MISSION
The mission of the Pharmaceutical and Chemical Sciences Graduate Program (PCSP) is to prepare Doctor of Philosophy and Master of Science graduates for working in the increasingly complex and integrated research in the pharmaceutical, chemical and biotechnological environment. This integrated, multidisciplinary program provides a student-centered learning environment and will produce new scientists with both broad and in-depth training by preparing them for work as part of interdisciplinary research/development teams.

The PCSP program is offered jointly by the School of Pharmacy and College of the Pacific. The participating departments in the program are Chemistry, Pharmacy Practice, Pharmacology and Physiology and Pharmaceutics and Medicinal Chemistry.

PROGRAMS OFFERED
The program offers training in one of these five focus areas: Bioanalytical and Physical Chemistry, Chemical Synthesis, Drug Discovery and Design, Molecular-Cellular Pharmacology and Toxicology, and Pharmacoconomics and Health Care Outcomes and Clinical Services, leading to the following degrees in Pharmaceutical and Chemical Sciences:

1. Master of Science
2. Doctor of Philosophy
3. Combined Doctor of Pharmacy and Doctor of Philosophy

PROGRAM GOALS
The goals of the PCSP curriculum are to:

• prepare students for the challenges in both basic and applied research
• advance knowledge in pharmaceutical and chemical sciences
• encourage fundamental discovery in the chemical, pharmaceutical and healthcare sciences

For additional information and admission requirements visit:
http://www.pacific.edu/Documents/school-graduate/acrobat/PharmChem.pdf

Master of Science in Pharmaceutical and Chemical Sciences
Students must complete a minimum of 32 units with a Pacific cumulative grade point average of 3.0 in order to earn the Master of Science degree in Pharmaceutical and Chemical Sciences.

I. Category I (minimum 8 units)
PCSP 201 Statistics and Experimental Design 3
PCSP 203 Information and Laboratory Management 1
PCSP 209 Technical Writing and Presentation 1
PCSP 263 Analytical Techniques in Pharmacoconomics and Health Care Outcomes and Services 4
Select one of the following: 3-4
PCSP 205 Instrumental Analytical Chemistry
PCSP 207 Bioanalytical Techniques
PCSP 208 Applied Pharmaceutical Analysis

II. Category II (minimum 7 units)
PCSP 283 Multidisciplinary Project 1

PCSP 295 Graduate Seminar (Required to register once every academic year) 1
PCSP 297 Graduate Research 1-4
PCSP 299 Thesis 1-6

Thesis – minimum required and elective courses in specialized area:

Categories 1 and 2 12

Total minimum required units for MS degree: 32 units

Note: Students are encouraged to complete coursework during the early part of their graduate studies so that the latter part of the program can be spent on full-time research.

Thesis Requirement
Students conduct research, write a thesis and complete a final oral defense of their thesis. The thesis is based upon a research project that constitutes a contribution to knowledge, or the student must design and evaluate a unique procedure or program in their field. A minimum of two semesters of full-time residence at the University is required following the baccalaureate degree or the equivalent in part-time residence during summers. The average time to complete the program is approximately 2-3 years.

Thesis Committee
The committee is formed after a student selects an advisor for his/her research. The committee assists the student in designing a plan of study, providing the student with guidance in his/her thesis research and monitoring the student’s research progress.

Doctor of Philosophy in Pharmaceutical and Chemical Sciences
Students must complete a minimum of 45 units with a Pacific cumulative grade point average of 3.0 in order to earn the Doctor of Philosophy degree in Pharmaceutical and Chemical Sciences.

I. Category I (minimum 8 units)
PCSP 201 Statistics and Experimental Design 3
PCSP 203 Information and Laboratory Management 1
PCSP 209 Technical Writing and Presentation 1
PCSP 263 Analytical Techniques in Pharmacoconomics and Health Care Outcomes and Services 4
Select one of the following: 3-4
PCSP 205 Instrumental Analytical Chemistry
PCSP 207 Bioanalytical Techniques
PCSP 208 Applied Pharmaceutical Analysis

II. Category II (minimum 14 units)
PCSP 283 Multidisciplinary Project 1
PCSP 387 Internship 2-4
PCSP 395 Graduate Seminar (Required to register once every academic year) 3
PCSP 397 Graduate Research (6 units is minimum total degree requirement) 6
A. Bioanalytical and Physical Chemistry (minimum 8 units)

Required Courses
- PCSP 240 Molecular Spectroscopy 4
- PCSP 244 High-Resolution NMR Spectroscopy 4
- PCSP 247 Mass Spectrometry 4

Preferred Elective Courses
- PCSP 206 Models and Concepts in Chemistry 4
- PCSP 215 Molecular Modeling and Drug Design 4
- PCSP 217 Drug Biotransformation 3
- PCSP 222 Thermodynamics of Pharmaceutical Systems 3
- PCSP 230 Molecular Pharmacology of Nucleic Acids 3
- PCSP 234 Neurochemical Pharmacology 3
- PCSP 237 Cell Culture Techniques 3
- PCSP 241 Advanced Organic/Bioorganic Chemistry 4
- PCSP 242 Selected Topics: Advanced Organic Chemistry 4
- PCSP 243 Applied Computational Chemistry 4
- PCSP 245 Proteins and Nucleic Acids 3
- PCSP 248 Enzymology 4

Total minimum required and elective courses in specialized area:

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<th>Category/Sub-category</th>
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<td>PhD</td>
<td>22</td>
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<tr>
<td>Thesis (MS)</td>
<td>14</td>
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B. Chemical Synthesis, Drug Discovery and Design (minimum 12 units)

Required Courses
- PCSP 241 Advanced Organic/Bioorganic Chemistry 4
- PCSP 242 Selected Topics: Advanced Organic Chemistry 4
- PCSP 244 High-Resolution NMR Spectroscopy 4

Preferred Elective Courses
- PCSP 206 Models and Concepts in Chemistry 4
- PCSP 211 Drug Design 4
- PCSP 213 Biotransformation of Pharmaceutical Agents 3
- PCSP 215 Molecular Modeling and Drug Design 4
- PCSP 217 Drug Biotransformation 3
- PCSP 222 Thermodynamics of Pharmaceutical Systems 3
- PCSP 230 Molecular Pharmacology of Nucleic Acids 3
- PCSP 234 Neurochemical Pharmacology 3
- PCSP 237 Cell Culture Techniques 3
- PCSP 245 Proteins and Nucleic Acids 3
- PCSP 247 Mass Spectrometry 4
- PCSP 248 Enzymology 4

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C. Pharmacoeconomics and Health Care Outcomes and Clinical Services

Required Courses
- PCSP 258 Teaching and Evaluation of Learning and Competency 2
- PCSP 265 Health Care Economics 2

Preferred Elective Courses
- BUSI 250 Health Finance: Health Insurance 3
- PCSP 255 Long Term Care Practice 3
- PCSP 256 Health Services Management and Finance 2
- PCSP 257 Ambulatory Care Practice 3
- PCSP 259 Topics in Acute Care Practice 3
- PCSP 260 Advances in Neuropsychiatric Pharmaceutical Care 2
- PCSP 261 Advances in Cardiovascular Pharmaceutical Care 3
- PCSP 262 Vascular, Renal and Pulmonary Care 4
- PCSP 263 Analytical Techniques in Pharmaceutics and Health Care Outcomes and Services 4
- PCSP 264 Applied Statistics in Health Services Research and Analysis 3
- PCSP 266 Pharmacoeconomics and Microeconomics/Managerial Economics 2

or other approved electives.
Pharm Chem Sciences Courses

PCSP 201. Statistics and Experimental Design. 3 Units.
This course involves the study of the application and limitations of statistical methods of inference as they apply to the fields of chemistry and the pharmaceutical sciences. Topics include the use of parametric statistics for statistical inference, comparisons of means, analysis of variance and linear regression. Parametric statistics and nonparametric measures of association and elements of good experimental design are also included. Graduate standing.
PCSP 214. Advanced Molecular Biochemistry. 4 Units.
This course is designed to present an opportunity for pharmacy students who are fluent or proficient in the Spanish language to act as teaching assistants and assist other pharmacy students to learn Spanish for the Pharmacy Professional. Teaching assistants will meet with the instructor prior to each class session for class preparation and will then participate during class sessions. Prerequisite: Graduate standing.

PCSP 215. Molecular Modeling and Drug Design. 4 Units.
The course presents a thorough and in-depth overview of methods and techniques in computer assisted drug design (CADD) where especially the needs of the pharmaceutical industry are considered. Graduate standing or permission of instructor.

PCSP 217. Drug Biotransformation. 3 Units.
This course generally meets two times a week (two 75-minute lectures per week). In this course, a mechanistic approach is employed to study human drug metabolizing enzymes. Other aspects related to the differential expression of these enzymes are discussed. Students need to submit a research proposal at the end of the course. Graduate standing or permission of instructor.

PCSP 218. Animal Techniques for Pharmaceutical Sciences. 2 Units.
This course is designed to present an opportunity for graduate students to understand and apply animal techniques to pharmaceutical science research. Prerequisite: Graduate standing or permission of the instructor.

PCSP 221. Fundamentals of Dosage Forms. 3 Units.
In this course the fundamental physicochemical properties and composition of various dosage forms is taught. Graduate standing.

PCSP 222. Thermodynamics of Pharmaceutical Systems. 3 Units.
This is a classical course on the applications of thermodynamics to the study of pharmaceutical systems. The course includes a review of the basic principles of thermodynamics. These principles are used to describe and study physical and chemical transformations of pure substances and mixtures in pharmaceutical systems. Graduate standing or permission of instructor.

PCSP 223. Pharmacokinetics and Pharmacodynamics. 3 Units.
This course teaches critical concepts and basic principles of pharmacokinetics and pharmacodynamics. Such concepts and principles are required for the students to understand the drug behavior in the body. Graduate standing or permission of instructor.

PCSP 224. Diffusion in Pharmaceutical Sciences. 3 Units.
Students discuss diffusion theories, experimental methods, and application to pharmaceutical/biological systems. Prerequisites: CHEM 161 and MATH 033 or equivalent or permission of instructor.

PCSP 225. Pharmaceutical Technologies. 2 Units.
Students study theory and practice in industrial pharmacy that include pre-formulation, formulation and pharmaceutical manufacture. Prerequisites: PHAR 114, 123, 133. Graduate standing.

PCSP 228. Mathematical Modeling in Pharmaceutical Research. 3 Units.
Students study the mathematical modeling theory and application to problems in pharmaceutical research. Modeling is applied to three major areas: drug delivery, metabolic/biological cascades and pharmacological response kinetics. Prerequisites: PHAR 113 or permission of instructor. Recommended: MATH 057; PHAR 114 and PHAR 134.

PCSP 229. Advances in Drug Delivery Systems. 3 Units.
This course the design and formulation/fabrication of controlled release and other novel drug delivery systems for oral, transdermal, ocular and other routes of delivery are covered. The biopharmaceutical rational and evaluation of such systems is also discussed. Graduate standing.

PCSP 230. Molecular Pharmacology of Nucleic Acids. 3 Units.
Students study the mechanisms by which drugs and other chemicals can affect gene expression and cell division through actions on DNA structure and nucleic acid and protein metabolism. Graduate standing.

PCSP 231. Molecular Pharmacology I. 4 Units.
This is the first course in the Molecular Pharmacology series. Effects of autonomic and central nervous system therapeutic agents and the mechanisms whereby these effects are induced. Drug classes are presented to illustrate the effects of drug classes in the treatment of disease. The molecular principles of drug action and receptor theory are covered. Enrollment in the PCSP program is required.

PCSP 232. Molecular Pharmacology II. 4 Units.
This is the second course in the Molecular Pharmacology series, effects of cardiovascular, endocrine, cancer chemotherapy, immunologic therapeutic agents and the mechanisms whereby these effects are induced. Drug classes will be presented to illustrate the effects of drug classes in the treatment of diseases. Enrollment in the PCSP program is required.

PCSP 233. Molecular Pharmacology III. 4 Units.
This is the third course in the Molecular Pharmacology series, effects of antimicrobial, hematologic and gastrointestinal therapeutic agents and the mechanism whereby these are induced. Drug classes are presented to illustrate the effects of drug classes in the treatment of diseases. The mechanisms of drug toxicity are also covered. Enrollment in the PCSP program is required.

PCSP 234. Neurochemical Pharmacology. 3 Units.
Students study neurobiology of nerve cells and the neurochemical pharmacology associated with function of central and peripheral nervous systems. Graduate standing.

PCSP 235. Current Topics in Pharmacology and Toxicology. 2 Units.
Each week this course focuses on a different area of research interest in pharmacology and toxicology. It involves discussions of assigned research papers that provide students with a current perspective and understanding of issues and techniques associated with the selected research topics. Graduate standing in the PCSP program.

PCSP 236. Selected Topics: Advanced Toxicology. 2 Units.
This course teaches students the organ systems and mechanistic approach to toxicological assessment. Quantitative, environmental and regulatory aspects of toxicology are included as essential elements of toxicological evaluation. Graduate standing in the PCSP program or permission of instructor.

PCSP 237. Cell Culture Techniques. 3 Units.
This course teaches students basic techniques in mammalian cell culture. In addition, advanced topics of cellular techniques are demonstrated and discussed representative of current research methods. Permission of PCSP Program Director.

PCSP 240. Molecular Spectroscopy. 4 Units.
The basic theory behind infrared, visible, ultraviolet, and magnetic resonance spectroscopy are studied. The course includes the quantum mechanics of light absorption, atomic absorption and emission spectroscopy, vibrational spectroscopy of diatomic and polyatomic molecules, absorption and emission electronic spectroscopy and magnetic resonance spectroscopy. Graduate standing or permission of instructor.

PCSP 241. Advanced Organic/Bioorganic Chemistry. 4 Units.
Synthetically useful organic reactions not normally covered in the introductory courses are emphasized. The reactions are grouped according to their mechanistic type and discussed in terms of their reaction mechanisms and synthetic utility. Prerequisites: CHEM 121 and CHEM 123 with a "C" or better.
PCSP 242. Selected Topics: Advanced Organic Chemistry. 4 Units. Topics presented at various times under this course description include: Physical organic, natural products and structure elucidation, stereochemistry, heterocycles and carbohydrate chemistry. Prerequisites: CHEM 121 and CHEM 123 with a "C" or better.

PCSP 243. Applied Computational Chemistry. 4 Units. Besides the normal laboratory experiments traditionally expected, modern chemists/biochemists, whether in the chemical/pharmaceutical industry or academia, perform "experiments" on the computer by calculating the outcome of chemical and biochemical reactions. This in silico chemistry has become an integral part of the education in chemistry and the present course will provide an introduction into this field by addressing a general audience of chemists/biochemists and students from neighboring fields.

PCSP 244. High-Resolution NMR Spectroscopy. 4 Units. A study of one and two dimensional FT-NMR techniques used for structure elucidation of organic molecules. Emphasis is placed on understanding the capabilities and limitations of these techniques, the information they provide and the practical aspects of their implementation. Permission of instructor.

PCSP 245. Proteins and Nucleic Acids. 3 Units. Students study the chemical, physical and biological properties of the proteins and nucleic acids and their constituents. Topics include isolation, determination of composition, sequence and structure; correlation of structure and biological properties. Prerequisite: CHEM 151 with a "C" or better.

PCSP 247. Mass Spectrometry. 4 Units. Students study the fundamentals of mass spectrometry, theory, instrumentation and applications to organic and biological molecules. Prerequisite: PCSP 205.

PCSP 248. Enzymology. 4 Units. This class gives an introduction into the biochemistry of the various classes of enzymes with emphasis on laboratory techniques. Prerequisite: CHEM 151 with a "C" or better.

PCSP 249. Research Processes: Publications, Presentations, Grants and IRB. 3 Units. This course prepares graduate students in Pharmaceconomics and Health Care Outcomes and Services to meet the challenges of a broad assortment of health services related research by providing fundamental principles and tools for the discipline. The class uses real world examples of research design, statistical evaluations and database selection and use to assess therapeutic, economic and humanistic outcomes. Prerequisites: PCSP 201 and PCSP 203.

PCSP 250. Long Term Care Practice. 3 Units. This course covers the clinical pharmacy component of a long term facility with special emphasis on opportunities and research needs. Students study the systematic approach to monitor the drug therapy of the long term care patient. Graduate standing.

PCSP 251. Health Services Management and Finance. 2 Units. Health Care Finance offers an introduction to accounting, financial theory and practice in health care settings. It is designed to familiarize students with financial concepts and issues confronting managers in the health and pharmaceutical sectors. Prerequisites: Admission to the PCSP graduate program and permission of the instructor.

PCSP 252. Applied Statistics in Health Services Research and Analysis. 3 Units. Students examine the application of clinical pharmacy to ambulatory care settings in an affiliated clinic or community pharmacy. Special emphasis is placed on opportunities and research needs. Graduate standing.

PCSP 253. Teaching and Evaluation of Learning and Competency. 2 Units. Student abilities in development as a teacher are developed in an interactive, evidence-based manner covering the major components of teaching, learning, evaluation and assessment. Prerequisites: Admission to the PCSP graduate program and permission of the instructor.

PCSP 254. Pharmacoeconomics and Health Care Outcomes and Services to meet challenges associated with pharmacoeconomics and Health Care Outcomes and Services. 4 Units.

PCSP 255. Topics in Acute Care Practice. 3 Units. Students examine the application and investigation of clinical pharmacy in acute care setting with emphasis on medical management of common diseases and rational drug selection and dosing. Graduate standing.

PCSP 256. Advances in Neuropsychiatric Pharmaceutical Care. 2 Units. Students examine pharmaceutical care for the patient with neurologic and psychiatric disorders. Emphasis is placed on appropriate use of drug therapy in the management of these disorders. Graduate standing. Permission of instructor.

PCSP 257. Ambulatory Care Practice. 3 Units. Students examine the application of clinical pharmacy to ambulatory care settings in an affiliated clinic or community pharmacy. Special emphasis is placed on opportunities and research needs. Graduate standing.

PCSP 258. Teaching and Evaluation of Learning and Competency. 2 Units. Student abilities in development as a teacher are developed in an interactive, evidence-based manner covering the major components of teaching, learning, evaluation and assessment. Prerequisites: Admission to the PCSP graduate program and permission of the instructor.

PCSP 259. Topics in Acute Care Practice. 3 Units. Students examine the application and investigation of clinical pharmacy in acute care setting with emphasis on medical management of common diseases and rational drug selection and dosing. Graduate standing.

PCSP 260. Advances in Neuropsychiatric Pharmaceutical Care. 2 Units. Students examine pharmaceutical care for the patient with neurologic and psychiatric disorders. Emphasis is placed on appropriate use of drug therapy in the management of these disorders. Graduate standing. Permission of instructor.

PCSP 261. Advances in Cardiovascular Pharmaceutical Care. 3 Units. Students explore the application of Drug Therapy to patient care with assignments that expand the students' knowledge of background material that support therapeutic guidelines. Permission of instructor.

PCSP 262. Vascular, Renal and Pulmonary Care. 4 Units. Students study the pharmaceutical care for the patient with cardiovascular, respiratory and renal diseases. Emphasis is placed on appropriate use of drug therapy in the management of the disease. Prerequisites: Successful completion of all courses in semesters 1-3 of the Doctor of Pharmacy Program.

PCSP 263. Analytical Techniques in Pharmaceconomics and Health Care Outcomes and Services. 4 Units. This course prepares graduate students in Pharmaceconomics and Health Care Outcomes and Services to meet the challenges of a broad assortment of health services related research by providing fundamental principles and tools for the discipline. The class uses real world examples of research design, statistical evaluations and database selection and use to assess therapeutic, economic and humanistic outcomes. Prerequisites: PCSP 201 and PCSP 203.

PCSP 264. Applied Statistics in Health Services Research and Analysis. 3 Units. This course prepares graduate students in Pharmaceconomics and Health Care Outcomes and Services to meet the challenges posed by the needed to rapidly and accurately review, critique and assimilate information from health care and economic literature and to complete a full, advanced statistical analysis such as that required for the introduction and discussion sections of a research article or dissertation in pharmaceconomics and health care outcomes. Prerequisites: PCSP 201, 203, 263.

PCSP 265. Health Care Economics. 2 Units. This course is a current medical literature based course and is designed to prepare graduate students in Pharmaceconomics and Health Care Outcomes and Services to meet challenges associated with understanding microeconomics terms and tools used in health care, medical literature and health care decision making processes. Readings, lectures and discussions emphasize processes used in economic decisions made by health care consumers, providers and third party payers. Primary topics include the demand for health care, how it may vary based on payment/payer options and the scope and supply of care available. Prerequisites: PCSP 263, 264, and permission of the instructor.
PCSP 266. Pharmacoeconomics and Microeconomics/Managerial Economics. 2 Units.
This course is designed to prepare graduate students in Pharmacoeconomics and Health Care Outcomes and Services to evaluate the applicability, importance and relevancy of pharmacoeconomics, microeconomics and managerial economics in answering questions and solving problems within the US health care system. Additionally, after completion of this course, students can assess, apply, interpret and determine the appropriate utilization of pharmacoeconomics, microeconomic, and managerial economic principles to address relevant healthcare issues and questions. Prerequisites: PCSP 201 and permission of the instructor.

PCSP 270. Theory and Methodology of Simulation of Natural Rock Formation. 4 Units.
This course is created particularly for PhD students of the Pharmaceutical and Chemical Sciences Program. It offers a comprehensive integration of multi-disciplinary sciences such as biology, life science, geoscience, ocean science, environment science, material science, etc. The course introduces some new breakthroughs and frontier discovery which reveal the mystery relationship between life science and geoscience. Upon completion of this course, PhD students are able to carry out professional lab and on-site tests and measurements. Graduate standing in chemistry, biology, geology, material science, environmental science or engineering or permission of instructor.

PCSP 283. Multidisciplinary Project. 1 Unit.
Students in the Pharmaceutical and Chemical Science Graduate Program design an interdisciplinary project based upon the relevant contributions of their backgrounds. Enrollment in PCSP Graduate Program.

PCSP 287. Internship. 1-4 Units.
The internship offers an experiential learning program at a pharmaceutical/chemical/biotechnological industry, academic institution, government laboratory, or a clinical site that entitles the students to learn advanced techniques and practical application of the theoretical principles learned in a number of courses. Graduate students that have completed Category I course work, or obtained permission of coordinator shall enroll in this course. For students in thesis/dissertation tracks, concurrence of thesis/dissertation adviser(s) is required.

PCSP 291. Independent Study. 1-4 Units.
Independent Study is restricted to masters or doctoral (PhD) candidates. It may be repeated with permission as progress warrants. No more than eight credits may be used toward doctoral degree requirements. The student must be in good academic standing. Approval of the required contract for Independent Graduate Study is required. Graduate standing and permission of the instructor.

PCSP 299. Thesis. 1-6 Units.
This course provides one-to-one work by student with faculty research mentor to plan, organize, conduct, evaluate and write an original research project as a thesis for partial fulfillment of the MS degree. Admission to MS thesis program (PCSP) and permission of research advisor.

PCSP 387. Internship. 1-4 Units.
This internship offers an experiential learning program at a pharmaceutical/chemical/biotechnological industry, academic institution, government laboratory, or a clinical site that entitles the students to learn advanced techniques and practical application of the theoretical principles learned in a number of courses. Graduate Standing with completed Category I course work or permission of coordinator. For students in thesis/dissertation tracks, concurrence of thesis/dissertation adviser(s) is required.

PCSP 391. Independent Study. 1-4 Units.
Independent Study is restricted to masters or doctoral (PhD) candidates. It may be repeated with permission as progress warrants. No more than eight credits may be used toward doctoral degree requirements. The student must be in good academic standing. Approval of the required contract for Independent Graduate Study is required. Graduate standing and permission of the instructor.

PCSP 391D. Independent Study. 1-4 Units.
PCSP 395. Graduate Seminar. 1 Unit.
This seminar presents research-related topics given by both PCSP faculty and graduate students. Enrolled students are required to attend all seminars given throughout the pharmacy academic year and to give one seminar in that year. This course is required for all graduate students for the first three years of their tenure in the PCSP. Students who have already enrolled in this course for three years are encouraged to attend seminars without official enrollment. PCSP faculty members present a short talk on their research areas at the beginning of the fall semester each year. Graduate standing.

PCSP 397. Graduate Research. 1-4 Units.
Graduate Research is limited to masters or doctoral (PhD) candidates. It may be repeated with permission as progress warrants. No more than eight credits may be used toward doctoral degree requirements. Admission to the graduate program and permission of research director.

PCSP 397D. Graduate Research. 1-4 Units.
PCSP 397E. Graduate Research. 1-4 Units.
PCSP 399. Dissertation. 1-6 Units.
This course is only open to doctoral (PhD) candidates. No more than eight credits may be used toward doctoral degree requirements. Admission to PhD program (PCSP) and permission of research advisor.