in pharmaceutical sciences. Taught by guest lecturers from various disciplines including 199 research course faculty. Helps Pharmaceutical Sciences students select electives appropriate to their future goals.

Prerequisite or corequisite: BIO SCI 99 and (CHEM 51C or CHEM H52C)

Grading Option: Pass/no pass only.

PHRMSCI 173. Pharmacotherapy. 4 Units.

An exploration of the clinical application of medications to selected disease states. Focus is on an understanding of underlying principles of pharmacology and how this knowledge can be applied to treatment of diseases.

Prerequisite or corequisite: PHRMSCI 170B

PHRMSCI 174. Biopharmaceutics and Nanomedicine. 4 Units.

Introduces theories and tools of new drug formulations. Particularly new novel therapeutics based on biological materials, pathological characteristics utilized to achieve the maximum efficacy and specificity, and drug delivery systems based on emerging nanotechnology are extensively discussed.

Prerequisite: PHRMSCI 170B

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

PHRMSCI 174L. Biopharmaceutics and Nanomedicine Lab. 3 Units.

Introduction to cancer drug screening using cellular models, and confirmation of comprehensive therapeutic efficacy using a live animal model. Includes basic cell culture, cytotoxicity assays, cell analysis, drug circulation test, and tumor eradication and imaging experiments. Materials fee.

Prerequisite: PHRMSCI 170B and BIO SCI 100

(Ib)**PHRMSCI 175. Drug Discovery Computing Techniques. 4 Units.**

Techniques used in computer-aided drug discovery, including theory behind these techniques and practical applications. Topics include scientific computing; python; classical force fields and simulations; visualization and movie-making; quantum mechanics in drug discovery; molecular dynamics; solvation models; and several others.

Prerequisite: CSE 41 or I&C SCI 31. CSE 42 or I&C SCI 32 is recommended.

Concurrent with PHRMSCI 275.

PHRMSCI 177. Medicinal Chemistry. 4 Units.

An introduction of the basics of drug activity and mechanisms. Strategies used to identify lead compounds such as natural product chemistry, combinatorial chemistry, molecular modeling, and high-through put screening. Relationship of molecular structure to pharmacological activity.

Prerequisite: CHEM 51A and CHEM 51B and CHEM 51C and (BIO SCI 98 or CHEM 128)

Same as CHEM 177.

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

PHRMSCI 177L. Medicinal Chemistry Laboratory. 3 Units.

An introduction of the basics of drug activity and mechanisms. Strategies used to identify lead compounds such as natural product chemistry, combinatorial chemistry, molecular modeling, and high-through put screening. Relationship of molecular structure to pharmacological activity. Materials fee.

Corequisite: PHRMSCI 177 or CHEM 177.

Prerequisite: CHEM 51A and CHEM 51B and CHEM 51C and BIO SCI 100 and (BIO SCI 98 or CHEM 128)

Same as CHEM 177L.

Restriction: Pharmaceutical Sciences Majors have first consideration for enrollment.

(Ib)

PHRMSCI 179. Emerging Technologies in Pharmaceutical Sciences and Medicine. 4 Units.

Introduces emerging, ground-breaking technologies in pharmaceutical sciences and medicine, including pharmacogenomics, genome editing, and stem cell and engineered T cell therapies. Explores these novel technologies with both their underlying theories and forward-thinking applications.

Concurrent with PHRMSCI 279.

PHRMSCI 197. Professional Internship. 4 Units.

Provides students with opportunity to develop leadership and professional skills necessary for competitive placement in their chosen industry. Students gain new and field-specific skills outside the classroom environment while participating in a supervised internship for a total of 100 hours.

Grading Option: Pass/no pass only.

Repeatability: May be repeated for credit unlimited times.

Restriction: Seniors only.

PHRMSCI 198. Independent Study in Pharmaceutical Sciences. 1-4 Units.

Students interested in independent study should arrange with a faculty member to sponsor and supervise such work. A time commitment of three hours per week per unit is expected. A written report is required at the end of each quarter.

Repeatability: May be taken for credit for 4 units.

PHRMSCI 199. Undergraduate Research. 1-4 Units.

Original research in the laboratory of Pharmaceutical Sciences faculty. Attendance at regular research group meetings is also generally expected, and a quarterly written report is required. Strongly recommended for students considering research careers and/or graduate degree programs.

Repeatability: May be repeated for credit unlimited times.

PHRMSCI H199. Honors Research in Pharmaceutical Sciences. 1-4 Units.

Undergraduate honors research in Pharmaceutical Sciences. A student time commitment of 10-15 hours per week is required.

Repeatability: May be repeated for credit unlimited times.

PHRMSCI 223. Biological Macromolecules. 4 Units.

Introduction to nucleic acid and protein structure, dynamics, and function. Topics include analytical methods, molecular evolution, folding, and catalysis.

Same as CHEM 223.

PHRMSCI 250A. Current Topics in Pharmaceutical Sciences. 1 Unit.

Intended to expose students to the primary literature and current research in the field of Pharmaceutical Sciences. Students analyze and present information for discussion. Guest speakers from academia and industry may participate throughout the quarter.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be taken for credit 3 times.

Restriction: Graduate students only. Math and Computational Biology Majors only.

PHRMSCI 250B. Current Topics in Pharmaceutical Sciences. 1 Unit.

Intended to expose students to the primary literature and current research in the field of Pharmaceutical Sciences. Students analyze and present information for discussion. Guest speakers from academia and industry may participate throughout the quarter.

Prerequisite: PHRMSCI 250A

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be taken for credit 3 times.

Restriction: Graduate students only. Math and Computational Biology Majors only.

PHRMSCI 250C. Current Topics in Pharmaceutical Sciences. 1 Unit.

Intended to expose students to the primary literature and current research in the field of Pharmaceutical Sciences. Students analyze and present information for discussion. Guest speakers from academia and industry may participate throughout the quarter.

Prerequisite: PHRMSCI 250B

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be taken for credit 3 times.

Restriction: Graduate students only. Math and Computational Biology Majors only.

PHRMSCI 263. Pharmacogenomics and Epigenetics. 4 Units.

Survey of the genetic and epigenetic basis of inter-subject variability in response to drugs. Covers drug efficacy, safety, and the need for their optimization in pharmacotherapy. Emphasizes genetic mechanisms of polymorphisms in the pharmacokinetics and pharmacodynamics of representative therapeutic drugs.

Restriction: Graduate students only.

Concurrent with PHRMSCI 163.

PHRMSCI 264. The RNA World: From Discovery to Mechanism. 4 Units.

Provides a comprehensive understanding of RNA in biology. Use of knowledge gained in organic chemistry, biochemistry, genomics, and molecular biology to understand how RNA is integrated into contemporary biology.

Restriction: Graduate students only.

PHRMSCI 265. New Frontiers in Chemical and Synthetic Biology. 4 Units.

Explores new developments in chemical and synthetic biology that span the areas of chemistry, molecular biology, genetics, bioengineering, systems biology, and computational genomics.

Restriction: Graduate students only.

PHRMSCI 270. Advanced Pharmacology. 4 Units.

Provides a mechanism-based overview of pharmacology with strong emphasis on clinical application of pharmacology. Students learn the most recent advances in pharmacology as they relate to drug discovery, development, and clinical application.

Restriction: Graduate students only.

Concurrent with PHRMSCI 170A.

PHRMSCI 272. Special Topics in Pharmaceutical Sciences. 2-4 Units.

Reserved for current topics of particular interest in areas of pharmaceutical sciences that are not covered by other courses. The subject will vary from year to year, highlighting, for example, significant emerging fields or highly specialized but vital research areas.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

PHRMSCI 275. Drug Discovery Computing Techniques. 4 Units.

Techniques used in computer-aided drug discovery, including theory behind these techniques and practical applications. Topics include scientific computing; python; classical force fields and simulations; visualization and movie-making; quantum mechanics in drug discovery; molecular dynamics; solvation models; and several others.

Restriction: Graduate students only.

Concurrent with PHRMSCI 175.

PHRMSCI 277. Medicinal Chemistry. 4 Units.

Fundamentals of medicinal chemistry covering diverse aspects of drug design, discovery, synthesis, and development. Molecular basis of drug action with an emphasis on the structure-to-function continuum.

PHRMSCI 279. Emerging Technologies in Pharmaceutical Sciences and Medicine. 4 Units.

Introduces emerging, ground-breaking technologies in pharmaceutical sciences and medicine, including pharmacogenomics, genome editing, and stem cell and engineered T cell therapies. Explores these novel technologies with both their underlying theories and forward-thinking applications.

Concurrent with PHRMSCI 179.

PHRMSCI 298. Research Seminar . 2 Units.

Presentation and discussion of current problems and methods in teaching and research in pharmaceutical sciences.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

PHRMSCI 299. Graduate Research. 1-12 Units.

Supervised original research or investigation under the direction of an individual faculty member.

Repeatability: May be repeated for credit unlimited times.

PHRMSCI 399. University Teaching. 1-4 Units.

Limited to Teaching Assistants.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

Pharmacology Courses

PHARM 241. Advanced Topics in Pharmacology. 2 Units.

Application of pharmacological principles in disease therapy. Advanced pharmacological mechanisms and in-depth study of drug action. Discussion of several major drug classes/therapeutic strategies: molecular mechanisms of action, physiological consequences of administration, and clinical use.

PHARM 251. Experimental Pharmacology. 4 Units.

Introduction to the concepts and techniques used in pharmacological science. Molecular biology, quantitative and biochemical pharmacology, fluorescent probes, behavior, genetics, animal handling, anatomical and receptor binding analysis, methods for ion channel study, the absorption, distribution, metabolism and elimination of drugs.

PHARM 254. Introduction to Pharmacology. 4 Units.

Ligand-gated ion channels, G protein-coupled receptors, receptor tyrosine kinases, ligand-regulated transcription factors, their signaling mechanisms, trafficking, macromolecular complexes, and physiological responses.

PHARM 255. Neuropharmacology. 2 Units.

Mechanisms underlying chemical signaling processes in the brain and periphery. Molecular biology, signal transduction, transmitter synthesis, and inactivation of major neurotransmitter systems. Drugs that act on these major neurotransmitters.

Restriction: Graduate students only.

PHARM 256. Experimental Design for Pharmacologists. 1 Unit.

Population and sample statistics, hypothesis testing, analysis of variance, nonparametric statistics, experimental design, power, and the use of statistical computer software.

Prerequisite: PHARM 251

PHARM 257. Ethics in Research. 1 Unit.

Ethical conduct in research including data handling, authorship, conflict of interest, animal rights, handling of misconduct.

Prerequisite: PHARM 299

Repeatability: May be taken for credit 2 times.

PHARM 270. Applied Pharmacology . 3 Units.

One week (five days, 40 hours) in-residence course offered on the UCI campus. Introduction to pharmacological techniques and current research problems; includes laboratory demonstrations and research seminars.

Restriction: Pharmacology Majors only.

PHARM 271. Principles of Pharmacology . 3 Units.

Principles of pharmacology: pharmacodynamics, pharmacokinetics, pharmacogenetics, drug interactions, and toxicity.

Restriction: Pharmacology Majors only.

PHARM 272. Receptors and Drug Targets . 3 Units.

Molecular basis of drug-receptor interaction. Receptor properties including gene and protein structure, signaling mechanisms, trafficking and physiological effects: G-protein linked receptors, ligand-gated ion channels, receptor tyrosine kinases, nuclear receptors, and ligand regulated transcription factors.

Restriction: Pharmacology Majors only.

PHARM 274. Research Techniques in Pharmacology. 3 Units.

Experimental techniques and model systems used in pharmacological research. Receptor analysis, bioassay, molecular biology, in vitro pharmacology, biochemical pharmacology, imaging, electrophysiology, in vivo pharmacology, disease models.

Restriction: Pharmacology Majors only.

PHARM 276. Experimental Design and Data Analysis . 3 Units.

Experimental design, data analysis and interpretation. Population and sample statistics, hypothesis testing, analysis of variance, nonparametric statistics, and power calculations.

Restriction: Pharmacology Majors only.

PHARM 277. Ethics in Scientific Research. 3 Units.

Ethical conduct in research including data handling, authorship, conflict of interest, animal rights, and handling of misconduct.

Restriction: Pharmacology Majors only.

PHARM 278. Concepts in Drug Discovery. 3 Units.

Critical steps involved in discovery and optimization of a new drug. Target selection, relationship of molecular structure to pharmacological activities, screening methods, strategies to identify lead compounds, and preclinical characterization necessary for development of the drug for clinical trials.

Restriction: Pharmacology Majors only.

PHARM 279. Special Topics in Pharmacology. 3 Units.

Topics of current interest in pharmacology; discussion of recent research publications.

Restriction: Pharmacology Majors only.

PHARM 280. Master's Project in Pharmacology. 3 Units.

Capstone research paper on topic of interest in pharmacology.

Restriction: Pharmacology Majors only.

PHARM 281. Neuropharmacology . 3 Units.

Autonomic and central nervous system pharmacology, including major drug classes and therapeutic uses. Mechanisms underlying chemical signaling processes in the brain and peripheral nervous system, including neurotransmitter synthesis, inactivation, and receptor action.

Restriction: Pharmacology Majors only.

PHARM 282. Behavioral Pharmacology. 3 Units.

Pharmacology of integrative function and behavior. Drug treatment of pain. Mechanisms of reward, addiction, and drugs of abuse.

Restriction: Pharmacology Majors only.

PHARM 283. Cardiovascular Pharmacology. 3 Units.

Basic understanding of drugs used in the prevention and treatment of cardiovascular disease. Mechanisms of action, clinical and adverse effects.

Restriction: Pharmacology Majors only.

PHARM 284. Endocrine, Respiratory, and Gastrointestinal Pharmacology . 3 Units.

Basic understanding of drugs used in endocrine, respiratory, and gastrointestinal conditions, including hormone replacement, contraceptives, and drugs for diabetes, asthma, obesity, ulcer, and gastric reflux. Mechanisms of drug action, clinical and adverse effects.

Restriction: Pharmacology Majors only.

PHARM 298. Seminar. 2 Units.

Presentation and discussion of current problems and methods in teaching and research in pharmacology, toxicology, and therapeutics.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

PHARM 299. Research. 1-12 Units.

Independent research with Pharmacology and Toxicology faculty.

Repeatability: May be repeated for credit unlimited times.

Restriction: Graduate students only.

Pharmacy Courses

PHMD 200A. Interprofessional Clinical Foundations I. 5 Units.

The first course in a four-part series that covers interprofessional patient communication, medical interviewing, physical examination, and health promotion. Direct instruction in professionalism, diversity, social determinants of health, kindness, mindfulness, well-being, epidemiology, and biostatistics.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 200B. Interprofessional Clinical Foundations II. 2 Units.

The second course in four-part series that covers interprofessional communication, medical interviewing, physical examination, and health promotion. Direct instruction in professionalism, diversity, social determinants of health, kindness, mindfulness, well-being, epidemiology, and biostatistics.

Prerequisite: PHMD 200A

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 200C. Interprofessional Clinical Foundations III. 2 Units.

The third course in a four-part series that covers interprofessional communication, medical interviewing, physical examination, and health promotion. Direct instruction in professionalism, diversity, social determinants of health, kindness, mindfulness, well-being, epidemiology, and biostatistics.

Prerequisite: PHMD 200A and PHMD 200B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 200D. Interprofessional Clinical Foundations IV. 2 Units.

The fourth course in a four-part series that covers interprofessional communication, medical interviewing, physical examination, and health promotion. Direct instruction in professionalism, diversity, social determinants of health, kindness, mindfulness, well-being, epidemiology, and biostatistics.

Prerequisite: PHMD 200A and PHMD 200B and PHMD 200C

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 201A. Principles of Pharmacy Practice I. 2 Units.

The first of a four-part series that covers the function and role of the health care team, Pharmacist Patient Care Process, immunization certification, communication and documentation, informatics, patient safety, interviewing, active listening, management/leadership, careers, resiliency, and student wellness.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 201B. Principles of Pharmacy Practice II. 2 Units.

The second of a four-part series that covers the function and roles of the health care team, Pharmacist Patient Care Process, immunization certification, communication and documentation, informatics, patient safety, interviewing, active listening, management/leadership, careers, resiliency, and student wellness.

Prerequisite: PHMD 201A

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 201C. Principles of Pharmacy Practice III. 2 Units.

The third of a four-part series that covers the function and role of the health care team, Pharmacist Patient Care Process, immunization certification, communication and documentation, informatics, patient safety, interviewing, active listening, management/leadership, careers, resiliency, and student wellness.

Prerequisite: PHMD 201A and PHMD 201B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 201D. Principles of Pharmacy Practice IV. 2 Units.

The fourth of a four-part series that covers the function and role of the health care team, Pharmacist Patient Care Process, immunization certification, communication and documentation, informatics, patient safety, interviewing, active listening, management/leadership, careers, resiliency, and student wellness.

Prerequisite: PHMD 201A and PHMD 201B and PHMD 201C

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 202A. Self Care I: Conventional and Complementary. 2 Units.

Educates pharmacy students about healthy lifestyle choices, the importance of mental and physical health, and self-care. Provides students with methods and techniques for dealing with the stressors of a professional educational environment and life challenges.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 202B. Self Care II: Conventional and Complementary. 2 Units.

The study of nonprescription products, complementary/alternative medicine, and non-pharmacological interventions for select self-treatable medical conditions commonly encountered by the pharmacist. Emphasis on the pharmacist's consultant role in product selection and non-pharmacological recommendations.

Prerequisite: PHMD 202A

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 202C. Self Care III: Conventional and Complementary. 2 Units.

Relates to patients' ability to care for themselves with emphasis on the pharmacist's consultant role and continues to explore self-treatable medical conditions commonly encountered by pharmacists, including non-pharmacologic interventions, nonprescription medications, and complementary/alternative products to treat them.

Prerequisite: PHMD 202A and PHMD 202B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203A. Pharmacotherapy Principles to Practice I: Central Nervous System. 8 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers the central nervous system.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203B. Pharmacotherapy Principles to Practice II: Immunology. 4 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers the immune system.

Prerequisite: PHMD 203A

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203C. Pharmacotherapy - Principles to Practice III: Cardiovascular and Respiratory Systems. 7 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers the cardiovascular and respiratory systems.

Prerequisite: PHMD 203A and PHMD 203B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203D. Pharmacotherapy - Principles to Practice IV: Endocrine System. 7 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers the endocrine system.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203E. Pharmacotherapy - Principles to Practice V: Gastrointestinal System, Dermatologic, and Ophthalmologic Disorders. 6 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers gastrointestinal, dermatologic, and ophthalmologic disorders.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203F. Pharmacotherapy - Principles to Practice VI: Infectious Diseases. 5 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers gastrointestinal, dermatologic, and ophthalmologic disorders.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203G. Pharmacotherapy - Principles to Practice VII: Hematology and Oncologic Disorders. 6 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers hematology and oncologic disorders.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 203H. Pharmacotherapy - Principles to Practice VIII: Special Population and Nutritional Disorders. 5 Units.

Integrates principles of biomedical and pharmaceutical sciences with evidence-based traditional and non-traditional therapies for management and prevention of disease. Topics include clinical chemistry, clinical toxicology, interprofessional health care, and public health. Covers special population and nutritional disorders.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 204A. Information Analytics and Numeracy I: Biostatistics. 2 Units.

Exposure to basic statistics and techniques that are commonly found in the medical and pharmacy literature, covering descriptive and inferential statistics. Students learn to choose the most appropriate statistical parametric and non-parametric tests and interpret findings from the literature.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 204B. Information Analytics and Numeracy II: Drug Information, Research Methods, and Literature Analysis. 3 Units.

Addresses development of knowledge, skills, and attitudes required for biomedical inquiry and discovery, including methods for data retrieval, analysis, interpretation, and synthesis.

Prerequisite: PHMD 204A

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 204C. Information Analytics and Numeracy III: Epidemiology. 2 Units.

Covers distribution of disease and health in groups of people and the factors that influence the distribution, including evaluation of therapeutic and diagnostic treatments and delivery of health care services.

Prerequisite: PHMD 204A and PHMD 204B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 205A. Molecular Basis of Health and Disease I: Microbiology and Immunology. 3 Units.

Principles of medical microbiology, immunology, virology, and parasitology. Introduction to classification, morphology, and physiology of microorganisms, particularly those that cause human pathology - bacteria, viruses, fungi, protozoans, parasite, and worms - and the body's immune response.

Prerequisite: PHMD 213 and PHMD 220

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 205B. Molecular Basis of Health and Disease II: Microbiology and Immunology . 3 Units.

Principles of medical microbiology, immunology, virology, and parasitology. Introduction to classification, morphology, and physiology of microorganisms, particularly those that cause human pathology - bacteria, viruses, fungi, protozoans, parasite, and worms - and the body's immune response.

Prerequisite: PHMD 213 and PHMD 220

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 205C. Molecular Basis of Health and Disease III: Clinical Chemistry. 2 Units.

Emphasis on normal human physiology and pathology as it related to clinical chemistry and assessment of disease states with the context of the Pharmacist Patient Care Process. Alterations of clinical chemistry results due to drug therapy are covered.

Prerequisite: PHMD 205A and PHMD 205B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 210. Principles of Pharmacology. 3 Units.

Provides an overview of the basic principles of pharmacology, covering pharmacodynamics - effects of drugs on the body - and pharmacokinetics - the process by which a drug is absorbed, distributed, metabolized, and excreted by the body.

Prerequisite: PHMD 220 and PHMD 277A and PHMD 277B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 211. Principles of Public Health. 4 Units.

Covers the framework, principles, and core responsibilities of public health research and practice from multidisciplinary perspectives. It also provides the necessary foundation for further studies using crosscutting approaches essential for public health practice.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

Concurrent with PUBH 200.

PHMD 212. Principles of Pharmacogenomics. 2 Units.

Walks students through the basics of genetics and genomics. Particular emphasis is placed on the use of genetics or genetic testing to assist in patient treatment regimens and evaluation of disease.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 213. Pharmaceutical Biochemistry. 4 Units.

Topics include the biological, chemical and cellular roles of carbohydrates, lipids, proteins, nucleic acids, hormones, enzymes and vitamins. In addition, the chemical and cellular basis of digestion, intermediary metabolism, biological oxidation and metabolic antagonism are discussed.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 214. Pharmacy Law and Ethics. 3 Units.

An introduction to California and federal legal requirements that impact pharmacy practice, emphasizing the legal and ethical principles applied by pharmacists in their decision-making. Explores approaches for resolving ethical dilemmas in patient care.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 215. Health Policy and Pharmacoeconomics. 3 Units.

Introduces students to the organization, financing, and delivery of health care services in the U.S. The relationship of providers, patients, payers, etc., are analyzed. Management and research principles utilized to manage drug therapy are introduced.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 216. Clinical Toxicology. 2 Units.

Fundamentals of pharmacology and mechanisms of action are reinforced and applied to learn the clinical effects of acute/chronic exposure derived from environmental, dietary, occupational and pharmaceutical sources. Students focus on information literacy skills and clinical management of poisonings.

Prerequisite: PHMD 210

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 220. Medical Physiology with Anatomic Correlates. 5 Units.

Concepts of physiology and mechanisms of body function at various levels of organization from cellular to organ systems. Emphasis on quantitative understanding of various body processes. Human anatomy is integrated with physiological concepts. Anatomic-physiologic relationships facilitated through virtual labs.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 274A. Pharmaceutics I. 4 Units.

The first in a foundational series designed to develop an understanding of the science behind drug formulation, mechanisms, pharmacokinetics and interconnections with the Pharmacist Patient Care Process.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 274B. Pharmaceutics II. 4 Units.

The second course in a foundational series designed to develop an understanding of the science behind drug formulation, mechanisms, pharmacokinetics and interconnections with the pharmacist patient care process. Topics include drug substances, dosage forms, and therapeutic effects. Includes laboratory.

Prerequisite: PHMD 274A

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 274C. Pharmaceutics III. 5 Units.

The final course in a foundational series designed to develop an understanding of the science behind drug formulation, mechanisms, pharmacokinetics, and interconnections with the Pharmacist Patient Care Process. In laboratory, students perform pharmacokinetic modeling, drug screening, and comprehensive therapeutic efficacy.

Prerequisite: PHMD 274A and PHMD 274B

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 277A. Medicinal Chemistry I. 4 Units.

Application of organic chemistry, biochemistry, molecular biology, physical chemistry, pharmacology, and physiology to understand the theory and mechanics of modern day medicinal chemistry. Topics include receptor-protein structure, dynamics, and interactions; drug development and design; and pharmacodynamics, and pharmacokinetics.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 277B. Medicinal Chemistry II. 6 Units.

Walks students through medicinal chemistry, broadly defined. Students utilize the knowledge gained in organic chemistry, biochemistry, molecular biology, physical chemistry, pharmacology and physiology in an integrated fashion as applied to modern medicinal chemistry. Continuation of Medicinal Chemistry I.

Prerequisite: PHMD 277A

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 280A. Scholarly Project I. 1 Unit.

Provides students an opportunity to develop independent thinking, with particular focus on maturing analytical skills. Students are encouraged to develop an independent project, with a mentor, to study pharmacy-related aspects of multiple areas. First phase identifies project focus.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 280B. Scholarly Project II. 1 Unit.

Provides students an opportunity to develop independent thinking, with particular focus on maturing analytical skills. Students develop an independent project, with a mentor, to study pharmacy-related aspects of multiple areas. Phase 2 focuses on final evaluation of project.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 290. Doctor of Pharmacy Epilogue. 2 Units.

Reinforces and assesses student pharmacist's performance on cumulative learning outcomes; pre-APPE and APPE knowledge, skills, and attitudes; entrustable professional activities; team- and practice-readiness; and to demonstrate that student pharmacists are achieving outcomes required by the ACPE.

Grading Option: Honors-Pass-Fail.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.

PHMD 298. Research Seminar . 2 Units.

Designed to engage students and expose them to seminar speakers that come to discuss research or case studies in pharmaceutical sciences and pharmacy.

Grading Option: Honors-Pass-Fail.

Repeatability: May be repeated for credit unlimited times.

Restriction: Doctor of Pharmacy students have first consideration for enrollment. Graduate students only.