

USC School of Pharmacy

Ranked in the top 10 by U.S. News and World Report for its Pharm.D. program, the USC School of Pharmacy uniquely covers the full spectrum of pharmaceutical care — from drug discovery and development to translation and regulation to patient care and outcomes — giving students the opportunity to learn and experience in a multidisciplinary, “bench-to-bedside” environment.

Founded in 1905, the USC School of Pharmacy is the oldest and foremost pharmacy school in Southern California. The school is a national leader known for its progressive curriculum and research excellence. Approximately 50 percent of the practicing pharmacists in Southern California are graduates of USC. The school has an average student body of 735 full-time students in the Pharm.D. program and 220 students pursuing M.S., Ph.D., and DRSc degrees in pharmacology and toxicology, pharmaceutical sciences, health economics, regulatory science and healthcare decision analysis. There are 67 full-time faculty and more than 400 part-time and volunteer faculty at the school.

The school occupies state-of-the-art facilities on the USC Health Sciences Campus in metropolitan Los Angeles, adjacent to the Los Angeles County+USC Medical Center (one of the largest teaching hospitals in the country), the USC Norris Cancer Hospital and the Keck Hospital of USC. USC pharmacy students receive clinical training at these facilities and many other affiliated hospitals, health care clinics, skilled nursing facilities, home health care agencies and pharmacies in the Southern California region.

Recognized as one of the most innovative schools of pharmacy, the USC School of Pharmacy serves as a model for other progressive schools. In 1950, USC was the first to establish a Doctor of Pharmacy program. Additional national “firsts” that distinguish the school include: first clinical pharmacy program and first M.S. in radiopharmacy (both in 1968); first Pharm.D./MBA dual degree program (1988); first M.S. and Ph.D. programs in pharmaceutical economics and policy (1994) and first professional doctorate in regulatory science (2008).

Consistently the top private pharmacy school nationwide, the school is a member of the American Association of Colleges of Pharmacy, and the Pharm.D. program is accredited by the Accreditation Council for Pharmacy Education.

Health Sciences Campus
John Stauffer Pharmaceutical Sciences Center
 1985 Zonal Avenue
 Los Angeles, CA 90089-9121
 (323) 442-1369
 FAX: (323) 442-1681
Office of Admission and Student Affairs
 (323) 442-1466
 Email: pharmadm@usc.edu
 Email: pharmfa@usc.edu
 pharmacyschool.usc.edu

Administration

R. Pete Vanderveen, Ph.D., R.Ph., Dean

Sarah F. Hamm-Alvarez, Ph.D., Executive Vice Dean and Vice Dean for Research and Graduate Affairs

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Fred G. Weissman, Pharm.D., J.D., Associate Dean, Student/Faculty Affairs and Admission

Michael Z. Wincor, Pharm.D., Associate Dean, Global Initiatives and Technology and Interim Chair, Titus Family Department of Clinical Pharmacy and Pharmaceutical Economics & Policy

Kathleen H. Besinque, Pharm.D., M.S.Ed., Assistant Dean, Curriculum and Assessment

Curtis Okamoto, Ph.D., Interim Chair, Department of Pharmacology and Pharmaceutical Sciences

Faculty

John Stauffer Dean's Chair in Pharmaceutical Sciences: R. Pete Vanderveen, Ph.D., R.Ph.

University Professor and Boyd P. and Elsie D. Welin Professor in Pharmaceutical Sciences: Jean Chen Shih, Ph.D.

Distinguished Professor: Walter Wolf, Ph.D.

Hygeia Centennial Chair in Clinical Pharmacy: Steven Chen, Pharm.D.

Quintiles Chair in Pharmaceutical Development and Regulatory Innovation: Darius Lakdawalla, Ph.D.

R. Pete Vanderveen Endowed Chair in Therapeutic Discovery and Development: Roberta Diaz Brinton, Ph.D.

John A. Biles Professor in Pharmaceutical Sciences: Wei-Chiang Shen, Ph.D.

Gavin S. Herbert Professor in Pharmaceutical Sciences: Sarah F. Hamm-Alvarez, Ph.D.

Charles Krown/Pharmacy Alumni Professor in Pharmaceutical Sciences: Enrique Cadenas, M.D., Ph.D.

Provost Professor of Cell and Neurobiology, Pharmacology and Pharmaceutical Sciences, and Psychology: Pat Levitt, Ph.D.

Provost Professor of Medicine and Pharmacy: Michael Kahn, Ph.D.

Professors: Enrique Cadenas, M.D., Ph.D.; Roberta Diaz Brinton, Ph.D.; Dana Goldman, Ph.D.; Sarah F. Hamm-Alvarez, Ph.D.; Michael B. Nichol, Ph.D.; Wei-Chiang Shen, Ph.D.; Jean C. Shih, Ph.D.; Rajindar Sohal, Ph.D.; R. Pete Vanderveen, Ph.D.; Walter W. Wolf, Ph.D.

Associate Professors: James D. Adams, Jr., Ph.D.; Julio A. Camarero, Ph.D.; Jason N. Doctor, Ph.D.; Roger F. Duncan, Ph.D.; Ian S. Haworth, Ph.D.; Geoffrey Joyce, Ph.D.; Jeffrey S. McCombs, Ph.D.; Curtis T. Okamoto, Ph.D.; Neeraj Sood, Ph.D.; Bangyan Stiles, Ph.D.; Clay C.C. Wang, Ph.D.

Assistant Professors: J. Andrew MacKay, Ph.D.; Bogdan Z. Olenyuk, Ph.D.

Lecturer: Rebecca Romero, Ph.D.

Research Associate Professors: Chuanqing Ding, Ph.D.; Julie Zissimopoulos, Ph.D.

Research Assistant Professors: Liana Asatryan, Ph.D.; Julianna Hwang, Pharm.D., Ph.D.; Jennica Zaro, Ph.D.

Professors of Pharmacy: Frances Richmond, Ph.D.; Glen L. Stimmel, Pharm.D.; Bradley R. Williams, Pharm.D.; Annie Wong-Beringer, Pharm.D.

Associate Professors of Pharmacy: Melvin F. Baron, Pharm.D., MPA; Paul M. Beringer, Pharm.D.; Kathleen H. Besinque, Pharm.D., M.S.Ed.; Steven Chen, Pharm.D.; Daryl L. Davies, Ph.D.; Julie A. Dopheide, Pharm.D.; Kevin L. Forrester, Pharm.D.; William C. Gong, Pharm.D.;

Cynthia L.L. Lieu, Pharm.D.; Stanley G. Louie, Pharm.D.; Gladys H. Mitani, Pharm.D.; Tien Ng, Pharm.D.; Kathleen Rodgers, Ph.D.; Irving Steinberg, Pharm.D.; Fred G. Weissman, Pharm.D., J.D.; Michael Z. Wincor, Pharm.D.

Assistant Professors of Pharmacy: Betty Chan, Pharm.D.; Marc Cosep, Pharm.D.; Jennifer H. Cupo-Abbott, Pharm.D.; Melissa Durham, Pharm.D.; Emily Han, Pharm.D.; Jiwon Kim, Pharm.D.; Kum Ja K. Lee, Pharm.D.; May C. Mak, Pharm.D.; Emi Minejima, Pharm.D.; Edith Mirzaian, Pharm.D.; Rory O'Callaghan, Pharm.D.; Eunjoo Pacifici, Pharm.D., Ph.D.; Susie Park, Pharm.D.; Paula Phongsamron, Pharm.D.; Florence H. Wong-Yu, Pharm.D.

Distinguished Emeritus Professor and Dean: John A. Biles, Ph.D.

Emeritus Professor and Dean: Timothy M. Chan, Ph.D.

Emeritus Professor: Eric J. Lien, Ph.D.

Programs

The School of Pharmacy offers curricula leading to the Doctor of Pharmacy (Pharm.D.) and Doctor of Regulatory Science (D.R.Sc.) degrees and graduate degrees through the Graduate School including: Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) in pharmaceutical sciences, Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) in molecular pharmacology and toxicology, Master of Science (M.S.) in pharmaceutical economics and policy, Doctor of Philosophy (Ph.D.) in health economics, Master of Science (M.S.) in Health Care Decision Analysis, Doctor of Philosophy (Ph.D.) in clinical and experimental therapeutics, Master of Science (M.S.) in regulatory science, and Master of Science (M.S.) in management of drug development. Seven dual degree programs, one joint program and numerous certificate programs are also offered, including: Pharm.D./J.D., Pharm.D./MBA, Pharm.D./MPH, Pharm.D./M.S. in regulatory science, Pharm.D./M.S. in gerontology, Pharm.D./M.S. in global medicine, Pharm.D./Ph.D., Pharm.D./graduate certificate in gerontology, Pharm.D./M.S. in health care decision analysis, and graduate certificates in clinical research design and management, food safety, preclinical drug development, and patient and product safety.

The USC School of Pharmacy Doctor of Pharmacy program is accredited by Accreditation Council for Pharmacy Education, 135 S. LaSalle Street, Suite 4100, Chicago, IL 60603-4810, phone: (312) 664-3575, Fax (312) 664-4652 or (312) 664-7008.

Tuition and Fees (Estimated)

Tuition for School of Pharmacy degree programs (Pharm.D.; M.S. and Ph.D. in pharmaceutical sciences; M.S. and Ph.D. in molecular pharmacology and toxicology; M.S. and Ph.D. in health economics) is charged at a flat rate (which differs from standard USC tuition). See the Tuition and Fees section for fee information. These fees are subject to change.

Doctor of Pharmacy students must pay a \$500 non-refundable acceptance deposit that is applicable toward tuition. For deposit information in other degree programs in the School of Pharmacy, please consult appropriate offices.

Honor Societies

Rho Chi

Theta chapter of Rho Chi, the academic honor society in pharmacy, was established at USC in 1925. Charters for chapters of this organization are granted only to student groups in those colleges that are members in good standing of the American Association of Colleges of Pharmacy. Eligibility for membership is based on high attainment in scholarship, character, personality and leadership. All candidates selected for membership must

have completed three semesters of the pharmacy program, and they must be approved by the Dean of the School of Pharmacy.

Phi Lambda Sigma

The Phi Lambda Sigma chapter was established at USC in 1988. This national pharmacy leadership society is devoted to identifying, supporting and recognizing the contribution of pharmacy students to their colleges, their classmates, their campuses, their communities and to their chosen profession.

Student Housing and Service Facility, Health Sciences Campus

There are limited university-managed accommodations on the Health Sciences Campus. The Blanche and Frank R. Seaver Student Residence, adjacent to the John Stauffer Pharmaceutical Sciences Center, provides dining facilities and a bookstore. For residence information, call (323) 442-1576; for bookstore information, call (323) 442-2674. Students may also live in student housing on the University Park Campus, located about eight miles from the Health Sciences Campus.

Student Health Services, Health Sciences Campus

Services of the Student Health Center, covered by the mandatory student health fee, include the ambulatory care health services provided by the Student Health Center nursing staff. The Student Health Center is located in the USC Health Care Consultation Center, 1500 San Pablo Street, Suite 104, adjacent to the USC University Hospital, one block northeast of the School of Pharmacy. The telephone number is (323) 442-5980. In addition to the student health fee, all Pharm.D. students must have major medical insurance coverage from the USC Student Health Plan. A student may request a waiver of the USC Student Health Plan if covered by a personal medical plan that meets criteria established by the Health Insurance Office.

Professional Degrees

Doctor of Pharmacy

The USC School of Pharmacy offers a full-time, four-year course of study leading to the Doctor of Pharmacy (Pharm.D.). An undergraduate B.A. or B.S. degree is required for admission to the program. A description of the curriculum is listed in the following pages. The degree will be conferred upon successful completion of all Doctor of Pharmacy degree requirements. The USC School of Pharmacy Doctor of Pharmacy program is accredited by the Accreditation Council for Pharmacy Education, which is the national agency that accredits professional degree programs in pharmacy and providers of continuing pharmacy education.

Application Procedure

The School of Pharmacy requires applicants to complete both the Pharmacy College Application Service (PharmCAS) and a supplemental application for admission. The supplemental application is available at pharmacyschool.usc.edu.

Both the PharmCAS and the supplemental applications deadlines are November 1. Follow the instructions carefully for both the PharmCAS and supplemental applications. Applications will not be reviewed until both applications have been received by the Office of Admission and Student Affairs. An on-campus interview is required for admission. Only applicants with complete application files and are evaluated for an on-site interview and only highly qualified applicants will be granted interviews. Not all applicants will be invited for an interview. Applicants are encouraged to apply well before the November 1 deadline to allow time for file review.

All documents mailed directly to the School of Pharmacy and received from PharmCAS by the Office of Admission become the property of the university and cannot be returned or duplicated for other than USC's purposes.

Admission Guidelines

The Admission Committee considers several factors in making admissions decisions: strong academic performance; the on-site interview including the writing component; letters of recommendation; and other components of the completed application. The committee also considers a candidate's motivation to pursue pharmacy, interpersonal skills, oral and written communication skills, and leadership abilities. While the School of Pharmacy gives equal consideration to every qualified applicant, the school cannot accommodate all qualified candidates who apply for admission.

Admission of International Students

Applicants for the School of Pharmacy's Doctor of Pharmacy (Pharm.D.) program holding international visas should contact the USC School of Pharmacy for information.

Entrance Requirements

Admission to the School of Pharmacy requires completion of a baccalaureate degree, completion of the specified prerequisite college courses, with a grade of C or better and a minimum 3.0 (A = 4.0) grade point average and a minimum cumulative 3.0 grade point average.

Pre-pharmacy Requirements

To be eligible for admission to the School of Pharmacy, students must take required prerequisite college courses, including general chemistry, organic chemistry, general biology, physics, biochemistry, upper-division molecular biology or cell biology, microbiology, human physiology, calculus, statistics, a social sciences course related to human behavior, and a course in microeconomics. The science requirements should be completed at an accredited four-year university. All other requirements may be completed at a two-year college.

Grades of pass/no pass or credit/no credit will not be accepted (unless a course is only offered on a pass/no pass basis). Online courses are not accepted for science courses with a laboratory requirement. Prerequisite courses are subject to change, and applicants are encouraged to check with the school prior to submitting an application.

Mathematics and Physical Sciences

Courses must include calculus, statistics, general chemistry, organic chemistry and physics. Only courses for science majors are acceptable. It is highly recommended that math and science courses be completed during the regular academic year and not during a summer term.

Calculus: one semester or two quarters of calculus are required. The course should include differential and integral calculus for science majors. The recommended course at USC is MATH 125.

Statistics: One course in statistics (not business statistics) is required.

General chemistry: a one-year course for science majors, including laboratory, is required. The course should include inorganic chemistry and qualitative analysis. The recommended courses at USC are CHEM 105L&BL.

Organic chemistry: a one-year course for science majors, including laboratory, is required. If the school offers less than a one-year course, the student must

complete the second semester at another institution. The recommended courses at USC are CHEM 322a&L.

Physics: a one-semester (two quarters) course in physics for science majors with laboratory is required (inclusion of thermodynamics and electromagnetism is recommended). The recommended courses at USC are PHYS 135a&L or PHYS 151L and PHYS 152L. Online courses may not be used for prerequisite courses requiring a laboratory.

Biological Sciences

General biology: a one-year course (two semesters, three quarters) for science majors is required in general biology with laboratory (excluding courses in human anatomy, human physiology, botany and microbiology). If the school offers less than a one-year course, the student must complete the second semester at another institution. The recommended courses at USC are BISC 120Lx and BISC 220L.

Microbiology: one course in fundamental microbiology for science majors is required. The recommended course at USC is BISC 300L. Lab is recommended but not required.

Molecular or cell biology: one upper division course in molecular or cell biology for science majors is required. The recommended course at USC is BISC 320L or BISC 411.

Biochemistry: one upper division course in biochemistry for science majors is required. The recommended course at USC is BISC 330L. Upper-division courses must be taken at a four-year institution and may not be taken at a community college.

Human physiology: one course in human physiology for science majors is required (courses in plant anatomy and cell physiology cannot be used to meet this requirement). A combined anatomy and physiology course is acceptable if a full academic year (two semesters or three quarters) is completed.

Social and Behavioral Sciences

One course in human behavior (psychology, sociology, cultural anthropology or related courses is required).

Economics: one course in microeconomics is required. If a one-year course is offered, both semesters may be taken and excess units may be applied to either the remainder of the unit requirements for the subject area or as elective units. The equivalent course at USC is ECON 203.

Advanced Placement and International Baccalaureate Examinations

Applicants may use AP and IB courses to meet certain USC School of Pharmacy prerequisites with the following provisos. AP results are acceptable only with scores of 4 or 5. IB results are acceptable with a score of 5. AP or IB may be applied to a maximum of one semester/one quarter of general chemistry or general biology; they may not be used to satisfy the laboratory requirement. Applicants are advised that a maximum of 2 AP course credits will be accepted and applied to the prerequisites. Note: AP/IB courses used to meet prerequisites will be for course credit only (i.e., they will not count toward the GPA). The Admission Committee recommends that applicants enroll in all of the required pre-pharmacy courses. Please contact the School of Pharmacy Office of Admission for specific information.

Entrance Examination

An in-person interview is required for admission. The PCAT is not required at this time.

Special Admission Program for Entering Freshmen

The Trojan Admission Pre-pharmacy (TAP) program provides priority consideration for admission to the USC School of Pharmacy's four-year Doctor of Pharmacy (Pharm.D.) program for USC undergraduates who are accepted to the program. Students accepted into the TAP program must apply to the Doctor of Pharmacy program during their senior year and meet all regular admission criteria including a B.A./B.S. degree at USC, meeting academic performance standards and an on-site interview. Students in the TAP program are required to complete all prerequisite courses at USC and meet regularly with a TAP program adviser. The TAP program is designed to attract highly qualified, mature high school seniors applying to USC. A specific listing of USC courses and a recommended program for TAP participants can be obtained from the School of Pharmacy Office of Admission or online at pharmacyschool.usc.edu/programs/pre/tap.

General Education Requirements (TAP Students Only)

TAP students must meet the university's general education requirements; see The USC Core and the General Education Program for details.

Pharm.D. Curriculum Requirements

The completion of a four-year professional curriculum is required for the Doctor of Pharmacy (Pharm.D.) degree. The Pharm.D. curriculum is a "block" program. All students must enroll in the specified block of courses each semester. Students do not have a choice in the course sequence. Year III and IV students have a limited number of elective course choices. Student progress is permitted only when the prior semester has been successfully completed. Students should view the curriculum outlined here as advisory only and subject to modification. A minimum of 144 units is required for graduation.

Students enrolled in the Doctor of Pharmacy program are required to be licensed by the California Board of Pharmacy as an intern pharmacist for the entire length of the program. Completion of the program requires placement in health care settings for experiential learning. The School of Pharmacy has developed technical standards to inform students of the non-academic requirements of the program. Placement in health care settings may require the applicants pass criminal background screening and/or drug screening tests.

The pharmacist of tomorrow will provide preventive and therapeutic pharmaceutical care, provide drugs to patients, communicate in health care matters, meet the ethical and legal requirements of the practice of pharmacy and maintain professional expertise.

The curriculum committee of the School of Pharmacy has developed guidelines and patient care competencies consistent with interpretations of this new role. An appropriate and dynamic educational program is needed to develop these competencies. Therefore curriculum changes may be necessary in order to meet scientific advances, population profile changes, increasing health expectations, technological advances, or changes in health services.

Core Curriculum

Foundation courses in the biomedical, pharmaceutical, social-administrative and clinical sciences comprise the first three years of the program. Students complete Introductory Pharmacy Practice Experiences (IPPE) along with classroom-based courses. The final (fourth) year of the program includes the Advanced Pharmacy Practice Experiences (APPE), which are set in health care setting throughout the greater Los Angeles area, and a capstone course leading to a final paper/project.

Year I Curriculum		Units
PHRD 501	Pharmaceutics I	4
PHRD 502	Pharmaceutics II	3

PHRD 503	Biological Systems I	4
PHRD 504	Biological Systems II	6
PHRD 505	Molecular Genetics and Therapy	3
PHRD 507	Health Care Delivery Systems	2
PHRD 509	Pharmacy Practice and Experience I	4
PHRD 510	Pharmacy Practice and Experience II	4
PHRD 554	Public Health and Epidemiology	2
PHRD 555	Biochemical and Molecular Sites of Drug Action	4

Year II Curriculum		Units
PHRD 506	Self Care and Non-Prescription Therapies	5
PHRD 508	Pharmacy Literature Analysis and Drug Information	3
PHRD 551	Immunology	3
PHRD 552	Pharmaceutics III	3
PHRD 553	Management Within Health Care Organizations	2
PHRD 557	Therapeutics I	4
PHRD 559	Therapeutics II	3
PHRD 560	Therapeutics III	6
PHRD 561	Pharmacy Practice and Experience III	3
PHRD 562	Therapeutics IV	4

Year III Curriculum		Units
PHRD 601	Therapeutics V	6
PHRD 603	Therapeutics VI	3
PHRD 605	Therapeutics VII	4
PHRD 606	Therapeutics VIII	2
PHRD 607	Nutrition	2
PHRD 608	Therapeutics IX	2
PHRD 610	Therapeutics X	3
PHRD 612	Therapeutics XI	2
PHRD 614	Pharmaceutical Economics and Outcome Studies	3
PHRD 616	Pharmacy Law and Ethics	3
Electives (two, one course per semester)*		
*Students choose elective courses from courses approved by the School of Pharmacy Curriculum Committee and available during that semester. Students will be provided a list of courses approved each year.		

Required APPE Courses (all five courses)

Year IV Curriculum	
PHRD 701	Acute Care Clinical APPE
PHRD 704	Primary Care APPE
PHRD 705	Community Pharmacy APPE
PHRD 718	Hospital Pharmacy Practice APPE
PHRD 750	Advanced Pharmacy Practice Elective APPE

Elective APPE Course (choose one course from list):

PHRD 714	Nuclear Pharmacy APPE
PHRD 725	International Pharmacy Practice Experience
PHRD 726	Directed Clinical Project I APPE
PHRD 727	Directed Clinical Project II APPE
PHRD 731	Advanced Geriatrics APPE
PHRD 735	Clinical Pharmacy Research APPE
PHRD 738	Pharmaceutical Industry APPE

Capstone	
PHRD 796ab	Doctor of Pharmacy Capstone (a in the fall, and b in the spring)

Total for Pharm.D. degree: 144 semester units

Degree Requirements

All students in the Doctor of Pharmacy degree program must meet course requirements, grade point average

requirements and program residency requirements. All course requirements must be completed with a grade of C or better for letter graded courses and a grade of A or B quality in non-letter graded courses. The degree will not be conferred until the student has successfully completed all Doctor of Pharmacy degree requirements. Students are subject to the degree requirements in the *USC Catalogue* current for the semester of their admission into the Doctor of Pharmacy program. Students must have a cumulative grade point average of 3.0 in the Pharm.D. curriculum to meet graduation requirements.

Registration

Details of the School of Pharmacy registration procedure will be included in the orientation program prior to the first week of classes.

Cancellation of Registration

During the first three years of the Doctor of Pharmacy program (Years I, II and III), a student will only be permitted to withdraw from the entire block of courses enrolled in a semester and may not selectively withdraw from a single course or group of courses. During the fourth year, students must contact the School of Pharmacy Office of Admission and Student Affairs for withdrawal guidelines. Procedures for readmission into the program or make-up of incomplete courses are included in the school's brochure on academic policies and procedures.

Graduate Degrees

The School of Pharmacy, through the Graduate School, offers curricula leading to the M.S. and Ph.D. degrees in pharmaceutical sciences, in molecular pharmacology and toxicology, and in health economics, as well as a Ph.D. in clinical and experimental therapeutics. The school also offers interdisciplinary M.S. degrees in regulatory science and in the management of drug development. The M.S. degree in pharmaceutical economics and policy is offered jointly with the USC Price School of Public Policy and the Department of Economics. In addition, the school offers dual degrees with the schools of law, business, gerontology and medicine as well as other programs. Instructions given in the Admission section of this catalogue are to be followed, but the application and the supplemental information requested should first be submitted to: Graduate Programs Office, USC School of Pharmacy, 1985 Zonal Avenue, Los Angeles, CA 90033. Additional information may be obtained by calling (323) 442-1474 or sending email to pharmgrd@usc.edu.

Admission Requirements for the Master of Science and Doctor of Philosophy in Pharmaceutical Sciences

Applicants should possess a bachelor's degree or equivalent from an accredited college or university. A minimum grade point average of 3.0 and qualifying scores on the GRE in the verbal and quantitative tests are required. In addition to excellent communication skills, applicants should possess knowledge and competence equivalent to one year of acceptable course work in at least three of the following disciplines: mathematics, organic chemistry, physical chemistry, biochemistry, physiology and pharmacology. In addition to the application for admission, three letters of recommendation from faculty members who can evaluate the promise of the applicant for graduate study and a personal statement summarizing career objectives and research interests must be submitted.

Applicants who do not meet all the specific requirements indicated above, but who show unique potential, may be considered for admission with

conditions, which may be fulfilled during the first semester of enrollment. See the Graduate School section of this catalogue.

Admission Requirements for the Master of Science and Doctor of Philosophy in Molecular Pharmacology and Toxicology

Applicants should possess a bachelor's degree or equivalent from an accredited college or university. A minimum grade point average of 3.0 and qualifying scores on the GRE in verbal and quantitative tests are required. In addition to excellent communication skills, applicants should possess knowledge and competence equivalent to one year of work in at least three of the following disciplines: mathematics, organic chemistry, physical chemistry, biochemistry, molecular biology, cell biology, physiology, pharmacology, economics, statistics and computer sciences. In addition to the application for admission, the candidate must submit three letters of recommendation from faculty members who can evaluate the promise of the applicant for graduate study and a personal statement summarizing the candidate's career objectives and research interests. Students will be selected for admission on the basis of their academic and scientific record, and, whenever possible, interviews (in person or by phone) with one or more members of the faculty.

Admission Requirements for the Master of Science in Pharmaceutical Economics and Policy

Applicants for admission must have achieved a minimum 3.0 GPA in undergraduate or professional school and adequate scores on the GRE. In addition, applicants will be required to have completed upper division courses in statistical methods, calculus and microeconomics.

Admission Requirements for the Doctor of Philosophy in Clinical and Experimental Therapeutics

Applicants should possess a bachelor's degree in quantitative/biological sciences (or health profession) or an advanced health professional degree (i.e., Pharm.D., M.D., DDS) from an accredited college or university. A minimum grade point average of 3.0 and qualifying scores on the GRE in the verbal and quantitative tests are required. A student currently enrolled in the Pharm.D. program may pursue a Pharm.D./Ph.D. dual degree following the admission procedure in the Catalogue.

In addition to the application for admission, three letters of recommendation from faculty members who can evaluate the promise of the applicant for graduate study and a personal statement summarizing career objectives and research interests must be submitted.

Applicants who do not meet all the specific requirements indicated above, but who show unique potential, may be considered for admission with conditions, which may be fulfilled during the first semester of enrollment. See the Graduate School section of this catalogue for further information.

Admission Requirements for the Doctor of Philosophy in Health Economics

Candidates with a bachelor's, master's or Pharm.D. degree are invited to apply. Applicants must have demonstrated proficiency in verbal and written English and aptitude in economics, mathematics, statistics and computer science. Deficiencies in economics and statistical background can be addressed through preliminary course work after admission to the program.

A minimum grade point average of at least 3.0 (A = 4.0) is required. Special attention is given to the grades achieved in economics, statistics and mathematics courses relevant to the program. A qualifying score on the GRE in verbal and quantitative areas is required. Students

with GRE scores of 1200 or better will be given priority for financial aid support.

Admission Requirements for the Master of Science in Health Care Decision Analysis

Applicants should possess a bachelor's degree or equivalent from an accredited college or university. Applicants with graduate or professional degrees are encouraged to apply. A minimum grade point average of 3.0 and qualifying scores on the GRE examination are required. The program encourages the participation of part-time students with work experience. Acceptance criteria for those individuals will be assessed on a case-by-case basis. English proficiency is essential. Additional requirements for international students are outlined by university regulations under Admission of International Students.

Admission Requirements for the Master of Science in Regulatory Science

Applicants should possess a bachelor's degree or equivalent from an accredited college or university. Applicants with graduate or professional degrees are encouraged to apply. A minimum grade point average of 3.0 or qualifying scores on the GRE or equivalent examination are required. The program encourages the participation of part-time students with work experience.

Acceptance criteria for those individuals will be assessed on a case-by-case basis. English proficiency is essential. Students will be selected for admission, whenever possible, after interviews with one or more members of faculty.

Admission Requirements for the Master of Science in Management of Drug Development

Applicants should possess a bachelor's degree or equivalent from an accredited college or university. Applicants with graduate or professional degrees are encouraged to apply. A minimum grade point average of 3.0 or equivalent and qualifying scores on the GRE or equivalent examination are required. The program encourages the participation of part-time students with work experience. Acceptance criteria for those individuals will be assessed on a case-by-case basis. English proficiency is essential.

Admission of International Students to Graduate Degree Programs

All requirements described in this section are also applicable to the admission of international students. In addition, special application and admission procedures are required of international students. Refer to the section on Admission of International Students in this catalogue.

Degree Requirements

These degrees are under the jurisdiction of the Graduate School. Students should also refer to the Requirements for Graduation section and the Graduate School section of this catalogue for general regulations. All courses applied toward the degrees must be courses accepted by the Graduate School.

Master of Science in Pharmaceutical Sciences

A Master of Science in the pharmaceutical sciences will be granted on the basis of completion of at least 24 units of formal course work and presentation of an acceptable thesis (PSCI 594ab, 4 units) based on the results of an original investigation.

The 24 units of course work must be at the 500-level or above, exclusive of directed research. At least 16 of the 24 required units must be taken from courses offered within the Department of Pharmacology and Pharmaceutical

Sciences (courses within the department have designations of either PSCI or MPTX). The remaining units can be taken from courses offered within the Department of Pharmacology and Pharmaceutical Sciences or in various related disciplines outside the department if approved by the Department of Pharmacology and Pharmaceutical Sciences Graduate Affairs Committee.

Master of Science in Molecular Pharmacology and Toxicology

A Master of Science in molecular pharmacology and toxicology will be granted on the basis of completion of at least 24 units of formal course work and presentation of an acceptable thesis (MPTX 594ab, 4 units) based on the results of an original investigation.

The 24 units of course work must be at the 500-level or above, exclusive of directed research. At least 16 of the 24 required units must be taken from courses offered within the Department of Pharmacology and Pharmaceutical Sciences (courses within the department have designations of either PSCI or MPTX). The remaining units can be taken from courses offered within the Department of Pharmacology and Pharmaceutical Sciences or in various related disciplines outside the department if approved by the Department of Pharmacology and Pharmaceutical Sciences Graduate Affairs Committee.

Master of Science in Pharmaceutical Economics and Policy

The Department of Pharmaceutical Economics and Policy (School of Pharmacy) offers a program of study leading to the M.S. degree. Applicants must apply to the Graduate School and meet the admissions requirements of the program. This program requires students to demonstrate skills in the analysis of pharmaceutical and health technology innovations, as well as an understanding of contemporary health policy issues.

A minimum of 36 units of graduate level courses is required.

Grade Point Average

A grade point average of at least 3.0 (A = 4.0) must be achieved on graduate course work at USC.

Recommended Courses

It is recommended that the student complete the following 36 units of graduate level course work: ECON 611 (4 units), ECON 500 (4 units) or PPD 501ab (4 units), PM 511aL (4 units), PM 512 (4 units) or approved elective, PMEP 509 (4 units), PMEP 519 (4 units), PMEP 529 (4 units), PMEP 538 (4 units) and PMEP 539 (4 units).

Students must complete all recommended courses for the degree within five years of entry into the program.

Additional Degree Requirements

The student must satisfactorily complete the recommended courses in economics, preventive medicine and public administration prior to enrolling in PMEP 538. The student is also required to complete an empirical research project on a topic relevant to pharmaceutical economics and policy.

Master of Science in Health Care Decision Analysis Curriculum Requirements

A Master of Science degree in health care decision analysis will be granted upon completion of at least 33 units of formal course work. Students with experience in industry or government can substitute an equivalent amount of formal course work with a research project, subject to the approval from program administrators.

Course requirements normally include a minimum of eight courses (24 units) with emphasis on applied health care policy, business intelligence and technical analysis. Recommended course work and electives include some courses available in other departments of the university and will be selected in consultation with the program advisers according to the areas of intended specialization of the participant in order to meet the credit requirements of the program. Students should develop a specific plan of study in consultation with the graduate advisers before beginning the program.

Grade Point Average

A grade point average of at least 3.0 (A = 4.0) must be achieved on graduate course work at USC.

Master of Science in Regulatory Science

Regulatory science relates the regulatory and legal requirements of biomedical product development to the scientific study needed to establish product safety and efficacy. A Master of Science degree in regulatory science will be granted upon completion of at least 36 units of formal course work, which can include an optional research project in an internship setting. Students with experience in industry or government can substitute an equivalent amount of formal course work for the research project with the permission of the program director. Course requirements normally include a minimum of three courses concerned with regulatory aspects of medical product development and a minimum of one course each in quality assurance, clinical research, business, statistics and law. Recommended course work includes some courses available in other departments of the university. Students should develop a specific plan of study in consultation with the graduate advisers before beginning the program.

Master of Science in Management of Drug Development

A Master of Science degree in the management of drug development will be granted upon completion of at least 32 units of course and research project work. The program is offered on both a full-time and part-time basis, and courses are also available in distance formats. Most students will take six units of directed research as part of this program. Students with appropriate industry or laboratory experience can substitute an equivalent amount of formal course work for the research project with the permission of the program director. Course requirements normally include a minimum of three courses concerned with translational aspects of medical product development. Recommended courses to satisfy this core requirement include RSCI 530, RSCI 531, RSCI 532, PSCI 664 or CXPT 609. The program must also include a minimum of one course in each of: regulatory science, quality assurance, clinical research, business and statistics. Students should develop a specific plan of study in consultation with graduate advisers before beginning the program.

Doctor of Regulatory Science

The Doctor of Regulatory Science program cultivates research, leadership and inquiry skills for advanced students in the emerging profession of global regulatory science. It is designed to produce graduates with expertise in strategic management, policy development and research assessment who can play leadership roles in the public sector, academia and the medical products industry. Participants in this program will take a set of interdependent courses that extend from a strong core of basic regulatory science course work and additionally focus on three main areas: global product strategy, product lifecycle strategy, and project and personnel management. After students have completed foundational course work, they will participate as a cohort that typically has a two-year cycle of classes and an additional year of dissertation research. The program has

been designed to meet the needs of individuals who are already working full-time outside of the university. The doctoral degree will be administered by the School of Pharmacy.

Admission

The program is designed for individuals with strong professional experience and demonstrated intellectual and leadership capabilities. Applicants are expected to have a GPA of 3.0 on university-level course work and five or more years of professional experience. Admission requirements include university transcripts, a resume, at least three letters of reference, and a one-page personal statement that outlines the background and goals of the applicant. Students are encouraged even at this early stage to identify areas in which they are interested in conducting research. Additional requirements for international students are outlined by university regulations under Admission of International Students. Students are not required to provide GRE scores unless indicated by the program director.

Students with an appropriate graduate or professional degree may use some previous graduate courses as transfer units toward the overall credit requirements of the Doctor of Regulatory Science program with the approval of the program director and under the normal rules of the university. Students who have graduated from the M.S. program in Regulatory Science can apply all of the previously taken course work toward the doctoral degree. Students with graduate degrees from outside of the regulatory science program are required to take a minimum of 32 units of course work and 4 units of dissertation research to complete the requirements for graduation. The course work requirements will be determined on an individual basis in consultation with the program director and participant's advisers.

Curriculum Requirements

The Doctor of Regulatory Science is administered by the School of Pharmacy. It requires participants to complete 64 units that include the following elements:

REQUIREMENTS	UNITS
Foundation courses	15
Product lifecycle strategy	8
Global strategy	8
Project/personnel management	8
Research methods	4
Dissertation	4

Additional elective course work will be selected in consultation with the program advisers according to the areas of intended specialization of the participant in order to meet the credit requirements of the program. Typically foundational courses and some electives will be taken in the first two years of the program. Advanced courses in product lifecycle strategy, global strategy and project/personnel management will normally be taken by the doctoral cohort of students during the third and fourth years of the program. Dissertation planning and research will typically commence in the third year of the program, and extend until the successful completion of the dissertation.

Foundation Courses

Fifteen or more units of foundation courses may be taken as part of the master's program in regulatory science, or with prior approval, from another graduate program with similar objectives. Required foundational courses normally include: MPTX 511 Introduction to Medical Product Regulation; two from MPTX 512 Regulation

of Pharmaceutical and Biological Products, MPTX 513 Regulation of Medical Devices and Diagnostics, MPTX 514 Regulation of Food and Dietary Supplements; MPTX 515 Quality Systems and Standards; MPTX 516 Medical Products and the Law; MPTX 517 Structure and Management of Clinical Trials. Other courses may be substituted after the participant's background preparation has been considered.

Product Lifecycle Strategy

Eight or more units of course work related to product lifecycle management, from discovery to commercialization, will be drawn from a broad list of courses offered in regulatory science or through the Titus Family Department of Clinical Pharmacy and Pharmaceutical Economics and Policy. Included in this list are: PMEPE 538 Pharmaceutical Economics; PMEPE 539 Economic Assessment of Medical Care; RSCI 601 Biomedical Commerce. Other courses may also be considered in consultation with the supervisors and program director. Students are also encouraged to take courses outside the School of Pharmacy when more specialized courses fit their professional research or development plans.

Global Regulatory Strategy and Policy

Eight or more units of course work related to global regulatory strategy could include some of the following courses: MPTX 519 Global Regulation of Medical Products; PPD 571 International Public Policy and Management Seminar; RSCI 604 Regulatory Strategy in Asia; RSCI 608 Regulatory Strategy in Europe and the Americas.

Project and Personnel Management

Eight or more units of relevant course work should typically include: MPTX 602 Science, Research and Ethics; RSCI 603 Managing Complex Projects; RSCI 605 Managing Organizations and Human Resources. Graduate courses in other university departments or schools can be substituted with the approval of the program director.

Research Methods

Participants will typically take PMEPE 509 Research Design or MPTX 522 Introduction to Clinical Design and Statistics.

Student Progress and Assessments

In the third year, students are expected to identify a pair of advisers including one USC faculty member and one adviser from industry or the private sector. Students are typically placed in study groups of three or four whose dissertation interests are most similar and whose collective supervisors will oversee their academic and research progress. This committee will form the dissertation committee.

At the completion of the foundational course work, students will undergo a competency review that will include considerations of academic progress. Students are expected to maintain a GPA of 3.0 and will be required to pass a written examination designed to assure the professional competence of the student prior to advancing further in the program. Students who do not pass this preliminary review, administered prior to entering the dissertation and advanced course work phase of the program, will be notified of dismissal from the program in writing by the associate dean for graduate studies in the School of Pharmacy.

Doctoral Dissertation

Students must enroll in RSCI 794 Doctoral Dissertation for at least two terms, during which time they will develop a dissertation proposal and conduct the necessary research and analysis in collaboration with the supervisory team. The dissertation committee will approve the thesis plan and monitor its progress. Each student will be required to produce and defend an independent dissertation as a requirement for graduation. A maximum of 6 dissertation units can be applied to satisfy the degree requirement, but students should register for the dissertation units in each term subsequent to the completion of their course work requirements. Institutional Review Board approval is required for all human studies.

Doctor of Philosophy in Clinical and Experimental Therapeutics

The goal of the Ph.D. program in Clinical and Experimental Therapeutics is to develop a scientist who is engaged in team science through interdisciplinary education; competent in conducting research across clinical and basic science disciplines; and integrates basic investigations and clinical observations in applied research to better understand disease process, advance drug development and evaluate efficacy and toxicity of therapeutic regimens with the goal of improving the safe, effective and economical use of therapeutic modalities by patients.

The program applies an interdisciplinary approach that focuses the graduate studies directly toward translational, rather than basic science, aiming to educate students with the perspective and skill set to identify important connections between fundamental biomedical research and human disease. This program emphasizes cross-training between clinical and basic sciences focusing on the investigation of disease processes, drug development and the efficacy and toxicity of therapeutic regimens. Course requirements and research opportunities for graduate students enrolled in the program provide both experimental (basic) and disease-focused experiences that complement the graduate's research focus.

Course Requirements

A minimum of 60 units is required. At least 26 of the 60 units are to be formal graduate course work at the 500-level or above, exclusive of seminars and directed research. Students must complete 14 units of course work before they are eligible for the screening procedure. Additional course work relevant to the research interests of the student may be required by the student's advisers or the student's qualifying exam committee, with an emphasis on cross-training and taking into account the amount and level of previous scientific preparation and the nature of the research dissertation that will be the major endpoint of the program. Specifically, recommended course work differs between students who have an advanced professional degree (Track I) and those who do not (Track II). A maximum of 12 units may be transferred from graduate studies elsewhere.

In the first year, all students (Tracks I and II) are recommended to take 14 units of course work in translational medicine (RSCI 530, 2 units), research design (CXPT 609, 4 units), biostatistics (PM 510L, 4 units), and clinical trial design (MPTX 517, 4 units). In the second year, Track I students will take the remaining 12 units of course work as electives based on the background of the student and the proposed research focus of the student. Track II students who do not have an advanced professional degree are recommended to select from the following courses as part of their electives: systems physiology and disease (INTD 572 and INTD 573, 4 units each) or pathology (INTD 550 and INTD 551, 4 units each). Other electives that can be chosen are INTD 531, INTD 561, PM 533, PM 538, PM 570, PSCI 661L and PSCI 665.

The remaining 34 of the 60 units required for the Ph.D. degree may be fulfilled with other courses including ethics, interdisciplinary seminar, directed research and dissertation. Note that to become eligible to take the qualifying exam, Track II students must fulfill the prescribed clinical experiences that match the disease-related topic of the student's thesis work as approved by the student's advisers and advisory committee. Students with a bachelor's degree in a health care subject area (e.g., nursing, pharmacy, medicine) will be evaluated on a case basis and may be required to meet the therapeutic course work or clinical experience component described above, as determined by their background and previous experiences.

Foreign Language Requirement

There is no formal language requirement. However, an individual qualifying exam committee can require competency in a foreign language or a computer language if it is relevant for the student's area of research.

Qualifying Exam Committee

Upon admission, the student will be assigned to a member of the graduate faculty who will serve as his or her temporary adviser until a permanent adviser has been identified. The student's program of study will be under the direction of the qualifying exam committee composed of at least five members, one of whom must be from outside the department. Because of the centrality of research in the Ph.D. program, the student is encouraged to get acquainted with the participating faculty mentors from the day they enter the program, and have selected a research direction, paired graduate advisers (clinical and basic scientists), and qualifying exam committee no later than the third semester of study. The graduate affairs committee will serve as the qualifying exam committee until one is selected.

Screening Procedure

The performance of each student will be evaluated no later than the end of the second semester of enrollment in the graduate program. This screening procedure is conducted by the student's qualifying exam committee or, if a student has not yet selected a qualifying exam committee, by the graduate affairs committee. The committee reviews the student's progress to date in various areas including course work, research interests, and laboratory performance on his or her research project or laboratory rotations. If a performance deficiency is determined, specific goals will be established that the student must fulfill to continue in the program. Passing this screening procedure is prerequisite to continuation in the Ph.D. program.

Qualifying Examination

Students will be required to pass a comprehensive written and oral examination on the chosen disease-focused area of research emphasis. The examination will encompass basic scientific concepts relevant to the disease under study and the laboratory techniques in that discipline, fundamental principles of clinical research and design, biostatistics, and therapeutics in the chosen disease-focused area of research. The examination is administered by the qualifying exam committee and consists of two parts: a written examination administered to all students at the end of their second year of study and a detailed written proposal and its oral presentation and defense by the student to the qualifying exam committee. The examination process is conducted by the student's advisory committee with oversight by the graduate affairs committee. All course and qualifying examination requirements for the Doctor of Philosophy must be completed within two-and-a-half years after admission. After passing these examinations, the student is admitted to candidacy for the Ph.D. degree.

Dissertation

A dissertation based on original investigation in a relevant scientific area is required for the Ph.D. The dissertation research must represent a significant contribution to science and should demonstrate the candidate's scholarly advancement and competence to undertake independent research. An oral defense of the dissertation will be held after the candidate submits the final draft of the dissertation to the dissertation committee. (See Theses and Dissertations in the Graduate School section.)

Student Teaching

Teaching experience is considered an integral part of the training of graduate students. As part of the general requirements for the Ph.D. degree, each student is required to participate in the teaching program of the School of Pharmacy.

Doctor of Philosophy in Health Economics

The Titus Family Department of Clinical Pharmacy and Pharmaceutical Economics and Policy (School of Pharmacy) offers a program of study leading to the Ph.D. degree in Health Economics. The program focuses on microeconomics; econometrics; health economics and policy; public finance; pharmaceutical economics and policy. The program offers one track in microeconomics and a second track in pharmaceutical economics and policy.

Microeconomics Track

Students in the microeconomics track will complete the microeconomic theory and econometric sequence and course work in health economics. They will receive focused training and mentoring in health economics through collaboration on research projects.

Foreign Language Requirement

There is no formal foreign language requirement. However, competence in the use of one computer programming language is required for the graduate degrees. Such competence can be demonstrated either by course work or examination.

Grade Point Average

A grade point average (GPA) of at least 3.0 and typically considerably higher (on a scale of 4.0) must have been achieved on all graduate work at USC for the passing of the screening procedure. The Graduate School requires a minimum GPA of 3.0 on all course work taken as a graduate student at USC.

Unit Requirements and Recommended Courses

The Ph.D. in Health Economics requires a minimum of 64 units of graduate-level courses numbered 500 or higher (excluding 794) and a minimum of 4 units of 794. A maximum of two full courses (eight units) or their equivalent may be PMEP 790 (research) since directed research will generally be incorporated into most 500- and 600- level courses. Exceptions will be considered on an individual basis. Normally, a full-time graduate student course load is three full courses or their equivalent per semester, with a four-course maximum.

Microeconomics Track	Units
Satisfactory completion of the economic theory sequence with a grade point average of B or higher. At least one of the econometrics courses must be completed with a grade of B or higher:	
ECON 601	Microeconomic Theory I (4), or

GSBA 602	Selected Issues in Economic Theory (3)	3-4
ECON 603	Microeconomic Theory II (4)	4
ECON 609	Econometric Methods	4
ECON 611	Probability and Statistics for Economists	4
ECON 615	Applied Econometrics	4

Satisfactory completion of the health economics sequence with a grade point average of B or higher:

PMEP 509	Research Design	4
PM 511aBL	Data Analysis	4
PMEP 519	Survey Research and Quality of Life Assessment	4
PMEP 529	Risk, Probabilities and Preferences	4
PMEP 534	Health Economics I	4
PMEP 544	Health Economics II	4
ECON 693	Seminar in Applied Economics and Public Policy, or	2, max 4
PMEP 698	Seminar in Pharmaceutical Economics and Policy	1, max 4

Three electives at the 500 level or higher from the School of Pharmacy's Health Economics Program and from the departments of economics, mathematical statistics, biometry, epidemiology, public administration, computer science or other relevant fields are required.

Qualifying Exam

The student will be assigned to a member of the graduate faculty who will serve as his or her temporary adviser until the formation of a qualifying exam committee. The student should consult the health economics director of graduate studies on the appointment of a Ph.D. qualifying exam committee after taking the written screening examinations. The chairman of the student's Ph.D. qualifying exam committee advises the student on matters of curriculum and graduate opportunities. The qualifying exam committee comprises three to five members, at least one of whom can be from outside the department; at least two members must specialize in the student's area of emphasis; and at least three of the members must be suitable for service on the student's dissertation committee. The composition of all Ph.D. qualifying exam committees must be approved by the health economics director of graduate studies. The student must form his or her qualifying exam committee soon after passing the departmental screening procedure.

Screening Procedure

The student's progress will be reviewed after each semester and before registration for any additional course work to determine if progress has been satisfactory. The screening procedure will include satisfactory performance on written screening exams covering the major topics covered in the recommended course work for each track.

Seminar Requirements

Every student is recommended to take and satisfactorily complete 4 units of research seminars chosen from ECON 693, PMEP 698 or the equivalent. At least one of these seminars must be related to the student's major field, and the same seminar may be taken more than once. Before completing the dissertation, it is recommended that the student present at least one original research paper in a seminar of his or her choice. This paper should typically consist of original results contained in the student's dissertation.

Dissertation Proposal Preparation

The student is required to register for two units of PMEP 790 and write a research paper on a topic suitable for a dissertation. Typically, the chair of the student's guidance committee directs this work. The resulting essay

becomes, part of the student's written dissertation proposal, which is presented and critiqued during the oral portion of the qualifying examination.

Qualifying Examination

Upon successful completion of the first two years of course and grade requirements, and following passing of required screening procedures, the student takes a general written and oral examination on the chosen area of research emphasis after presenting a detailed written dissertation proposal. After passing these examinations, the student is admitted to candidacy for the Ph.D. degree.

Dissertation

After admission to candidacy, the student forms a dissertation committee comprising three faculty members, one of whom can be from an outside department. The chair of this committee is the dissertation supervisor. The student must register for PMEP 794 each semester, excluding summer sessions, until the dissertation and all other degree requirements are completed.

The student is expected to complete a dissertation based on an original investigation. The dissertation must represent a significant contribution to knowledge and must be defended in an oral examination administered by the dissertation committee (see the section on Theses and Dissertations).

Student Teaching

Teaching experience is considered an integral part of the training of graduate students. As part of the general requirements for the Ph.D., all students are required to undergo training as an educator. This will include participating in seminars on educational techniques and hands-on teaching experiences through participation in didactic and small group teaching in the School of Pharmacy or the USC Price School of Public Policy.

Pharmaceutical Economics and Policy Track

Students in the pharmaceutical economics and policy track will specialize in areas such as cost-effectiveness, comparative effectiveness, drug therapy outcomes and organization of pharmaceutical markets. They will receive focused training and mentoring in pharmaceutical economics and policy through collaboration on research projects.

Foreign Language Requirement

There is no formal foreign language requirement. However, competence in the use of one computer programming language is required for the graduate degrees. Such competence can be demonstrated either by course work or examination.

Grade Point Average

A grade point average of at least 3.0 (A = 4.0) must have been achieved on graduate course work at USC. ECON 615 or a higher-level course in econometrics must be completed with a grade of B or higher.

Unit Requirements and Recommended Courses

Students are required to complete a minimum of 64 units of graduate level course work. The following courses are recommended towards fulfilling the 64-unit requirement: ECON 401, ECON 500, ECON 513, ECON 514, ECON 609, ECON 615, PM 511a, PMEP 509, PMEP 519, PMEP 529, PMEP 538, PMEP 539, PMEP 549 and PMEP 698. Students may transfer and substitute up to 24 units of graduate course work from other universities to fulfill the required 64 units of graduate credit subject to the approval of the department.

Pharmaceutical Economics and Policy Track Units

Satisfactory completion of the economic theory sequence with a grade point average of B or higher. At least one of the econometrics courses must be completed with a grade of B or higher:

ECON 401	Mathematical Methods in Economics	4
ECON 500	Microeconomic Analysis and Policy	4
ECON 609	Econometric Methods	4
ECON 611	Probability and Statistics for Economists	4
ECON 615	Applied Econometrics	4

Satisfactory completion of the pharmaceutical economics and policy sequence with an average grade of B or higher:

PMEP 509	Research Design	4
PMEP 519	Survey Research and Quality of Life Assessment	4
PMEP 529	Risk, Probabilities and Preferences	4
PMEP 538	Pharmaceutical Economics	4
PMEP 539	Economic Assessment of Medical Care	4
PMEP 549	Applied Pharmacoeconometrics	4
PMEP 698	Seminar in Pharmaceutical Economics and Policy	1, max 4

A minimum of three electives at the 500 level or higher from the School of Pharmacy's Pharmaceutical Economics and Policy Program and from the departments of economics, mathematical statistics, biometry, epidemiology, public administration, computer science or other relevant fields are required.

Qualifying Exam Committee

The student will be assigned to a member of the graduate faculty who will serve as his or her temporary adviser until the formation of a qualifying exam committee. The student should consult the pharmaceutical economics and policy director of graduate studies on the appointment of a Ph.D. qualifying exam committee after taking the written qualifying examination. The chairman of the student's Ph.D. qualifying exam committee advises the student on matters of curriculum and graduate opportunities. The qualifying exam committee comprises three to five members, at least one of whom can be from outside the department; at least two members must specialize in the student's area of emphasis; and at least three of the members must be suitable for service on the student's dissertation committee. The composition of all Ph.D. qualifying exam committees must be approved by the pharmaceutical economics and policy director of graduate studies. The student must form his or her qualifying exam committee soon after passing the departmental screening procedure.

Screening Procedure

The student's progress will be reviewed after each semester and before registration for any additional course work to determine if progress has been satisfactory. The screening procedure may include satisfactory performance on written screening exams covering the major topics covered in the recommended course work for each track.

Seminar Requirements

Every student is recommended to take and satisfactorily complete 4 units of research seminars chosen from PMEP 698 or the equivalent. At least one of these seminars must be related to the student's major field and the same seminar may be taken more than once. Before completing the dissertation, it is recommended that the student present at least one original research

paper in a seminar of his or her choice. This paper should typically consist of original results contained in the student's dissertation.

Dissertation Proposal Preparation

The student is required to register for two units of PMEP 790 and write a research paper on a topic suitable for a dissertation. Typically, the chair of the student's guidance committee directs this work. The resulting essay becomes part of the student's written dissertation proposal which is presented and critiqued during the oral portion of the qualifying examination.

Qualifying Examination

Upon successful completion of the first two years of course work and grade requirements, including the passing of required screening procedures, the student takes a general written and oral examination on the chosen area of research emphasis after presenting a detailed written dissertation proposal. After passing these examinations, the student is admitted to candidacy for the Ph.D. degree.

Dissertation

After admission to candidacy, the student forms a dissertation committee comprising three faculty members, one of whom can be from an outside department. The chair of this committee is the dissertation supervisor. The student must register for PMEP 794 each semester, excluding summer sessions, until the dissertation and all other degree requirements are completed.

The student is expected to complete a dissertation based on original investigation. The dissertation must represent a significant contribution to knowledge and must be defended in an oral examination administered by the dissertation committee (see the section on Theses and Dissertations).

Student Teaching

Teaching experience is considered an integral part of the training of graduate students. As part of the general requirements for the Ph.D., all students are required to undergo training as an educator. This will include participating in seminars on educational techniques and hands-on teaching experiences through participation in didactic and small group teaching in the School of Pharmacy.

Doctor of Philosophy in Pharmaceutical Sciences

This program emphasizes basic as well as applied research in drug delivery and targeting, utilizing medicinal chemistry, computational chemistry, pharmaceuticals, pharmacodynamics, molecular pharmacology, immunology and cell biology.

A minimum of 60 units is required for the Doctor of Philosophy degree. At least 24 units of course work are required at the 500-level or above, exclusive of seminar and directed research. The Doctor of Philosophy candidate must select a minimum of 12 units from courses offered in the Department of Pharmacology and Pharmaceutical Sciences (PPSI), eight of which must be selected from the core 4-unit courses. The remainder of the 24 units may be taken from PPSI courses or from courses offered in other departments that are approved by the PPSI graduate affairs committee. The qualifying exam committee may require more than 24 units of course work. A maximum of 12 units can be transferred from graduate studies elsewhere.

Foreign Language Requirement

There is no formal foreign language requirement. However, an individual qualifying exam committee can

require competency in a foreign language or some other research tool such as computer language, if this is relevant for the student's area of research.

Qualifying Exam Committee

Upon admission, the student will be assigned to a member of the graduate faculty who will serve as his or her temporary adviser until a permanent adviser has been identified. The student's program of study will be under the direction of a qualifying exam committee composed of at least five members, one of whom must be from outside the department granting the degree. The student should select a graduate adviser and qualifying exam committee no later than the third semester in residence.

Screening Procedure

The performance of each student will be evaluated no later than the end of the second semester of enrollment in the graduate program. This screening procedure is conducted by the student's qualifying exam committee or, if a student has not selected his or her research adviser at that time, by the Graduate Review Committee of the department. The committee reviews thoroughly the student's progress up to that point in various areas including course work, research interests and laboratory performance on his or her research project or laboratory rotations. If a performance deficiency is detected at that point by the committee, the student will be recommended to either take additional course work or transfer to the Master of Science program. Passing this screening procedure is prerequisite to continuation in the Ph.D. program.

Qualifying Examination

Students will be required to pass a comprehensive qualifying examination in major areas of the pharmaceutical sciences. The examination is administered by the qualifying exam committee and consists of two parts: a written examination and a written proposition outlining a research project, followed by an oral examination based on the proposition and questions dealing with the written examination.

All course and qualifying examination requirements for the Doctor of Philosophy must be completed within two and one half years after admission.

Dissertation

A dissertation based on original investigation is required. The research should make a contribution to science and should demonstrate the candidate's scholarly advancement and competence to undertake independent research. An oral defense of the dissertation will be held after the candidate submits the final draft of the dissertation to the dissertation committee (see Theses and Dissertations).

Student Teaching

Teaching experience is considered an integral part of the training of graduate students. Thus, as part of the general requirements for the Ph.D., each student is required to participate in the teaching program of the School of Pharmacy.

Doctor of Philosophy in Molecular Pharmacology and Toxicology

This program emphasizes basic as well as applied research in various aspects of drug discovery and molecular and behavioral mechanisms of action. Research opportunities span investigations of fundamental molecular and cellular physiological mechanisms, including receptor activity, intracellular signaling and the regulation of gene expression, to the molecular bases of disease and aging, including avenues of pharmacological intervention.

A minimum of 60 units is required for the Doctor of Philosophy degree. At least 24 units of course work are required at the 500-level or above, exclusive of seminar and directed research. The Doctor of Philosophy candidate must select a minimum of 12 units from courses offered in the Department of Pharmacology and Pharmaceutical Sciences (PPSI), eight of which must be selected from the core 4-unit courses. The remainder of the 24 units may be taken from PPSI courses or from courses offered in other departments that are approved by the PPSI graduate affairs committee. The qualifying exam committee may require more than 24 units of course work. A maximum of 12 units can be transferred from graduate studies elsewhere.

Foreign Language Requirement

There is no formal language requirement. However, an individual qualifying exam committee can require competency in a foreign language or a computer language if it is relevant for the student's area of research.

Qualifying Exam Committee

Upon admission, the student will be assigned to a member of the graduate faculty who will serve as his or her temporary adviser until a permanent adviser has been identified. The student's program of study will be under the direction of a qualifying exam committee composed of at least five members, one of whom must be from outside the department. The student should select a graduate adviser and qualifying exam committee no later than the third semester in residence. The graduate affairs committee will serve as the qualifying exam committee until one is selected.

Screening Procedure

The performance of each student will be evaluated no later than the end of the second semester of enrollment in the graduate program. This screening procedure is conducted by the student's qualifying exam committee or, if a student has not yet selected a qualifying exam committee, by the graduate affairs committee. The committee reviews the student's progress to date in various areas including course work, research interests and laboratory performance on his or her research project or laboratory rotations. If a performance deficiency is determined, specific goals will be established that the student must fulfill to continue in the program. Passing this screening procedure is prerequisite to continuation in the Ph.D. program.

Qualifying Examination

Students will be required to pass a comprehensive qualifying examination in major areas of molecular pharmacology, including fundamental principals of molecular and cellular biology. The examination is administered by the qualifying exam committee and consists of two parts: a written examination administered to all students at the end of their second year of study and a written proposal outlining the dissertation goals, and its oral presentation and defense by the student to the qualifying exam committee. The examination process is conducted by the student's advisory committee with oversight by the graduate affairs committee. The qualifying examination must be completed within three years after admission, unless an extension is obtained from the qualifying exam committee.

Annual Research Appraisal (ARA)

Beginning in the third year, each graduate student will meet with the qualifying exam committee and present a progress report on his or her research. Prior to the meeting the student will present a short written document describing significant experiments during the past year, problems and projected studies. This document is distributed to the committee members and is included in the student's file. The oral ARA meeting is intended to be a

working session between the student and the qualifying exam committee. Experimental results and problems are discussed in this context, as well as a research plan for the next year of work. A satisfactory ARA is required for each year in the graduate program.

Dissertation

A dissertation based on original investigation in a relevant scientific area is required for the Ph.D. The dissertation research should demonstrate the student's ability to undertake independent research through planning, conducting and evaluating experiments. The dissertation research must represent a significant contribution to knowledge. A public oral defense of the dissertation will be held after the candidate submits the final draft of the dissertation to the dissertation committee, and it is approved by the graduate adviser and dissertation committee. For additional details, see Theses and Dissertations.

Student Teaching

Teaching experience is considered an integral part of the training of graduate students. As part of the general requirements for the Ph.D. degree, each student is required to participate in the teaching program of the School of Pharmacy.

Pharm.D./Juris Doctor

Admission Requirements

Admission to the dual Pharm.D./J.D. program is competitive, and involves meeting admission requirements and gaining acceptance to both the School of Pharmacy and the USC Gould School of Law. Students will not be given special consideration for admission to either program because they are applying for the dual degree. Students who have a baccalaureate degree may apply to the dual Pharm.D./J.D. degree program in two ways. First, they may apply at the time they submit their Pharm.D. application by concurrently submitting applications to both schools. Students who elect this approach must identify themselves on their Pharm.D. applications as potential dual Pharm.D./J.D. degree students. Students who are admitted to both schools will be offered admission to the dual degree contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 GPA. Students pursuing the dual Pharm.D./J.D. degree must notify the law school in a timely fashion that they will be enrolling in the dual Pharm.D./J.D. degree program and will not matriculate at the law school until the following year. Students who are accepted by only one school may choose to attend that school but will not be eligible for the dual degree. Second, students can apply to the dual degree by submitting an application to the Gould School of Law during their first year of enrollment in the Pharm.D. program prior to the law school's published application deadline. Students who elect this approach must apply through the School of Pharmacy. Students who are admitted to the law school using this approach would be offered admission to the dual degree contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 GPA. See the admissions section of the School of Pharmacy and the Gould School of Law for specific requirements.

Pharm.D. Requirements

Dual degree students must successfully complete 144 units of Pharm.D. and acceptable J.D. units to receive the Pharm.D. degree. The 144 units must include 132 units of required and elective pharmacy course work plus 12 units of J.D. course work deemed acceptable to meet Pharm.D. elective requirements. Dual degree students should graduate with their Pharm.D. degrees at the completion of

the first semester of the sixth academic year of the dual degree program. Students will be eligible to sit for the Pharmacy Board Exams after completion of the Pharm.D. degree requirements. However, dual degree students will not actually be awarded their Pharm.D. degrees until they complete requirements for both degrees.

Juris Doctor Requirements

Dual degree students must successfully complete 88 units of J.D. and acceptable Pharm.D. course work during the second to sixth years of the dual degree program to receive the J.D. degree. The 88 units must be composed of 76 units of J.D. course work, including satisfaction of the upper-division writing requirement and any other substantive requirements, plus 12 units of Pharm.D. course work deemed acceptable to meet J.D. elective requirements. No J.D. credit will be awarded for Pharm.D. course work completed prior to matriculation in the law school. Students cannot receive the J.D. degree under requirements for the dual degree program without prior or simultaneous completion of the Pharm.D. degree.

Both professions require passing a state board or bar exam to practice the respective professions. Neither of these professional doctoral degrees requires a thesis or comprehensive final exam.

Pharm.D./MBA Dual Degree Program

Responding to the growing demand on pharmacists to be knowledgeable in both science and business administration, the USC School of Pharmacy in 1988 helped pioneer an innovation in pharmaceutical education by offering this unique five-year dual degree program.

The Pharm.D./MBA dual degree program is offered cooperatively by the School of Pharmacy and the USC Marshall School of Business. Students must complete concurrently all requirements established by both schools for their respective degrees.

The program involves completion of the first year in the School of Pharmacy, the second in the Marshall School of Business, and then completion of the balance of both degrees during the third through fifth years. A total of 48 units must be completed in the Marshall School of Business.

First Year: Required Pharmacy School courses.

Second Year: Required MBA courses and graduate business electives.

Third to Fifth Years: 108 units of Pharmacy courses and graduate business electives sufficient to bring the total units completed in the Marshall School of Business to at least 48. Dual degree students may not count courses taken outside the Marshall School of Business toward the 48 units.

The Pharm.D. and the MBA are awarded simultaneously upon completion of the School of Pharmacy and the Marshall School of Business requirements.

Admission Requirements

Applicants to this program must have a baccalaureate degree from an accredited college or university and should apply during their first year of pharmacy studies. Only students who have successfully completed one year in the School of Pharmacy will be considered for admission to the Marshall School of Business. See the Marshall School of Business for admission requirements.

Pharm.D./M.S., Gerontology

The emerging impact of the elderly on the health care system has created a need for health care providers who

understand the unique needs of the elderly. As drug therapy remains the primary therapeutic option for chronic disease, the demand for prescription drugs will continue to rise. There is a demand for pharmacists who are equipped to meet the pharmaceutical care needs of this population. Geriatric pharmacy is recognized as a specialty, with board certification through the Commission for Certification in Geriatric Pharmacy. The Pharm.D./M.S., Gerontology program will provide extensive education and training in the unique health care needs of older adults. It will allow student pharmacists with a career interest in geriatrics or gerontology to work with health care planning or delivery organizations to develop and implement progressive pharmaceutical care programs for the elderly.

Application and Admission Requirements

Students who intend to pursue the dual Pharm.D./MSG degree must be accepted by both programs. This includes having completed a baccalaureate degree from an accredited college or university with a minimum GPA of 3.0 and a minimum equivalent GRE score of 1000. Students will not be given special consideration for admission to either program because they are applying for the dual degree. Students may apply to the dual Pharm.D./M.S. degree program in two ways. First, they may apply at the time they submit their Pharm.D. application by concurrently submitting applications to both programs. Students who elect this approach must identify themselves on both applications as potential dual degree students. Students who are admitted to both programs will be offered admission to the Pharm.D. and will be offered admission to the dual degree program. Second, students can apply to the dual degree by submitting an application to the M.S. program during their first year of enrollment in the Pharm.D. prior to the M.S. published application deadline. Students who elect this approach must apply through the School of Pharmacy. Students admitted to the M.S. program using this approach will be offered admission to the dual degree contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 GPA. Students accepted to the dual degree program must maintain a minimum 3.0 GPA in their Gerontology and Pharm.D. courses.

Recommended Program

First year: Required Year I Pharm.D. course work

Second year: Required Gerontology course work

Third year: Required Year II Pharm.D. course work

Fourth year: Required Year III Pharm.D. course work

Fifth year: Required Year IV Pharm.D. course work

Graduation Requirements

Students must complete all requirements for the Pharm.D. (see the Professional Degrees page) and M.S., Gerontology degrees as listed in the current catalogue with a minimum cumulative 3.0 GPA. The specific M.S. course requirements for the dual Pharm.D./M.S. degree are listed on the School of Gerontology Dual Degree Programs page.

Pharm.D./Master of Science, Global Medicine

The dual degree in Pharmacy and Global Medicine is designed for students who are interested in providing pharmaceutical care to underserved populations around the world. Students enrolled in this dual degree program will benefit from an advanced understanding of the role of, and issues surrounding, modern medicine in developing countries.

Requirements

Students must gain admission to and fulfill the degree requirements for both programs, which include 138 units for the Doctor of Pharmacy and 24 units for the M.S. in Global Medicine. Six units of GM elective units can be used towards the Pharm.D. elective requirement, and PHRD 503 and PHRD 504 substitute for MEDS 503 and MEDS 504.

Program Adaptation

Because MEDS 503 and MEDS 504, core requirements for the M.S. in Global Medicine program, cover the same material as PHRD 503 and PHRD 504, the Pharm.D./Global Medicine dual degree program substitutes PHRD 503 and PHRD 504 for MEDS 503 and MEDS 504 as core requirements for the dual degree.

Pharm.D./Master of Science, Health Care Decision Analysis

The Health Care Decision Analysis (HCDA) program gives students the tools and knowledge to succeed in the complex world of health care data analytics, international access and reimbursement, product pricing and value assessment, insurance operations and design, along with competitive business intelligence. A dual degree of Doctor of Pharmacy and Master of Science in Health Care Decision Analysis will be granted upon the completion of the course work required for the Pharm.D. degree, and the HCDA core and elective units. Dual degree students will be credited up to 9 units of appropriate Pharm.D. course work toward the M.S., HCDA. Dual degree students will select from a series of HCDA core courses and required electives to meet the M.S., HCDA degree requirements. Electives will be considered from the disciplines: applied health care policy, business intelligence, regulatory science, and health care economics, along with all required clerkships and rotations offered through the USC School of Pharmacy. Students should develop a specific plan of study in consultation with program administrators before beginning the program.

Pharm.D./Master of Public Health

The School of Pharmacy and the Master of Public Health program, in recognition of the rapidly changing health care environment, and in response to the growing demand for pharmacists who are knowledgeable in both pharmacy and population-based health care issues, have developed a dual degree program. The joint Pharm.D./MPH degree will enable graduates to be more responsive to today's health care needs and will provide training for pharmacists who seek to be agents of change within the profession and to assume leadership roles in the pharmacy field and in public health at the local, state and national levels.

Students who are enrolled in the School of Pharmacy must apply to the Master of Public Health program no later than January of their first year. All requirements for admission to the regular MPH program must also be fulfilled by dual degree applicants.

The Pharm.D./MPH program spans five years (four years of pharmacy school courses and one year of public health courses). Students begin the core MPH courses following the successful completion of the first year of pharmacy school. The last three years of the program are devoted to course work and the clinical rotations of the School of Pharmacy and to the completion of the elective courses and practicum (field experience) of the MPH program.

All students in the Pharm.D./MPH program must meet course requirements, grade point average requirements and program residency requirements of both programs. Students must have a cumulative GPA of 3.0 in the Pharm.D. curriculum and a 3.0 in the MPH curriculum to meet graduation requirements.

The Pharm.D. and the MPH degrees are awarded simultaneously upon completion of the School of Pharmacy and the Master of Public Health requirements.

Admission Requirements and Procedures

Students applying for the dual degree program must meet the respective admission requirements for each program. This includes having completed a baccalaureate degree from an accredited college or university with a minimum GPA of 3.0 and having acceptable GRE and TOEFL or IELTS scores as applicable. Students will not be given special consideration for admission to either program because they are applying for the dual degree. Students may apply to the dual Pharm.D./MPH degree program in two ways. First, they may apply at the time they submit their Pharm.D. application by concurrently submitting applications to both programs. Students who elect this approach must identify themselves on both applications as potential dual degree students. Students who are admitted to both programs will be offered admission to the Pharm.D. and will be offered admission to the dual degree program contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 GPA. Students who are accepted by only one program may choose to attend that program, but will not be eligible for the dual degree. Second, students can apply to the dual degree by submitting an application to the MPH program during their first year of enrollment in the Pharm.D. prior to the MPH published application deadline. Students who elect this approach must apply through the School of Pharmacy. Students admitted to the MPH program using this approach will be offered admission to the dual degree contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 GPA.

Pharm.D./M.S., Regulatory Science

Regulatory science is that branch of knowledge which relates the regulatory and legal requirements of biomedical product development to the scientific testing and oversight needed to ensure product safety and efficacy. The program provides an opportunity for advanced preparation in the fields of regulatory affairs, quality assurance and clinical research. Students must complete concurrently all of the requirements established for the respective degrees. The program alternates the courses required for the Pharm.D. program during the fall and spring terms with courses required in summer terms for the M.S. program. Students will typically take courses in the summers of years two-four. Up to 12 appropriate units of course work from the Pharm.D. program can be applied toward the M.S. degree. The Pharm.D. and the M.S., Regulatory Science degrees will be awarded simultaneously upon completion of requirements for the two programs.

Admission Requirements and Procedures

Students applying for the dual degree program must meet the respective admission requirements for each program and must have a baccalaureate degree. Students will not be given special consideration for admission to either program because they are applying for the dual degree. Students may apply to the dual Pharm.D./M.S., Regulatory Science degree program in two ways. First, they may apply at the time they submit their Pharm.D. application by concurrently submitting applications to both programs. Students who elect this approach must identify themselves on both applications as potential dual degree students. Students who are admitted to both programs will be offered admission to the Pharm.D. and will be offered admission to the dual degree program contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 GPA. Students who are accepted by only one program may choose to attend that program but will not be eligible for the dual degree. Second, students can apply to the dual degree by submitting an application to the M.S. in Regulatory Science program during their first or second year of

enrollment in the Pharm.D. prior to the M.S. in Regulatory Science published application deadline. Students who elect this approach must apply through the School of Pharmacy. Students admitted to the M.S. in Regulatory Science using this approach will be offered admission to the dual degree contingent on passing all courses in their Pharm.D. studies with a minimum 3.0 GPA.

Pharm.D./Doctor of Philosophy

The Doctor of Pharmacy/Doctor of Philosophy (Pharm.D./Ph.D.) program is designed to permit qualified Pharm.D. students with a bachelor of science or equivalent degree to pursue research training in the pharmaceutical sciences and toxicology. A student accepted into the joint program must meet all requirements for the Pharm.D., as well as the requirements for the Ph.D. in the pharmaceutical sciences or toxicology sections listed in this catalogue. A maximum of 20 units from the Pharm.D. program may be credited toward the Ph.D. Up to 12 units of these Pharm.D. courses may, at the discretion of the student's Ph.D. adviser, be counted toward the required 24 units of core course work.

Admission Procedure

Students applying for the dual degree program must meet the respective admission requirements for each program. This includes having completed a baccalaureate degree from an accredited college or university with a minimum GPA of 3.0 and a minimum GRE score of 1000. Students will not be given special consideration for admission to either program because they are applying for the dual degree. Students may apply to the dual Pharm.D./Ph.D. degree program in two ways. First, they may apply at the time they submit their Pharm.D. application by concurrently submitting applications to both programs. Students who elect this approach must identify themselves on both applications as potential dual degree students. Students who are admitted to both programs will be offered admission to the Pharm.D. and will be offered admission to the dual degree program contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 GPA. Students who are accepted by only one program may choose to attend that program but will not be eligible for the dual degree. Second, students can apply to the dual degree by submitting an application to one of the Ph.D. programs in the School of Pharmacy during their first two years of enrollment in the Pharm.D. prior to the respective published application deadlines for the Ph.D. programs. Students who elect this approach must apply through the Pharm.D. program. Students admitted to the Ph.D. program using this approach will be offered admission to the dual degree contingent on their having maintained a minimum 3.0 GPA in the Pharm.D. program.

Pharm.D./Graduate Certificate in Gerontology

This integrated program in pharmacy and gerontology prepares students with an interest in geriatric pharmacy to assume leadership roles at academic, administrative or policy levels within the profession. The program involves the completion of 16 units of core area courses in physiology, psychology, sociology and social policy aspects of aging offered by the USC Davis School of Gerontology. In addition, students are required to complete 8 units of approved elective courses in gerontology or geriatric pharmacy to be credited toward the requirements for the Pharm.D. and the Graduate Certificate in Gerontology. It is expected that the program can be successfully completed by candidates taking electives in geriatric pharmacy or gerontology during the regular semester and completing one core course in gerontology during each summer in the four year Pharm.D. program.

See the Davis School of Gerontology for complete requirements.

Admission Requirements

Students who have a baccalaureate degree from an accredited college or university must submit separate applications to the School of Pharmacy and the Davis School of Gerontology. All requirements for admission to the regular Pharm.D. program must be fulfilled by the candidate. GRE scores are not required for admission to the certificate program.

Certificate Programs

Regulatory Science Program

USC School of Pharmacy
1540 Alcazar St., CHP G32
Los Angeles, CA 90089
(323) 442-3102
Email: regsci@usc.edu
regulatory.usc.edu

Certificate in Clinical Research Design and Management

The graduate certificate in clinical research design and management is designed to strengthen the statistical, research and project management skills of clinical researchers and their associated clinical team members. Students must complete at least 12 units of course work including at least two courses in clinical design and trial management, one course in ethics and one course in a specialized aspect of design, management or statistics, subject to the approval of the program director. The program will include course work delivered in nontraditional formats such as intensive weekend sessions and will use distance learning tools, Webcast lectures and study materials. Courses can be taken on site, by distance or as a blended combination. Students should confirm their specific course work plan in consultation with the graduate advisers before beginning the program. Students who have bachelor's degrees from accredited colleges or universities must submit an application for graduate study through the regulatory science program of the School of Pharmacy. GRE scores are not required for admission to the certificate program. Students are expected to enroll each semester until the program is completed.

Requirements	Units
Introduction to Clinical Trials	
MPTX 517 Structure and Management of Clinical Trials	4

Clinical Design/Statistics (choose one)

PM 510L Principles of Biostatistics	4
MPTX 522 Introduction to Clinical Trial Design and Statistics	3

Biomedical Ethics

MPTX 602 Science, Research and Ethics	2
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Additional options in specialized aspect of design or management (choose one):

MPTX 511 Introduction to Medical Product Regulation	3
MPTX 520 Risk Management for Health Care Products	3
PM 510L Principles of Biostatistics	4
PM 511a Data Analysis	4
PM 512 Principles of Epidemiology	4
PM 523 Design of Clinical Studies	3
RSCI 527 Medical Product Safety	3
RSCI 528 Safety in the Health Care Environment	3

Certificate in Food Safety

The graduate certificate in food safety is a 12-unit program of course work designed to strengthen the knowledge base and functional "toolkit" of individuals who deal with the production and management of food in

industry and government. Students are required to take an entry-level course that focuses on regulatory requirements for foods and dietary supplements and two additional courses that focus on food science and food/drug toxicology respectively. Final course work will be selected from a small grouping of electives that deal with quality systems or risk management. The program will include course work delivered in nontraditional formats, such as intensive weekend sessions, and will use distance learning tools, Webcast lectures and study materials. Courses can be taken on site, by distance or as a blended combination. Students should confirm their specific course work plan in consultation with the graduate advisers before beginning the program. Students who have bachelor's degrees from accredited colleges or universities must submit an application for graduate study through the regulatory science program of the School of Pharmacy. GRE scores are not required for admission to the certificate program. Students are expected to enroll each semester until the program is completed.

Requirements		Units
MPTX 514 Regulation of Food and Dietary Supplements		3
MPTX 524 Introduction to Food Science and Technology		3
RSCI 525 Introduction to Drug and Food Toxicology		3

Quality/Risk Management Option:

MPTX 515 Quality Systems and Standards		3
MPTX 526 Chemistry Manufacturing and Controls		3
RSCI 520 Introduction to Risk Management for Health Care Products		2
RSCI 529 Application of Risk Management Tools and Techniques		2

Certificate in Patient and Product Safety

The graduate certificate in patient and product safety is a 12-unit program that educates students in the emerging field of safety and risk management in the health care environment. It is designed to produce graduates who have a particular expertise in the evaluation and mitigation of medical errors and health-care product problems. Course work is typically delivered in nontraditional formats such as intensive weekend sessions and will use distance learning tools, Webcast lectures and study materials. Courses can be taken on site, by distance or as a blended combination. Students should confirm their specific course work plan in consultation with the graduate advisers before beginning the program. Students who have bachelor's degrees from accredited colleges or universities must submit an application for graduate study through the regulatory science program of the School of Pharmacy. GRE scores are not required for admission to the certificate program. Students are expected to enroll each semester until the program is completed.

Students must complete 12 units of specified course work, that normally will include an introductory course in the basic principles of risk management, a second course in the use of risk management tools, and two additional courses in patient and product safety respectively as listed below. In addition, a course in medical ethics is recommended. Most students will take the courses that are listed in the sample student program below, but if students have already strong previous experience in risk management or safety, other statistical or quality courses taught in graduate programs at USC may be substituted with the permission of the program director. The certificate can be completed on a part-time basis but must be finished within five years.

Requirements		Units
MPTX 602 Science, Research and Ethics		2
RSCI 520 Introduction to Risk Management for Health Care Products		2
RSCI 527 Medical Product Safety		3
RSCI 528 Safety in the Health Care Environment		3
RSCI 529 Application of Risk Management Tools and Techniques		2

Certificate in Preclinical Drug Development

The graduate certificate in preclinical drug development provides advanced foundational training in preclinical aspects of drug development, translational research and regulatory control. Students must complete at least 12 units of course work including at least three courses in preclinical design and development (typically, RSCI 530 Translational Medicine: An Overview; RSCI 531 Drug Discovery; RSCI 532 Early Stage Drug Development) and one course in a related aspect of research design, regulation or ethics, subject to the approval of the program director. The program will include course work delivered in nontraditional formats such as intensive weekend sessions and will use distance capabilities, Webcast lectures and study materials. Courses can be taken on site, by distance or as a blended combination. Students should confirm their specific course work plan in consultation with graduate advisers before beginning the program. Students who have baccalaureate degrees from accredited colleges or universities must submit an application for graduate study through the regulatory science program of the School of Pharmacy. GRE scores are not required for admission to the certificate program. Students are expected to enroll each semester until the program is completed.

Certificate in Regulatory and Clinical Affairs

The graduate certificate in regulatory and clinical affairs is designed to provide specialized education for individuals interested in developing a systematic understanding of the U.S. regulatory system for medical products. Students must complete at least 12 units of course work including an introductory course in regulatory affairs:

Requirements		Units
One introductory course in regulatory affairs		
MPTX 511 Introduction to Medical Product Regulation		3
RSCI 530 Translational Medicine: An Overview		2
RSCI 532 Early Stage Drug Development		3

At least one specialized course in regulatory management of a particular product type

MPTX 512 Regulation of Pharmaceutical and Biological Products		3
MPTX 513 Regulation of Medical Devices and Diagnostics		3
MPTX 514 Regulation of Food and Dietary Supplements		3

At least one course in clinical design

MPTX 517 Structure and Management of Clinical Trials, or		
MPTX 522 Introduction to Clinical Trial Design and Statistics		4

One course in quality systems or risk management

MPTX 515 Quality Systems and Standards		3
MPTX 526 Chemistry Manufacturing and Controls		3
MPTX 520 Risk Management for Health Care Products		3
RSCI 525 Introduction to Drug and Food Toxicology		3

Other courses may be substituted with the approval of the program director. The program will include course work delivered in nontraditional formats such as intensive weekend sessions and will use distance capabilities to capture and Webcast lectures and study materials. Courses can be taken on site, by distance or as a blended combination. Students should confirm their specific course work plan in consultation with the graduate advisers before beginning the program. Students who have a baccalaureate degree from an accredited college or university must submit an application for graduate study through the regulatory science program of the School of Pharmacy. This program is particularly directed at Ph.D. students who wish to take the certificate during their USC studies. GRE scores are not required for admission to the certificate program. Students are expected to enroll each semester until the program is completed.

Non-Degree Programs

Office of Continuing Professional Development
1985 Zonal Avenue
Los Angeles, CA 90089-9121
(323) 442-2403
FAX: (323) 442-3600
Email: pharmce@usc.edu
<http://pharmacyschool.usc.edu/programs/ce/>

Continuing Education

The School of Pharmacy, Office of Continuing Professional Development, is a recognized provider of continuing pharmacy education accredited by the Accreditation Council for Pharmacy Education (ACPE) and recognized by the California State Board of Pharmacy and throughout the United States.

The school serves as a primary educational resource for pharmacists in California and as a supplementary resource for other health professionals and pharmacists, nationally and internationally.

Programs are designed to educate pharmacists about current issues in pharmaceutical care, practice management, therapeutics and other topics of professional interest. Continuing education programs are held at the School of Pharmacy and other locations.

For information concerning continuing education programs contact: Office of Continuing Professional Development.

Courses of Instruction

The terms indicated are expected but are not guaranteed. For the courses offered during any given term, consult the Schedule of Classes.

- Clinical And Experimental Therapeutics (CXPT)
- Health Care Decision Analysis (HCDA)
- Molecular Pharmacology and Toxicology (MPTX)
- Pharmacy (PHRD)
- Pharmaceutical Economics and Policy (PMEP)
- Pharmaceutical Sciences (PSCI)

- Regulatory Science (RSCI)

Clinical And Experimental Therapeutics (CXPT)

CXPT 609 Preclinical Experimental Therapeutic Development (4, FaSpSm) Evolution of a chemical entity as it is transformed into a drug candidate. Open only to students in clinical and experimental therapeutics and management of drug development.

CXPT 664 Clinical Problem Solving (3, Sp) (Enroll in PHRD 664)

Health Care Decision Analysis (HCDA)

HCDA 501 Fundamentals of Health Care Insurance Design (3, Fa) Introduction to insurance payer types, functions, actuarial pricing methods, network design and business operations impacting the provision of health benefits and reimbursement for medical products and services. *Recommended preparation:* undergraduate degree in pharmacy, medicine, other health care, economics and administrative sciences or related disciplines; enrollment in a related M.S. or Ph.D. program.

HCDA 502 Comparative International Health Care Systems (3) Health coverage and funding across seven industrial countries, with examination of variances and similarities in stated policy and outcomes by region and population mix. *Recommended preparation:* HCDA 501 and undergraduate degree in pharmacy, medicine, other health care, economics and administrative sciences or related disciplines; enrollment in a related M.S. or Ph.D. program.

HCDA 503 Competitive Health Care Intelligence and Pricing (3) Analysis and techniques to evaluate marketplace opportunities and value and pricing determinations for medical products; considers product launch and positioning strategies, intelligence gathering, and decision-making. *Recommended preparation:* HCDA 501 and undergraduate degree in pharmacy, medicine, other health care, economics and administrative sciences or related disciplines; enrollment in a related M.S. or Ph.D. program.

HCDA 510 Business Implications of Health Care Reform (3) Coverage, access and reimbursement changes from health care reform; individual and mandated benefits, medical loss ratio, health care exchanges and impact of comparative effectiveness review.

HCDA 520 Health Economic and Outcomes Methodology (3) Comprehensive review of core biostatistics principles and applications through practical problem solving approach and case studies. Statistical methods, data validation and outcomes research, clinical trials.

HCDA 525 Healthcare Literature Analysis and Applications (3) Review and critique of health economics, P&T and outcomes literature. Core biostatistical measures used to deconstruct and evaluate published research through case studies. *Recommended preparation:* HCDA 520.

HCDA 550 Healthcare Innovation: Creativity to Value (3) Systematically review creativity and innovation techniques across healthcare industry, examine breakthrough genomic and biopharmaceutical processes and thinking, evaluate novel therapeutic and economic measures transforming outcomes.

HCDA 553 Advanced Pricing Strategies (3) Positioning products in global markets; market share

targets, payer value, life cycle and launch techniques, tools for formulary positioning and reimbursement.

HCDA 560 Managing Effective Partnerships and Mergers (3) M&A and partnering in the health care industry; law, due diligence, contracts, research alliances, structured agreements, global partners, and tactical business strategies.

HCDA 590 Directed Research (1-12, max 12, FaSpSm) Research leading to the master's degree. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

HCDA 599 Special Topics (2-4, max 8, FaSpSm) Special topics in Healthcare Decision Analysis.

Molecular Pharmacology and Toxicology (MPTX)

MPTX 500 Molecular Pharmacology and Toxicology I (4, Fa) This is the first part of a two-semester introductory and survey course for the molecular pharmacology and toxicology degree program. *Prerequisite:* knowledge of biochemistry.

MPTX 501 Molecular Pharmacology and Toxicology II (4, Sp) The second part of the two-semester course covers the general aspects of molecular pharmacology and toxicology on the basis of biochemical, molecular, biological and environmental approaches. *Prerequisite:* MPTX 500.

MPTX 502 Pharmacology (4, Fa) Fundamentals of pharmacology in the context of the rapidly developing knowledge of related disciplines.

MPTX 511 Introduction to Medical Product Regulation (3, Sm) Introduction to regulatory environments surrounding medical product development, manufacturing and marketing; operation of federal, state and international regulatory bodies. *Recommended preparation:* undergraduate degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

MPTX 512 Regulation of Pharmaceutical and Biological Products (3, Sm) Ensuring safety and effectiveness of new drugs and biologics; marketing and monitoring approved pharmaceutical/biological products; management of genetically engineered products. *Recommended preparation:* undergraduate degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

MPTX 513 Regulation of Medical Devices and Diagnostics (3, Sm) Development and testing of new medical products according to U.S. and international regulatory requirements. *Recommended preparation:* undergraduate degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

MPTX 514 Regulation of Food and Dietary Supplements (3, Sm) Regulation and testing of foods, food additives and dietary supplements in the U.S. and abroad. *Recommended preparation:* undergraduate degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

MPTX 515 Quality Systems and Standards (3, Sm) Principles of quality assurance and quality control for medical-product development and manufacture. *Recommended preparation:* undergraduate degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

MPMX 516 Medical Products and the Law (3, Fa) Legal issues affecting intellectual property, medical product development, marketing and safety, taught through case studies and lectures. *Recommended preparation:* undergraduate degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

MPMX 517 Structure and Management of Clinical Trials (4, FaSpSm) Development and execution of clinical trials: bioethical principles, good clinical practices, project management and documentation.

MPMX 518 Writing Regulatory Drug Submissions (3, Sp) Developing form and content for investigational drug applications, new drug applications, biologic licensing applications to FDA; common technical documents; considerations of writing style.

MPMX 519 Global Regulation of Medical Products (3, Fa) Regulatory requirements governing medical products in European Union, Asia and other global markets.

MPMX 520 Risk Management for Health Care Products (3, Sp) Risk assessment and management techniques, including FMEA, HACCP, HAZAP, human factors analysis; policies, regulations, requirements and standards; loss control and liability prevention.

MPMX 522 Introduction to Clinical Trial Design and Statistics (3) Clinical designs and statistics commonly used to test medical products in general populations and special patient groups.

MPMX 524 Introduction to Food Science and Technology (3, Sm) Discusses the basic and applied concepts of food science and food safety, and demonstrates the principles of food chemistry, sensory evaluation, and product development. *Recommended preparation:* undergraduate degree in biological sciences or related disciplines.

MPMX 526 Chemistry Manufacturing and Controls (3, Fa) Provides a firm foundation in the domestic and international CMC process, from concept to commercialization of new active pharmaceutical ingredients and products. *Recommended preparation:* undergraduate degree in pharmacy, medicine or independent health science, engineering or equivalent.

MPMX 531 Cell Biology (4) (Enroll in INTD 531)

MPMX 561 Molecular Biology (4, Fa) (Enroll in INTD 561)

MPMX 571 Biochemistry (4, Sp) (Enroll in INTD 571)

MPMX 572 Systems Physiology and Disease I (4, Fa) (Enroll in INTD 572)

MPMX 573 Systems Physiology and Disease II (4, Sp) (Enroll in INTD 573)

MPMX 590 Directed Research (1-12, FaSpSm) Research leading to the master's degree. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

MPMX 594abz Master's Thesis (2-2-0, FaSpSm) Credit on acceptance of thesis. Graded IP/CR/NC.

MPMX 599 Special Topics (2-4, max 8) Special topics in Molecular Pharmacology and Toxicology.

MPMX 602 Science, Research and Ethics (2, Fa) A discussion of the unique technological and philosophical issues that challenge modern scientists and a discernment of ethical responses to those challenges.

MPMX 603 Molecular Mechanisms for Biological Signals (4, Fa) Biological mechanisms of hormone, neurotransmitter, growth factor and xenobiotic actions from

ligand-receptor interactions, signal transductions, modification processes to regulation of gene expression and cellular growth. *Prerequisite:* knowledge of physiology and biochemistry.

MPMX 630 Directed Field-Research Project (6, FaSpSm) Research/policy analysis conducted under preceptor supervision in an industrial or governmental setting. Open to students who have completed the majority of course credits in the Regulatory Science program. Graded CR/NC.

MPMX 700 Seminar in Molecular Pharmacology and Toxicology (1, max 8, FaSp) Contemporary advances in molecular pharmacology and toxicology research. Registration required during each year of residency.

MPMX 790 Research (1-12, FaSpSm) Research leading to the doctorate. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

MPMX 794abcdz Doctoral Dissertation (2-2-2-0, FaSpSm) Credit on acceptance of dissertation. Graded IP/CR/NC.

Pharmacy (PHRD)

PHRD 501 Pharmaceutics I (4, Fa) Introduction to physiochemical principles of dosage forms; properties of molecules in dosage forms, stability of pharmaceuticals and their interactions in body tissue, including computational approaches. Open to Doctor of Pharmacy students only.

PHRD 502 Pharmaceutics II (3, Sp) Principles involved in molecules movement across biological barriers. Properties, characteristics, application of homogeneous and heterogeneous dosage forms, liquid, semi-solid and solid. Open to Doctor of Pharmacy students only.

PHRD 503 Biological Systems I (4, Fa) Integrated teaching of anatomy, histology, physiology and pathophysiology using an organ-based approach. Open to Doctor of Pharmacy students only.

PHRD 504 Biological Systems II (6, Sp) Continued integrated teaching of anatomy, histology, physiology and pathophysiology, using an organ-based approach. Open to Doctor of Pharmacy students only.

PHRD 505 Molecular Genetics and Therapy (3, Fa) Principles of gene expression, and recombinant DNA methods and applications. Focus on human genetics and influence of genetic background on the utilization and effectiveness of drugs. Open to Doctor of Pharmacy students only.

PHRD 506 Self Care and Non-Prescription Therapies (5, Fa) Facilitate patient selection of self-care health care products: OTC drugs, dosages, pharmacology, efficacy, cost, side effects, adverse reactions, contraindications, and interactions with other medications. Open to Doctor of Pharmacy students only.

PHRD 507 Health Care Delivery Systems (2, Fa) Introduction to understanding the structure of the health care system. Includes health care financing and the role of pharmacy and the pharmacist in health systems.

PHRD 508 Pharmacy Literature Analysis and Drug Information (3, FaSp) Literature evaluation and biostatistics of clinical and health services research, and drug information services. Emphasis on drug therapy, patient outcomes, and formulary development. Open to Doctor of Pharmacy students only.

PHRD 509 Pharmacy Practice and Experience I (4, Fa) Introduction of principles and the application of pharmaceutical care in community or hospital pharmacy setting. Includes communications, basic practice skills, career pathways and leadership. Open to Doctor of Pharmacy students only.

PHRD 510 Pharmacy Practice and Experience II (4, Sp) Introduction of principles and the application of pharmaceutical care in community or hospital pharmacy setting. Includes calculations, drug information, and basic practice skills. Open to Doctor of Pharmacy students only.

PHRD 551 Immunology (3, Fa) Basic principles of immunology and their application to the understanding and treatment of immunologically-mediated diseases. Provides the scientific basis of immunotherapy and immunodiagnosis. Open to Doctor of Pharmacy students only.

PHRD 552 Pharmaceutics III (3, Sp) Principles and applications of controlled, targeted, and self-regulating drug delivery. Methods to deliver therapeutic peptides, proteins and genetic materials. Open to Doctor of Pharmacy students only.

PHRD 553 Management within Health Care Organizations (2, Fa) Management of the professional practice of pharmacy in organized health care systems. Introduction to formulary development and outcome analysis. Open to Doctor of Pharmacy students only.

PHRD 554 Public Health and Epidemiology (2, Sp) Introduction to epidemiology, environmental health, health education, health care organizations and financing. Orientation to social and governmental controls on the health care system. Open to Doctor of Pharmacy students only.

PHRD 555 Biochemical and Molecular Sites of Drug Action (4, Fa) Basic principles of drug action and receptor actions. Includes their application to the understanding and treatment of disease. Provides the scientific basis of pharmaceutical action.

PHRD 557 Therapeutics I (4, Fa) Integrated teaching of the principles of pharmacology, biomedical chemistry, pharmacogenomics and clinical therapeutics. Open to Doctor of Pharmacy students only.

PHRD 559 Therapeutics II (3, Fa) Integrated teaching of basic and clinical pharmacokinetic/pharmacodynamic concepts. Open to Doctor of Pharmacy students only.

PHRD 560 Therapeutics III (6, Sp) Integrated teaching of biomedical chemistry, pharmacology, clinical pharmacokinetics, and therapeutics of drugs, with emphasis on pharmaceuticals treating diseases associated with the central nervous system. Open to Doctor of Pharmacy students only.

PHRD 561 Pharmacy Practice and Experience III (3, FaSp) Introductory Pharmacy Practice Experiences (IPPEs) in hospital and community settings. Includes; didactic instruction, laboratory practicums, IV training and practical experience hours. Open only to Doctor of Pharmacy students.

PHRD 562 Therapeutics IV (4, Sp) Integrated teaching of biomedical chemistry, pharmacology, clinical pharmacokinetics, and therapeutics of drugs with an emphasis on treating diseases of the renal, GI and pulmonary systems. Open to Doctor of Pharmacy students only.

PHRD 601 Therapeutics V (6, Fa) Integrated teaching of biomedical chemistry, pharmacology, clinical pharmacokinetics, and therapeutics of drugs, with emphasis on pharmaceuticals affecting cardiovascular and circulatory diseases. CPR certification. Open to Doctor of Pharmacy students only.

PHRD 603 Therapeutics VI (3, Fa) Integrated teaching of biomedical chemistry, pharmacology, clinical pharmacokinetics and therapeutics of drugs with an emphasis on pharmaceuticals affecting the endocrine diseases, systems and women's health. Open to Doctor of Pharmacy students only.

PHRD 605 Therapeutics VII (4, Fa) Integrated teaching of the biomedical chemistry, pharmacology, clinical pharmacokinetics, and therapeutics of drugs; with emphasis on chemotherapy of infectious disease: bacterial, microbial, viral, parasitic, and fungal.

PHRD 606 Therapeutics VIII (2, Sp) Advanced topics and clinical therapeutics of drugs, with emphasis on the treatment of infectious disease: bacterial, microbial, viral, parasitic and fungal.

PHRD 607 Nutrition (2, Fa) Biomedical knowledge is correlated with assessments of clinical case-management problems to understand the interrelationship between nutrition and health in both hospitalized and healthy patients. Open to Doctor of Pharmacy students only.

PHRD 608 Therapeutics IX (2, Sp) Integrated teaching of biomedical chemistry, pharmacology, clinical pharmacokinetics and therapeutics of drugs, with emphasis on pharmaceuticals for managing oncological diseases. Open to Doctor of Pharmacy students only.

PHRD 610 Therapeutics X (3, Sp) Focuses on the pharmacology, pharmacokinetics, medicinal chemistry and clinical therapeutics that apply to pharmaceutical care of pediatric, geriatric and chronic pain patients.

PHRD 612 Therapeutics XI (2, Sp) Updates students on recent advances in clinical areas, prepares students for advanced practice experiences and assessment of clinical readiness via a final examination. Graded CR/NC.

PHRD 614 Pharmaceutical Economics and Outcome Studies (3, Sp) Economic analysis of the U.S. health care system, the pharmaceutical industry, and the profession; economic assessment of drug therapy costs and health care outcomes applying pharmacoeconomic research methodologies. Open to Doctor of Pharmacy students only.

PHRD 616 Pharmacy, Law and Ethics (3, Sp) To provide students with an understanding of ethical issues that arise in pharmacy practice along with state and federal statutes, regulations, and pharmacy-related cases. Open to Doctor of Pharmacy students only.

PHRD 651 Community Pharmacy I (3, Fa) Development of specialized knowledge and skills in community pharmacy practice involving location analysis, pharmacy management principles, and introduction to business law concepts. Open to Doctor of Pharmacy students only.

PHRD 652 Community Pharmacy II (3, Sp) A continuation of pharmacy business law concepts encompassing contract principles and forms of ownership, including a review of pharmacy laws, compounding principles, and OTC agents. Open to Doctor of Pharmacy students only. *Prerequisite:* PHRD 651.

PHRD 653 Health Systems Pharmacy I (3, Fa) Understanding formal and informal organizations in institutions, managed care, disease management, health care policy and financing, patients' chart organization, and clinical monitoring parameters. Open to Doctor of Pharmacy students only.

PHRD 654 Health Systems Pharmacy II (3, Sp) Recognizing resources available for drug information, familiarity with institutional formularies, medication counseling, writing chart notes, and clinical activities at an off-campus health care institution. Open to Doctor of Pharmacy students only. *Prerequisite:* PHRD 557.

PHRD 655 Geriatric Pharmacy I (3, Fa) Specialized knowledge and skills in geriatric pharmacy, pharmacology of aging, and unique functions of health care team providing care to the elderly patient. Open to Doctor of Pharmacy students only.

PHRD 656 Geriatric Pharmacy II (3, Sp) Specialized knowledge and skills in gerontology and geriatric pharmacy including the pathophysiology of selected cardiovascular, endocrine, genitourinary gastrointestinal disorders, osteoarthritis, and osteoporosis. Open to Doctor of Pharmacy students only. *Prerequisite:* PHRD 559.

PHRD 657L Basic Research Design (3, max 6, FaSp) Research experience to integrate research into Doctor of Pharmacy program. Research focuses on industrial, academic, or governmental issues. Open to Doctor of Pharmacy students only.

PHRD 658 Sleep and the Pharmacologic Management of Its Disorders (3, FaSp) Overview of normal sleep manifestations, and treatment of common sleep disorders, and the pharmacist's role in assessment, treatment, and referral. Open to Level III Doctor of Pharmacy students only.

PHRD 659 Molecular Therapeutics: Signal Transduction (3, FaSp) Principles of molecular therapeutics against signaling pathways; emphasis on biological mechanisms underlying hormone, growth factor, and neurotransmitter-mediated gene regulation, proliferation, and cell death. Open to Level III Pharm.D. students only.

PHRD 660 Disease State Management I (3, FaSp) The processes required to develop disease state management protocols based on data drawn from the medical research literature. Open to Level III Doctor of Pharmacy students only.

PHRD 661 Pharmacy Practice in Women's Health (3, FaSp) The pharmaceutical care of women patients is emphasized. Therapeutic, psychosocial factors and current research in women's health. Open to Level III Pharm.D. students only.

PHRD 662 Psychiatric Pharmacy Practice (3, Sp) Specialized knowledge and skills in psychiatric pharmacy practice including child, adult, and geriatric psychopharmacology applied to inpatient and outpatient treatment. Open to Level III Pharm.D. students only.

PHRD 663 Pharmaceutical Development (3, FaSp) Examination of pharmaceutical product development process including discovery, preclinical/clinical studies, regulatory-legal issues, and marketing. Open to Doctor of Pharmacy students only.

PHRD 664 Clinical Problem Solving (3, Sp) Integration of physical assessment, laboratory tests, history-taking, and diagnosis to formulate decisions for optimal treatment plans in specific disease states. Open to graduate pharmacy students only.

PHRD 665 Complementary/Alternative Therapeutics (3, FaSp) Examines the therapeutic use of complementary/alternative medicines, such as herbal medicines, homeopathic drugs, vitamins and other nutritional supplements. Open to Level III Pharm.D. students only.

PHRD 666 Therapeutic Drug Monitoring (3, FaSp) Application of pharmacokinetic and pharmacodynamic principles to individualize patient drug regimens. Open to Level III Pharm.D. students only.

PHRD 667 Drugs of Abuse (3, FaSp) Specialized knowledge and skills in specific substance abuse-related areas. Each area will include addiction, wellness, and

prevention components. Open to Doctor of Pharmacy students only.

PHRD 668 Computing Application (3, FaSp) Specialized knowledge and skills using computers in professional practice: telecommunication protocols, typical patient databases in hospital and community pharmacies, drug interactions, insurance billing, inventory control. Open to Doctor of Pharmacy students only.

PHRD 669 Health Care Needs of Special Populations (3, FaSp) Health care needs of the poor will be examined through participation in a multidisciplinary community clinic setting focusing on medication counseling and compliance. Open to Level III Pharm.D. students only.

PHRD 670 Marketing and Development in the Pharmaceutical Industry (3, FaSp) Basic and advanced strategies for marketing and development of new compounds or indication in the pharmaceutical industry. *Recommended preparation:* PHRD 663.

PHRD 671 Pharmacy Education Seminar (3, FaSp) A seminar course with a focus on educational methods and teaching skills providing career development for students interested in academia. Open to Doctor of Pharmacy students only.

PHRD 675 Travel Medicine (3, FaSp) An elective course for emphasizing the role of the pharmacist in preventing and treating travel related medical conditions. Open only to pharmacy majors.

PHRD 677 Risk Assessment and Management in Pharmacy Practice (3, FaSp) Specific risk management issues, legal and professional expectations of pharmacists, and assessing and avoiding risk. Open only to Doctor of Pharmacy students.

PHRD 701 Acute Care Clinical APPE (6, FaSpSm) Application of pharmaceutical care principles to the adult patient population in an acute care environment. Pharmacology, pharmacokinetics, and disease state management will be emphasized. Open to Doctor of Pharmacy students only. Graded CR/NC.

PHRD 703 Long Term Care Clerkship (6, FaSpSm) Application of pharmaceutical care to patients in long term care environments. Understanding of the therapeutic, legal and special needs of this patient population. Open to Level IV Doctor of Pharmacy students only.

PHRD 704 Primary Care APPE (6) Disease state management and a primary care setting. Modification and design of drug therapy regimens and primary patient care using a team based approach. Open to Doctor of Pharmacy students only. Graded CR/NC.

PHRD 705 Community Pharmacy APPE (6, FaSpSm) Pharmaceutical care principles applied to the community pharmacy environment. Participating in the development, implementation and outcome evaluation of patient care services in the community. Open to Doctor of Pharmacy students only. Graded CR/NC.

PHRD 706 Geriatrics Clerkship (6, FaSpSm) Drug therapy and management of geriatric patients with a focus on unique medical, economic, and psycho-social problems of this population. Open to Level IV Doctor of Pharmacy students only.

PHRD 714 Nuclear Pharmacy APPE (6, FaSpSm) Provides practical and theoretical aspects of radiopharmacy services delivery. Open only to Pharm.D. students.

PHRD 718 Hospital Pharmacy Practice APPE (6, FaSpSm) Practical experience in the practice of hospital pharmacy. Administrative, practice-based and

therapeutic competencies emphasized. Open to Doctor of Pharmacy students only.

PHRD 725 International Pharmacy Practice Experience (3, 6, FaSpSm) Practical experience in the practice of pharmacy in the international setting. Students will visit an international pharmacy practice setting and complete a project. Open to Doctor of Pharmacy students only.

PHRD 726 Directed Clinical Project I APPE (6, max 12, FaSpSm) Directed educational opportunities not presently offered as electives, e.g., research project or new and evolving practice models.

PHRD 727 Directed Clinical Clerkship Project II (6, FaSpSm) Directed educational opportunities not presently offered as electives, e.g., research projects or new and evolving clerkships. Open to Doctor of Pharmacy students only.

PHRD 730 Acute Care Geriatrics Clerkship (6, FaSpSm) Pharmaceutical care principles applied to the acutely ill geriatric patient population. Emphasis on drug therapy problem solving, physiology, pharmacokinetics and compliance problems. Open to Doctor of Pharmacy students only.

PHRD 731 Advanced Geriatrics APPE (6, FaSpSm) Directed projects/practical experience in geriatric drug therapy. Open to Doctor of Pharmacy students only.

PHRD 735 Clinical Pharmacy Research APPE (6, FaSpSm) Drug research administration: research design; ethics; record-keeping; and institutional review. Practical experience emphasized. Open to Doctor of Pharmacy students only.

PHRD 738 Pharmaceutical Industry APPE (6, FaSpSm) Practical experience within a pharmaceutical company may include: clinical affairs, drug development, research, and/or marketing process. Open to Doctor of Pharmacy students only.

PHRD 750 Advanced Pharmacy Practice Elective (APPE) (6, max 18, FaSpSm) Pharmacy practice experience (internship) course in a health care setting. Open only to pharmacy students.

PHRD 751 Non-traditional Advanced Pharmacy Elective (APPE) (6, FaSpSm) Pharmacy practice experience (internship) course in a non-traditional or emerging setting. Open only to pharmacy students.

PHRD 790 Directed Research (1–12, max 12) Research leading to doctorate in Clinical and Experimental Therapeutics. Graded CR/NC.

PHRD 794abcdz Doctoral Dissertation (2-2-2-2-0) Dissertation research required for completion of Doctor of Philosophy in Clinical and Experimental Therapeutics.

PHRD 796ab Doctor of Pharmacy Capstone (0-0, FaSpSm) Capstone course required for completion of Doctor of Pharmacy degree. Graded CR/NC. Open only to pharmacy students.

PHRD 796b Doctor of Pharmacy Capstone (0, SpSm) Capstone course required for completion of Doctor of Pharmacy degree. Graded CR/NC. Open only to pharmacy students.

Pharmaceutical Economics and Policy (PMEP)

PMEP 509 Research Design (4, Fa) Introduction to the concept of research design and examples of the variant research methods utilized in the field. Both the conceptual and practical issues of research including development of the research question, selection of appropriate methods,

data sources and analytic approaches to address the research question will be addressed.

PMEP 519 Survey Research and Quality of Life Assessment (4, Sp) Skills to develop and assess surveys which are integral in Pharmaceutical Economics and Policy research. *Prerequisite:* PMEP 509; *recommended preparation:* biostatistics, econometrics.

PMEP 529 Risk, Probabilities and Preferences (4, Sp) Analysis of economic and psychological constructs of risks, probabilities, and health related preferences and utilities.

PMEP 534 Health Economics I (4, Fa) Techniques of microeconomic analysis to inform health policy. Topics include: demand for health, medical care, and insurance, risk selection, medical innovation. *Recommended preparation:* ECON 601 and ECON 611.

PMEP 538 Pharmaceutical Economics (4, Sm) Introduction to pharmacoeconomics with special emphasis on the role of pharmaceuticals and the pharmaceutical industry, insurance, managed care, regulation and pricing. *Prerequisite:* ECON 500.

PMEP 539 Economic Assessment of Medical Care (4, Fa) Principles of cost-benefit analysis and medical cost-effectiveness analysis with applications in medical care and the pharmaceutical field. *Prerequisite:* ECON 500 and ECON 581.

PMEP 544 Health Economics II (4, Sp) Second part of series in techniques of microeconomic analysis to inform health policy. Topics include: patents and innovation, pharmaceutical regulation, hospital competition, physician practice. *Recommended preparation:* ECON 601, ECON 611 and PMEP 534.

PMEP 549 Applied Pharmacoeconometrics (4, Sp) Use of quantitative models to describe and analyze pharmaceutical and health care markets; experimental design/power calculations; survival models; multiple indicator models; qualitative and limited dependent variables models; estimation and application of such models to selected problems. *Prerequisite:* ECON 615.

PMEP 590 Directed Research (1–12, FaSpSm) Research leading to the master's degree. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

PMEP 698 Seminar in Pharmaceutical Economics and Policy (1, max 4, FaSp) Current research in pharmaceutical economics and policy presented by outside scholars, faculty and students. Graded CR/NC.

PMEP 790 Research (1-12) Research leading to the doctorate. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

PMEP 794abcdz Doctoral Dissertation (2-2-2-2-0) Credit on acceptance of dissertation. Graded IP/CR/NC.

Pharmaceutical Sciences (PSCI)

PSCI 531 Cell Biology (4) (Enroll in INTD 531)

PSCI 556 Principal Research Approaches in PPSI (2, Fa) Familiarize new graduate students with basic approaches used in biomedical research with focus on data interpretation and experimental approaches. Graded CR/NC.

PSCI 557 Introduction to Tools and Techniques for Chemical Biology (2, Sp) Multidisciplinary science where the knowledge of chemistry is utilized to solve problems in biology, and biological systems are evolved to gain new functions. This course aims to establish a great opportunity for graduate students at the interface of

biology and chemistry. *Recommended preparation:* formal course work in chemistry and biochemistry.

PSCI 561 Molecular Biology (4, Fa) (Enroll in INTD 561)

PSCI 571 Biochemistry (4, Fa) (Enroll in INTD 571)

PSCI 590 Directed Research (1–12, FaSpSm) Research leading to the master's degree. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

PSCI 594abz Master's Thesis (2-2-0, FaSp) Credit on acceptance of thesis. Graded IP/CR/NC. *Prerequisite:* completion of all required course work for the M.S. degree.

PSCI 599 Special Topics (2-4, max 8, FaSp) Topics in advanced pharmaceutical sciences.

PSCI 601 Molecular Biology of Gene Regulation (2, max 8) (Enroll in BIOC 601)

PSCI 633 Free Radical Chemistry, Biology, and Medicine (4, Fa) (Enroll in GERO 666)

PSCI 655 Immunopharmaceutics (2, 2 years, Fa) Lectures and discussion sessions on pharmaceuticals-related immunology, including drugs affecting the immune system, antibodies and cytokines as drugs, and new developments in immunobiotechnology.

PSCI 661L Advanced Pharmaceutical Analysis (4, 2 years, Fa) Theory and application of quantitative instrumental techniques to the pharmaceutical sciences. Includes principles of chromatography, spectrophotometry, fluorescence, mass spectrometry and immunologic assays. Lecture and laboratory.

PSCI 662 Advanced Pharmacokinetics/Pharmacodynamics (2, max 4, FaSp) Principles of advanced pharmacokinetics/pharmacodynamics. Mathematical description of drug disposition processes. Design and evaluation of pharmacokinetic/pharmacodynamic studies. Advanced approaches to parameter estimates.

PSCI 663 Advanced Drug Delivery Systems (2, Fa) Design and applications of polymers, liposomes, micro/nanoparticles, prodrugs, and macromolecules for parenteral, oral, transdermal, respiratory and CNS drug delivery. *Prerequisite:* PSCI 665; *recommended preparation:* college level chemistry and biology.

PSCI 664 Drug Discovery and Design (4, FaSpSm) Principles of drug discovery, design and characterization. Mechanisms of action of major classes of drugs. Open only to students in management of drug development. *Recommended preparation:* college level chemistry and biology.

PSCI 665 Drug Transport and Delivery (4, Fa) Principles of cellular drug transport, in vivo drug transport, and modern drug delivery, including drug targeting. *Recommended preparation:* college level chemistry and biology.

PSCI 667 Intracellular Drug Delivery and Targeting (2, 2 years, Sp) Mechanisms of membrane trafficking and intracellular transport and the utilization of these mechanisms in drug delivery and targeting. *Recommended preparation:* college level chemistry and biology, INTD 531.

PSCI 756ab Seminar in Pharmaceutical Sciences (1-1, FaSpSm) Review of current pharmaceutical and related research topics.

PSCI 790 Research (1–12, FaSpSm) Research leading to the doctorate. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

PSCI 791L Research (2-12, no max) Directed research for the M.S. thesis or Ph.D. dissertation.

PSCI 794abcdz Doctoral Dissertation (2-2-2-2-0, FaSpSm) Credit on acceptance of dissertation. Graded IP/CR/NC.

Regulatory Science (RSCI)

RSCI 520 Introduction to Risk Management for Health Care Products (2) Historical development, formal language and theoretical approaches to risk management in health care and medical product environment; policies, regulations, standards; liability prevention and loss control. (Duplicates credit in MPTX 520.) *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 521 Seminars in Regulatory Science (1, max 6, FaSpSm) Current problems in regulatory affairs, legal management, preclinical and clinical testing, scientific evaluation and quality assurance. (Duplicates credit in former MPTX 521.) Graded CR/NC. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience; enrollment in M.S., Regulatory Science program.

RSCI 523 Advanced Concepts in Risk Management for Medical Products (3) Managing risk in demanding health-care and medical-product situations: clinical trials, emerging technologies, counterfeit prevention, hard-to-reach populations. *Recommended preparation:* undergraduate or professional degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience; enrollment in M.S. (Regulatory Science), Certificate in Patient and Product Safety, or permission of instructor.

RSCI 525 Introduction to Drug and Food Toxicology (3) Factors affecting toxic responses to foods and drugs: dose-response relationships, absorption, distribution, biotransformation, elimination of toxicants; target organ toxicity, teratogenesis, mutagenesis, carcinogenesis, food allergies, risk assessment. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 527 Medical Product Safety (3) Management of medical product safety by manufacturers/suppliers including: safe manufacturing, labeling, packaging; pharmacovigilance, field observations, complaint handling; record-keeping, safety issues documentation; crisis management/recalls. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 528 Safety in the Health Care Environment (3) Regulatory expectations for health care facilities and services: JCAHO certification, environmental risk management, management of medical and medication errors, reduction of health hazards. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 529 Application of Risk Management Tools and Techniques (2) Use of risk management tools in the medical products arena: functional analysis, fault-tree analysis, failure modes and effects analysis, HACCP and six sigma methods. *Recommended preparation:* undergraduate degree in pharmacy, medical or

independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 530 Translational Medicine: An Overview (2, FaSpSm) An overview of principles and concepts underlying drug discovery and development, including terminology of translational science. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience; enrollment in M.S., Regulatory Science, Certificate in Preclinical Drug Development and M.S., Management of Drug Development.

RSCI 531 Industrial Approaches to Drug Discovery (4, FaSpSm) Examines the process of drug discovery from selection of disease and therapeutic target to characterization and validation of lead drug candidates. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience; enrollment in M.S., Regulatory Science, Certificate in Preclinical Drug Development and M.S., Management of Drug Development.

RSCI 532 Early Stage Drug Development (3, FaSpSm) Explores the activities involved in transforming an early drug or biological candidate to a drug approved for marketing by regulatory authorities. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience; enrollment in M.S., Regulatory Science, Certificate in Preclinical Drug Development and M.S., Management of Drug Development.

RSCI 533 Safety Evaluation during Drug Development (3) Safety pharmacology/toxicology requirements mandated by FDA and other regulatory agencies to move a new chemical entity from discovery stage to market approval.

RSCI 534 Drug Development in CNS Disorders (4) Successes and challenges related to central nervous system therapeutics. Major brain disorders, current and future therapeutic targets and clinical trial designs.

RSCI 540 Analysis of Food and Dietary Supplement Regulations (3) Changes and interpretation of regulations affecting food supply and dietary supplements impacting global markets. Product development, health-claim positioning, advertising, media messaging, consumer choices, personal health outcomes.

RSCI 590 Directed Research (1-12, max 12, FaSpSm) Research leading to the master's degree. Maximum units which may be applied to the degree to be determined by the department. Graded CR/NC.

RSCI 596 Internship for Curricular Practical Training in Regulatory Science (1, max 4, FaSpSm) Part-time or full-time practical work experience in Regulatory Science. The internship must be located at an off-campus facility. Students are individually supervised by faculty. Graded CR/NC. *Recommended preparation:* undergraduate or professional degree in pharmacy, medicine or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience; enrollment in M.S. (Regulatory Science).

RSCI 601 Biomedical Commerce (4) Introduction to business principles appropriate to medical products, including: supply and demand, product entry-exit strategies, financing, reimbursement, marketing and pricing in global marketplace. *Recommended preparation:* undergraduate degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience; enrollment in M.S., Regulatory Science.

RSCI 603 Managing Complex Projects (3) Theory and methods to manage complex projects in medical products sectors; timelines, intellectual property, security, contracts, budgets, review activities, reports, electronic tools, cross-cultural communication. *Recommended preparation:* undergraduate or professional degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 604 Regulatory Strategy in Asia (4, FaSpSm) Regulatory policy, standards and practices in different Asian markets: product licensing, import/export management, materials sourcing, quality systems compliance, reimbursement, prescribing practices. Travel may be required. *Recommended preparation:* undergraduate or professional degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 605 Managing Organizations and Human Resources (3) Theory and practice of personnel management, organizational structure and industrial relations in small, growing enterprises and large global companies typical of pharmaceutical and medical device sectors. *Recommended preparation:* undergraduate or professional degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 606 Regulation of Emerging Technologies and Biological Products (3) Policies, testing and regulatory requirements affecting commercialization of biologics and novel medical technologies. Focus on biologics, blood and tissue products, radiopharmaceuticals and nanotechnology.

RSCI 608 Regulatory Strategy in Europe and the Americas (4) Regulatory strategy in EU, Canada, Mexico and South America; culture, health-care practices, reimbursement, product registration, quality systems, trade restrictions, import/export requirements. Travel may be required. *Recommended preparation:* undergraduate or professional degree in pharmacy, medical or independent health sciences, engineering or equivalent mix of post-secondary training and industry experience.

RSCI 790 Directed Research (1-12, max 12, FaSpSm) Research leading to the doctorate. Maximum units which may be applied towards the degree to be determined by the department. Graded CR/NC.

RSCI 794abcdz Doctoral Dissertation (2-2-2-2-0) Dissertation research required for completion of doctoral degree in regulatory science. Graded IP/CR/NC.