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# USC School of Pharmacy



*The Pharm.D. curriculum combines rigorous basic science education with extensive clinical training in community and hospital settings as well as opportunities in research and industry.*

**F**ounded in 1905, the USC School of Pharmacy is the oldest and foremost pharmacy school in Southern California. In 2005 the school celebrated its 100-year anniversary – a milestone in pharmacy education and research. Approximately 50 percent of the practicing pharmacists in Southern California are graduates of USC. The school has an average student body of 740 full-time students in the professional program, 87 students in the Master of Science and Doctor of Philosophy programs, a full-time faculty of 74 and more than 355 part-time and volunteer faculty.

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 Comprehensive Cancer Center, the Doheny Eye Institute and the USC University Hospital. 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 in the nation, the USC School of Pharmacy serves as a model for other progressive pharmacy schools. USC was the first to establish the six-year program leading to the Doctor of Pharmacy degree as the first professional degree. In 1968, USC initiated one of the first clinical pharmacy programs in the nation. In 1988, the school started a Pharm.D./M.B.A. dual degree program, the first of its kind in the country. In collaboration with the Andrus Gerontology Center, a Pharm.D./Graduate Certificate in Gerontology was developed in 1990. In 1994, the school implemented the M.S. and Ph.D. programs in Pharmaceutical Economics and Policy, also the first of their kind in the country. In 2001, additional dual degree programs were introduced including the Pharm.D./J.D., the Pharm.D./M.S. in Regulatory Science and the Pharm.D./Master of Public Health, and in 2003, the school initiated the Pharm.D./M.S. in Gerontology.

The school is a member of the American Association of Colleges of Pharmacy, which promotes the interests of pharmaceutical education. All institutions holding membership must maintain certain minimum requirements for entrance and graduation. The school is accredited by the Accreditation Council for Pharmacy Education.

**Health Sciences Campus**  
**John Stauffer Pharmaceutical Sciences Center**  
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 Los Angeles, CA 90089-9121  
 (323) 442-1369 Office of the Dean  
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 (323) 442-1466 Office of Admission and Student Affairs  
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[www.usc.edu/schools/pharmacy](http://www.usc.edu/schools/pharmacy)

#### Administration

R. Pete Vanderveen, Ph.D., B.C.P.P., R.Ph.,  
*Dean*

Fred G. Weissman, Pharm.D., J.D., *Associate Dean, Academic and Clinical Affairs*

Cynthia C. White, B.A., *Associate Dean, Administrative Affairs*

Ronald L. Alkana, Pharm.D., Ph.D., *Associate Dean, Graduate Affairs and Curricular Development*

Enrique Cadenas, M.D., Ph.D., *Associate Dean for Research Affairs*

#### Faculty

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

*Hygeia Centennial Chair in Clinical Pharmacy:* Gilbert J. Burckart, Ph.D.

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

*Timothy M. Chan Professor of Complementary Therapeutics:* Rajindar S. Sohal, Ph.D.

*Garcin S. Herbert Professor of Pharmaceutical Sciences:* Sarah F. Hamm-Alvarez, Ph.D.

*Charles Kronen/Pharmacy Alumni Professor of Pharmaceutical Sciences:* Enrique Cadenas, M.D., Ph.D.

*QSAD Centurion Professor of Pharmaceutical Sciences:* Michael B. Nichol, Ph.D.

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

*Distinguished Professor:* Walter W. Wolf, Ph.D.

*Professors:* Ronald L. Alkana, Pharm.D., Ph.D.; Roberta D. Brinton, Ph.D.; Enrique Cadenas, M.D., Ph.D.; Timothy M. Chan, Ph.D.; Sarah F. Hamm-Alvarez, Ph.D.; Wei-Chiang Shen, Ph.D.; Jean C. Shih, Ph.D.; Rajindar Sohal, Ph.D.; Walter W. Wolf, Ph.D.

*Associate Professors:* James D. Adams, Jr., Ph.D.; Roger F. Duncan, Ph.D.; Ian S. Haworth, Ph.D.; Joel W. Hay, Ph.D.; Jeffrey S. McCombs, Ph.D. (*Gerontology*); Michael B. Nichol, Ph.D.; Curtis T. Okamoto, Ph.D.

*Assistant Professors:* Jeonghoon Ahn, Ph.D.; Nouri Neamati, Ph.D.; Bangyan Stiles, Ph.D.; Clay C.C. Wang, Ph.D.

*Research Associate Professors:* Kevin J.Y.H. Shin Chen, Ph.D.; Daryl L. Davies, Ph.D.

*Research Assistant Professors:* Julianna Hwang, Pharm.D.; Robin Mockett, Ph.D.; Jon Nilsen, Ph.D.; Xiao-Ming Ou, Ph.D.; Igor Rebrin, Ph.D.; Pikran Toroser, Ph.D.; Jun Ming Wang, Ph.D.; Kenji Wantanabe, Ph.D.; Liquin Zhao, Ph.D.

*Professors of Pharmacy:* Gilbert J. Burckart, Ph.D.; Ian Hutchinson, Ph.D.; Glen L. Stimmel, Pharm.D. (*Psychiatry and the Behavioral Sciences*); R. Pete Vanderveen, Ph.D.; Bradley R. Williams, Pharm.D. (*Clinical Gerontology*)

*Associate Professors of Pharmacy:* Melvin F. Baron, M.P.A., Pharm.D.; Paul M. Beringer, Pharm.D.; Kathleen H. Besinque, Pharm.D., M.S.Ed.; Alfred Chin, Pharm.D.; Julie A. Dopheide, Pharm.D. (*Clinical Psychiatry and the Behavioral Sciences*); Kevin L. Forrester, Pharm.D.; William C. Gong, Pharm.D.; Mary A. Gutierrez, Pharm.D.; Kathleen A. Johnson, Pharm.D., M.P.H., Ph.D. (*Pharmaceutical Economics and Policy*); Mervyn K. Kalman, M.B.A.; Jack W. Kern, Pharm.D.; Cynthia L.L. Lieu, Pharm.D.; Stanley G. Louie, Pharm.D. (*Family Medicine*); Gladys H. Mitani, Pharm.D.; Irving Steinberg, Pharm.D. (*Clinical Pediatrics*); Gregory A. Thompson, Pharm.D.; Fred G. Weissman, Pharm.D., J.D.; Michael Z. Wincor, Pharm.D. (*Clinical Psychiatry and the Behavioral Sciences*); Annie Wong-Beringer, Pharm.D.; Frances S. Wong, Pharm.D.

*Assistant Professors of Pharmacy:* Betty Chan, Pharm.D.; Steven Chen, Pharm.D.; Marc Cosep, Pharm.D.; Jennifer H. Cupo, Pharm.D.; Jeffery Goad, Pharm.D.; Emily Han, Pharm.D.; Kevin Kaneko, Pharm.D.; Armin Kasravi, Pharm.D.; Jiwon Kim, Pharm.D.; Kum Ja K. Lee, Pharm.D.; May C. Mak, Pharm.D.; Tien Ng, Pharm.D.; Thuy N. Nguyen, Pharm.D.; Susie Park, Pharm.D.; Paula Phongsamron, Pharm.D.; Florence H. Wong-Yu, Pharm.D.

*Distinguished Emeritus Professors:* John A. Biles, Ph.D.; Paul Hochstein, Ph.D.

*Emeritus Professors:* Glenn H. Hamor, Ph.D.; Eric J. Lien, Ph.D.

#### Programs

The School of Pharmacy offers curricula leading to the Doctor of Pharmacy (Pharm.D.) degree. Through the Graduate School, graduate degrees offered are: 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.) and Doctor of Philosophy (Ph.D.) in pharmaceutical economics and policy, Master of Science (M.S.) in Regulatory Science. Five dual degree programs, one joint program and one certificate program are also offered: Pharm.D./J.D., Pharm.D./M.B.A., Pharm.D./M.P.H., Pharm.D./M.S., Regulatory Science, Pharm.D./M.S., Gerontology, Pharm.D./Ph.D., and Pharm.D./Graduate Certificate in Gerontology.

The University of Southern California's Doctor of Pharmacy and Master of Science programs are accredited by the Accreditation Council for Pharmacy Education, 20 North Clark Street, Suite 2500, Chicago, IL 60602, Phone: (312) 664-3575, FAX (312) 664-4652.

#### 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 pharmaceutical economics and policy) is charged at the following rate (which differs from standard USC tuition): per semester (15-18 units) \$18,086; for less than 15 units and each unit above 18 units, \$1,206 per unit. See the Tuition and Fees section, page 39, for fee information. These fees are based upon current information available at the time of publication and are subject to possible later 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, national honorary pharmaceutical society, 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 two years of college work, 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. Students may wish to live in student housing on the University Park campus, located about eight miles from 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 book store. For residence information, phone (323) 442-1576; for bookstore information call (323) 442-2674.

**Student Health Services, Health Sciences Campus**

Services of the Student Health Center, covered by the mandatory student health fee, include the usual ambulatory care health services given by the faculty of the USC

Department of Family Medicine and the Student Health Center nursing staff. Hours are from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding USC holidays. 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 north-east 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 Health Plan. A student may request a waiver of the USC Health Plan if covered by a personal medical plan acceptable to the Health Insurance Office.

## Professional Degrees

### Doctor of Pharmacy

A four-year curriculum, following appropriate college prerequisite work, leading to the Doctor of Pharmacy (Pharm.D.) is offered to students admitted to the School of Pharmacy. A sample outline of the curriculum is listed in the following pages. The degree will not be conferred until the student has successfully completed all Doctor of Pharmacy degree requirements.

**Application Procedure**

The School of Pharmacy uses the College Application Service (PharmCAS) and a supplemental application for its admission process. Applications are available at [www.usc.edu/schools/pharmacy](http://www.usc.edu/schools/pharmacy). The PharmCAS and supplemental application deadline is November 1 (subject to change).

Applications received before November 1 will have priority interview consideration when the PharmCAS and supplemental application are submitted and all necessary criteria have been met. Follow the instructions carefully for the PharmCAS application and the supplemental application for the USC School of Pharmacy.

Evaluation of official transcripts is completed by the School of Pharmacy Admission Committee and a letter of acceptance is mailed to each applicant who qualifies for entrance. 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 university purposes.

**Admission Guidelines**

The Admission Committee considers several factors in making admissions decisions: strong academics; competitive performance in the interview; recommendation forms; and written comments specified in the application. The committee also considers a candidate's motivation to pursue pharmacy, strong interpersonal skills, excellent 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**

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.

**Entrance Requirements**

Admission to the School of Pharmacy requires: completion of the prerequisite college courses (90 semester or 135 quarter units) and a minimum 3.0 (A = 4.0) cumulative grade point average based on all transferable college course work.

Candidates who have received or will receive a baccalaureate degree or who have completed units in excess of the minimum required will be considered more favorably than applicants who have fulfilled only minimum requirements.

### Prepharmacy Requirements

To be eligible for admission to the School of Pharmacy, students must take the required prerequisite college courses, including general chemistry, organic chemistry, general biology, physics, biochemistry, molecular biology, microbiology, mammalian physiology, calculus, statistics, general psychology or introduction to sociology, macroeconomics or microeconomics, interpersonal communication, English and electives from the social and behavioral sciences and humanities. These science requirements should be completed at any 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).

#### *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 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 105a**LbL**.

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 322**abL**.

Physics: a one-year course in physics for science majors, including laboratory, is required. The recommended courses at USC are PHYS 135**abL** or PHYS 151**L** and PHYS 152**L**.

#### *Biological Sciences*

General biology: a one-year course for science majors is required in general biology with laboratory, for science majors (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 120**L** and BISC 220**L**.

Microbiology (with lab): one course in microbiology for science majors, including laboratory, is required. The recommended course at USC is BISC 300**L**.

Molecular biology: one course in molecular biology for science majors is required. The recommended course at USC is BISC 320**L**.

Biochemistry or cell biology: one course in biochemistry or cell biology for science majors is required. The recommended course at USC is BISC 330**L**.

Mammalian physiology: one course in mammalian physiology for science majors, with laboratory, is required. The recommended course at USC is BISC 307**L**.

#### *English*

Two semesters or three quarters of composition (or two quarters of composition and one quarter of literature) are required. Remedial English and English as a Second Language (ESL) are not acceptable. An English proficiency examination may be required.

#### *Communications*

One course (one semester or one quarter) in interpersonal communications is required. The course should include core theories of message production and reception in both interpersonal and public contexts. One semester or one quarter is required. The recommended courses at USC are COMM 200, COMM 304 or COMM 308.

#### *Social and Behavioral Sciences*

Psychology or sociology: one course in general psychology or introduction to sociology is required. The recommended courses at USC are PSYC 100 or SOCI 200.

Economics: one course in either macroeconomics or 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 or ECON 205.

Students who have earned a baccalaureate degree and meet the prerequisites described above (including general psychology or introduction to sociology and microeconomics or macroeconomics) at the time of admission will have fulfilled the requirement for social and behavioral sciences.

Students who will not have earned a baccalaureate degree at the time of admission must complete an additional two semesters or three quarters of courses in the social and behavioral sciences. Recommended areas include anthropology, psychology, psychobiology, economics, geography and sociology.

#### *Humanities*

Students who have earned a baccalaureate degree and meet the prerequisites described above at the time of admission will have fulfilled the requirements for humanities.

Students who will not have earned a baccalaureate degree at the time of admission must complete an additional two semesters or three quarters of courses in literature, philosophy, history, ethics, foreign language or fine arts. Studio or performance classes in art and music are not acceptable.

### Advanced Placement and International Baccalaureate Examinations

AP and IB scores are acceptable only for students entering the Pharm.D. program with a bachelor's degree. Non-degree holders should complete the next higher level class for prepharmacy requirements. The Admission Committee recommends that applicants enroll in all of the required prepharmacy courses. For students who may have been waived out of any prepharmacy requirement, the committee generally will consider the application of higher level course work toward prepharmacy requirements. Please contact the School of Pharmacy Office of Admission for specific information.

### Entrance Examination

The PCAT is not required but applicants who submit scores will be given favorable consideration in the application process. An interview is required for admission.

### Transfer Students

Transfer students from other U.S. accredited colleges of pharmacy are not accepted into the Pharm.D. program.

### Post-Baccalaureate Program

The School of Pharmacy accepts a limited number of applicants (if vacancies exist) who hold a recently conferred baccalaureate degree in pharmacy from a college of pharmacy accredited by the Accreditation Council for Pharmacy Education. Such applicants may not be required to meet all prepharmacy requirements in order to qualify for admission and, if admitted to the Doctor of Pharmacy program, may be accepted at an advanced level for a minimum of two years (72 semester units) of full-time study.

### Special Admissions Program for High School Students and USC Undergraduates

The Trojan Admission Prepharmacy (TAP) program provides guaranteed admission to the USC School of Pharmacy for USC undergraduates who meet preset performance standards. The TAP program is designed to attract highly qualified, mature high school seniors applying to USC. Admission requirements for high

school applicants to the TAP program include prior admission to any USC undergraduate program. Currently enrolled USC undergraduates may apply to the TAP program with a 3.2 GPA at USC. Transfer students are not eligible for the TAP program.

Students accepted into the TAP program must take full course loads each semester (minimum of 16 units) and complete their prepharmacy requirements with at least a 3.2 cumulative GPA. All prepharmacy courses must be taken for letter grades. Pass/no pass, credit/no credit grades and grades lower than C are not acceptable.

TAP program participants who fulfill the requirements listed above will be guaranteed admission to the Doctor of Pharmacy program at USC. Participants who fulfill the prepharmacy and TAP GPA requirements and wish to complete their baccalaureate degree can do so without losing their guaranteed admission to the School of Pharmacy, provided they meet or exceed the minimum cumulative GPA required for admission into the Pharm.D. program. TAP program students receive ongoing individual advisement, access to the School of Pharmacy's student services and the privilege of joining the student-run prepharmacy club, the USC Pharmaceutical Society. A specific listing of USC courses and a recommended program for TAP program participants can be obtained from the School of Pharmacy Office of Admission.

#### *General Education Requirements (TAP Students Only)*

The university's general education program provides a coherent, integrated introduction to the breadth of knowledge you will need to consider yourself (and to be considered by other people) a generally well-educated person. This program requires six courses in different categories, plus writing and diversity requirements, which together comprise the USC Core. See pages 60 and 231 for more information.

#### **Pharm.D. Curriculum Requirements**

The completion of a four-year professional curriculum is required to earn the Doctor of Pharmacy degree. The curriculum, except for the fourth year, is a "block" program. All students must enroll in 18 units each semester in courses designated for the fall or spring. Students do not have choices of courses to take nor are they permitted to drop any one course or courses during the semester. (Year III and IV students have elective course choices). Progress is permitted only when the prior semester is completed in full. Students should view the curriculum outlined here as advisory only and subject to modification. Aggregate hours must equal a minimum of 144 units to meet graduation requirements.

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, and curriculum changes are necessary and desirable in order to meet scientific advances, population profile changes, increasing health expectations, technological advances, the increasing role of the government in health services and other influences.

#### **Program of Courses**

YEAR I, FALL (18 UNITS)		UNITS
PHRD 501	Pharmaceutics I	4
PHRD 503	Biological Systems I	4
PHRD 507	Health Care Delivery Systems	2
PHRD 509	Pharmacy Practice and Experience I	4
PHRD 555	Biochemical and Molecular Sites of Drug Action	4

YEAR I, SPRING (18 UNITS)		UNITS
PHRD 502	Pharmaceutics II	3
PHRD 504	Biological Systems II	6
PHRD 505	Molecular Genetics and Therapy	3
PHRD 510	Pharmacy Practice and Experience II	4
PHRD 554	Public Health and Epidemiology	2

YEAR II, FALL (18 UNITS)		UNITS
PHRD 506	Self Care and Non-Prescription Therapies	5
PHRD 508	Pharmacy Literature Analysis and Drug Information, or	
PHRD 561	Parenteral Therapy Externship	3
PHRD 551	Immunology	3
PHRD 557	Therapeutics I	5
PHRD 559	Therapeutics II	2

YEAR II, SPRING (18 UNITS)		UNITS
PHRD 552	Pharmaceutics III	3
PHRD 553	Management within Health Care Organizations	2
PHRD 560	Therapeutics III	6
PHRD 561L	Parenteral Therapy Externship, or	
PHRD 508	Pharmacy Literature Analysis and Drug Information	3
PHRD 562	Therapeutics IV	4

YEAR III, FALL (18 UNITS)		UNITS
PHRD 601	Therapeutics V	6
PHRD 603	Therapeutics VI	3
PHRD 605	Therapeutics VII	4
PHRD 607	Nutrition	2
Elective		3

YEAR III, SPRING (18 UNITS)		UNITS
PHRD 606	Therapeutics VIII	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
Elective		3

Year III students must choose their electives from the following (3 units each):

PHRD 651	Community Pharmacy I
PHRD 652	Community Pharmacy II
PHRD 653	Health Systems Pharmacy I
PHRD 654	Health Systems Pharmacy II
PHRD 655	Geriatric Pharmacy I
PHRD 656	Geriatric Pharmacy II
PHRD 657L	Basic Research Design
PHRD 658	Sleep and the Pharmacologic Management of Its Disorders
PHRD 659	Molecular Therapeutics: Signal Transduction
PHRD 660	Disease State Management I
PHRD 661	Pharmacy Practice in Women's Health
PHRD 662	Psychiatric Pharmacy Practice
PHRD 663	Pharmaceutical Development
PHRD 664	Clinical Problem Solving
PHRD 665	Complementary/Alternative Therapeutics
PHRD 666	Therapeutic Drug Monitoring
PHRD 667	Drugs of Abuse
PHRD 668	Computing Application
PHRD 669	Health Care Needs of Special Populations
PHRD 670	Marketing and Development in the Pharmaceutical Industry

#### **YEAR IV, FALL (18 UNITS)**

Required Clerkships  
Elective Clerkships

#### **YEAR IV, SPRING (18 UNITS)**

Required Clerkships  
Elective Clerkships

**Required Clerkships (6 units each) — four rotations:**

PHRD 701	Acute Care Clinical Practice Clerkship
PHRD 705	Community Pharmacy Clerkship
PHRD 704 PHRD 707	Primary Care Clerkship, or Outpatient Psychiatric Pharmacy Clerkship

An inpatient practice elective must be satisfied by PHRD 702 if the student selects PHRD 707 Outpatient Psychiatric Pharmacy Clerkship. If the student selects PHRD 702, the student may take elective clerkships marked \* to satisfy the requirement.

**Elective Clerkships — two rotations:**

PHRD 702*	Inpatient Psychiatric Pharmacy Clerkship
PHRD 703	Long Term Care Clerkship
PHRD 706	Geriatrics Clerkship
PHRD 708*	Inpatient Clinical Practice Clerkship
PHRD 709*	Pediatric Drug Therapy Clerkship
PHRD 710*	Surgery Clerkship
PHRD 711*	Cardiovascular Drug Therapy Clerkship
PHRD 712*	Applied Clinical Pharmacokinetics Clerkship
PHRD 713	Drug Information Clerkship
PHRD 714	Radiopharmacy Clerkship
PHRD 715*	Oncology Clerkship
PHRD 716*	Ob-Gyn Clerkship
PHRD 717	Dermatology Clerkship
PHRD 718	Hospital Pharmacy Practice Clerkship
PHRD 719	Pain Management Clerkship
PHRD 720*	Critical Care Clerkship
PHRD 721	Drug Utilization and Evaluation Clerkship

PHRD 722	Home Health Care Clerkship
PHRD 723*	Nutritional Support Clerkship
PHRD 724	Advanced Community Pharmacy Clerkship
PHRD 725	International Pharmacy Clerkship
PHRD 726	Directed Clinical Project Clerkship I
PHRD 727	Directed Clinical Project Clerkship II
PHRD 728	Directed Clinical Project Clerkship III
PHRD 729	Directed Clinical Project Clerkship IV
PHRD 730	Acute Care Geriatrics Clerkship
PHRD 731	Advanced Geriatrics Clerkship
PHRD 732	Pharmacy Administration Clerkship
PHRD 733*	Anticoagulation Therapy Clerkship
PHRD 734*	Antimicrobial Therapy Clerkship
PHRD 735	Clinical Pharmacy Research Clerkship
PHRD 736*	Chemical Dependency Clerkship
PHRD 737*	Clinical Transplantation Clerkship
PHRD 738	Pharmaceutical Industry Clerkship
PHRD 739	AIDS/Immune Disorders Clerkship
PHRD 740	Health Care Systems Administration Clerkship
PHRD 741	Advanced Ambulatory Care Clerkship

\*Acceptable for satisfying the inpatient elective requirement.

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. 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 all 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 and clerkships 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 and in molecular pharmacology and toxicology. The school also offers an interdisciplinary M.S. in regulatory science. The Ph.D. degree in pharmaceutical economics and policy is offered jointly with the Department of Economics. The M.S. degree in pharmaceutical economics and policy is offered jointly with the School of Policy, Planning, and Development and the Department of Economics. In addition, the

school offers dual degrees with the schools of law, business and gerontology 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 addi-

tion 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, page 91.

#### **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 Pharmaceutical Economics and Policy**

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 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 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, page 81 and the Graduate School section of this catalogue for general regulations, page 91. 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.

#### **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 32 units: 24 units of formal course work, MPTX 594ab (4 units over two semesters), MPTX 700 (4 units over four semesters) and a presentation of an acceptable thesis based on the results of an original investigation.

#### **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.

#### *Course Requirements*

The student is required to complete the following 36 units of graduate level course work: ECON 414 (4 units), ECON 500 (4 units) or PPD 501 (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 requirements for the degree within five years of entry into the program.

### *Additional Degree Requirements*

The student must satisfactorily complete the specified courses in economics, preventive medicine and public administration prior to enrolling in PMEP 538 or PMEP 539. The student is also required to complete an empirical research project on a topic relevant to pharmaceutical economics and policy.

### **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 30 units of formal course work and 6 units of research project work in an internship setting (MPTX 630). 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 admissions committee. 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 advisors before beginning the program.

### **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 guidance committee may require more than 24 units of course work. A minimum of 12 units is to be taken in courses in the Department of Pharmaceutical Sciences and a minimum of 8 units must be taken in various related disciplines outside the department. The remaining 36 units may be fulfilled with other courses, directed research and dissertation.

### *Foreign Language Requirement*

There is no formal foreign language requirement. However, an individual guidance 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.

### *Guidance Committee*

Upon admission, the student will be assigned to a member of the graduate faculty who will serve as his or her temporary advisor until a permanent advisor has been identified. The student's program of study will be under the direction of a guidance 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 advisor and guidance 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 guidance committee or, if a student has not selected his or her research advisor 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 guidance 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, page 94).

### *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. At least 24 units of course work are required at the 500-level or above, exclusive of seminars and directed research. The guidance committee may require more than 24 units of course work in some cases. The specific requirements will depend on the student's background and research area and will be determined by the student's advisor and advisory committee. A minimum of 12 units is to be taken in appropriate courses offered by the School of Pharmacy. The remaining 36 units may be fulfilled with other courses, directed research and dissertation. A maximum of 12 units can be transferred from graduate studies elsewhere.

### *Foreign Language Requirement*

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

### *Guidance Committee*

Upon admission, the student will be assigned to a member of the graduate faculty who will serve as his or her temporary advisor until a permanent advisor has been identified. The student's program of study will be under the direction of a guidance committee composed of at least five members, one of whom must be from outside the department. The student should select a graduate advisor and guidance committee no later than the third semester in residence. The graduate affairs committee will serve as the guidance 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 guidance committee or, if a student has not yet selected a guidance 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 guidance 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 guidance 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 guidance committee.

*Annual Research Appraisal (ARA)*

Beginning in the third year, each graduate student will meet with the guidance 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 guidance 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 advisor and dissertation committee. For additional details, see Theses and Dissertations, page 94.

*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 Pharmaceutical Economics and Policy**

The Department of Pharmaceutical Economics and Policy (School of Pharmacy) offers a program of study leading to the Ph.D. degree. This program focuses on economic assessment of pharmaceuticals and medical technology and research into the finance and delivery of pharmaceuticals and pharmacy services. A minimum of 64 units of graduate level courses numbered 500 or higher (excluding 794) and a minimum of four units of 794 is required.

*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 511, ECON 514, 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.

*Guidance Committee*

The student will be assigned to a member of the graduate faculty who will serve as his or her temporary advisor until the formation of a guidance committee. The student should consult the pharmaceutical economics and policy director of graduate studies on the appointment of a Ph.D. guidance committee after taking the written qualifying examination. The chairman of the student's Ph.D. guidance committee advises the student on matters of curriculum and graduate opportunities. The guidance committee comprises three to five members, at least one of whom must 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. guidance committees must be approved by the pharmaceutical economics and policy director of graduate studies. The student must form his or her guidance committee within one month 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.

*Seminar Requirements*

Every student is required to take and satisfactorily complete three two-unit 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, the student must 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. It becomes part of the student's permanent file.

*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, 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 must 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, page 94).

### *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.

### **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.

#### *Degree Requirements*

The professions of pharmacy and law are distinctly different, yet pharmacists are often involved in legal issues and lawyers frequently deal with pharmacy, drug, health care, product development and toxin-related matters. This dual degree program provides qualified students with an efficient mechanism for obtaining the expertise and professional credentials that will enable them to develop professional practices that bring together expertise in both areas.

#### *Overall Requirements*

A student is required to complete all work for both degrees within six years of the date of matriculation at the School of Pharmacy (Pharm.D.) and five years of matriculation at the Gould School of Law (J.D.). The entire dual degree program will take six years to complete. Dual degree students will be allowed to use 12 units of approved J.D. course work (elective or required) to meet 12 units of Pharm.D. electives and 12 units of approved Pharm.D. course work (elective or required) to meet J.D. electives. A faculty guidance committee will determine the exact program for each student, including the appropriateness of courses in one program used to meet elective requirements for the other program. A total of 208 units are required for the dual degree.

#### *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.

#### *Recommended Program*

Pharm.D./J.D. dual degree students will begin with the first year of the Pharm.D. curriculum (36 units). During the second year, students will take the first year law core (33 units), plus 3-5 Pharm.D. units. Due to the rigor of the law school core, pharmacy courses during the first year of law school are limited to non-science courses. The third through fifth years of the program focus on Pharm.D. courses with sufficient law courses to maintain students' educational momentum in law. Students should complete their Pharm.D. requirements during the fall of their sixth year of the program and their law course work also during the sixth year. Students must complete both degree requirements by the end of the sixth year of the program.

### **Pharm.D./M.B.A. 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./M.B.A. 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 M.B.A. core courses

*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.

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

#### *Admission Requirements*

Students who have a baccalaureate degree from an accredited college or university and have been admitted and 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, page 147, 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 health-related 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 becoming increasingly recognized as a specialty. Pharmacists with expertise in gerontology and geriatrics are in an excellent position to play a leading role in health policy and direct patient care. 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 would like to pursue the dual Pharm.D./M.S. degree must be accepted by both programs. 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 G.P.A. 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./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 contingent on passing all courses in their first year of the Pharm.D. with a minimum 3.0 G.P.A. Students who are accepted only by 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. 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 G.P.A. Students accepted to the dual degree program must maintain a minimum 3.0 G.P.A. 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 page 793) and M.S., Gerontology degrees as listed in the current catalogue with a minimum cumulative 3.0 G.P.A. The specific M.S. course requirements for the dual Pharm.D./M.S. degree are listed on page 659.

#### **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./M.P.H. 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 M.P.H. program must also be fulfilled by dual degree applicants.

The Pharm.D./M.P.H. program spans five years (four years of pharmacy school courses and one year of public health courses). Students begin the core M.P.H. 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 M.P.H. program.

All students in the Pharm.D./M.P.H. 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 M.P.H. curriculum to meet graduation requirements.

The Pharm.D. and the M.P.H. 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 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./M.P.H. 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.P.H. program during their first year of enrollment in the Pharm.D. prior to the M.P.H. published application deadline.

Students who elect this approach must apply through the School of Pharmacy. Students admitted to the M.P.H. 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. These units cannot, however, be substituted for 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.

#### **Post-Pharm.D. Graduate Studies**

Qualified students who wish to continue graduate studies within the School of Pharmacy upon completion of the Pharm.D. may, with permission of the dean, substitute certain Pharm.D. courses with courses necessary for the graduate degree so that the graduate program will not be delayed. These units cannot, however, be substituted for the 24 units of core course work.

#### **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 Leonard 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 Leonard Davis School of Gerontology, page 658, 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 Leonard 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.

## Non-Degree Programs

Office of External Programs  
1985 Zonal Avenue  
Los Angeles, CA 90089-9121  
(323) 442-2403  
FAX: (323) 442-3600  
Email: [pharmce@usc.edu](mailto:pharmce@usc.edu)  
[www.usc.edu/schools/pharmacy/continuing\\_education](http://www.usc.edu/schools/pharmacy/continuing_education)

### Continuing Education

The School of Pharmacy, Office of External Programs, is a recognized provider of continuing pharmacy education and certificate programs 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, prior to many local and national association meetings, and annually in Las Vegas and Hawaii.

For information concerning continuing education programs contact: Office of External Programs.

## Courses of Instruction

### MOLECULAR PHARMACOLOGY AND TOXICOLOGY (MPTX)

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

#### 462 Physiology for the Health Professions (4) (Enroll in PHBI 462)

**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.

**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.

**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.

**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.

**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.

**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.

**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.

#### 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.

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

**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.

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

**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.

**521 Seminars in Regulatory Sciences**

**(1, FaSpSm)** Current problems in regulatory affairs, legal management, preclinical and clinical testing, scientific evaluation and quality assurance. Graded CR/NC.

**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.

**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.

**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.

**531 Cell Biology (4)** (Enroll in INTD 531)**561 Molecular Genetics (4, Sp)** (Enroll in INTD 561)**562 Systems and Integrative Physiology (4, Sp)** (Enroll in PHBI 562)**571 Biochemistry (4, Sp)** (Enroll in INTD 571)**572 Systems Physiology and Disease I (4, Fa)** (Enroll in INTD 572)**573 Systems Physiology and Disease II (4, Sp)** (Enroll in INTD 573)**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.

**594abz Master's Thesis (2-2-0, FaSpSm)**

Credit on acceptance of thesis. Graded IP/CR/NC.

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

**603 Molecular Mechanisms for Biological Signals (4, Fa)**

Biological mechanisms of hormone, neuro-transmitter, 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.

**605 Toxicology of Oxidants and Free Radicals (2, Sp)**

The chemistry, biochemistry, and physiology of oxygen and the biochemical mechanism of tissue-specific oxygen toxicity. *Prerequisite:* knowledge of biochemistry.

**606 Pulmonary Toxicology (2, Sp)**

Current concepts of inhalation toxicology and toxic mechanisms leading to lung injury. Lectures include basic pulmonary anatomy and physiology. *Prerequisite:* knowledge of biochemistry.

**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.

**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.

**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.

**794abcdz Doctoral Dissertation (2-2-2-0, FaSpSm)**

Credit on acceptance of dissertation. Graded IP/CR/NC.

**PHARMACY (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. (Duplicates credit in former PHAR 303.)

**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. (Duplicates credit in former PHAR 306L.)

**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. (Duplicates credit in former PHAR 309, PHAR 313, PHAR 314 and PHAR 419.)

**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. (Duplicates credit in former PHAR 310 and PHAR 419.)

**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. (Duplicates credit in former PHAR 316.)

**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. (Duplicates credit in former PHAR 331 and PHAR 332.)

**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.

**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. (Duplicates credit in former PHAR 319 and PHAR 366.)

**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. (Duplicates credit in former PHAR 361, PHAR 363, PHAR 365 and PHAR 450.)

**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. (Duplicates credit in former PHAR 362, PHAR 368 and PHAR 450.)

**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. (Duplicates credit in former PHAR 441.)

**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. (Duplicates credit in former PHAR 406.)

**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. (Duplicates credit in former PHAR 431 and PHAR 432.)

**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. (Duplicates credit in former PHAR 437.)

**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.

**557 Therapeutics I (5, Fa)** Introduction to principles of pharmacology, pharmacokinetics, medicinal chemistry and therapeutics. Open to Doctor of Pharmacy students only. (Duplicates credit in former PHAR 403L, PHAR 414 and PHAR 418.)

**559 Therapeutics II (2, Fa)** Integrated teaching of pharmacogenomics and biotechnology with emphasis on general principles, diagnostics, and future technology.

**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. (Duplicates credit in former PHAR 547.)

**561 Parenteral Therapy Externship (3, FaSpSm)** Drug weight/volume concentrations, dilutions and additive volumes are calculated in compounding of parenteral products in various patient-care settings using aseptic technique. Open to Doctor of Pharmacy students only. (Duplicates credit in former PHAR 414, PHAR 460 and PHAR 545.)

**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. (Duplicates credit in former PHAR 548 and PHAR 549.)

**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. (Duplicates credit in former PHAR 546.)

**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. (Duplicates credit in former PHAR 548 and PHAR 549.)

**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. (Duplicates credit in former PHAR 411L, PHAR 418.)

**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. (Duplicates credit in former PHAR 411L, PHAR 418.)

**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. (Duplicates credit in former PHAR 422.)

**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. (Duplicates credit in former PHAR 550 and PHAR 562.)

**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.

**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.

**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. (Duplicates credit in PHAR 406 and PHAR 553.)

**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. (Duplicates credit in former PHAR 552 and PHAR 554.)

**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. (Duplicates credit in former PHAR 541 and PHAR 555.)

**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. (Duplicates credit in former PHAR 556.) *Prerequisite:* PHRD 651.

**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. (Duplicates credit in former PHAR 541 and PHAR 557.)

**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. (Duplicates credit in former PHAR 558.) *Prerequisite:* PHRD 557.

**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. (Duplicates credit in former PHAR 559.)

**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. (Duplicates credit in former PHAR 560.) *Prerequisite:* PHRD 559.

**657L Basic Research Design (3, FaSp)**

Research experience to integrate research into Doctor of Pharmacy program. Research focuses on industrial, academic, or government issues. Open to Doctor of Pharmacy students only. (Duplicates credit in former PHAR 565.)

**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. (Duplicates credit in former PHAR 570.)

**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. (Duplicates credit in former PHAR 573.)

**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. (Duplicates credit in former PHAR 571.)

**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. (Duplicates credit in former PHAR 577.)

**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. (Duplicates credit in former PHAR 578.)

**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. (Duplicates credit in former PHAR 566.)

**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 Level III Pharm.D. students only. (Duplicates credit in former PHAR 574.)

**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. (Duplicates credit in former PHAR 579.)

**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. (Duplicates credit in former PHAR 575.)

**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. (Duplicates credit in former PHAR 568.)

**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. (Duplicates credit in former PHAR 568.)

**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. (Duplicates credit in former PHAR 576.)

**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.

**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.

**701 Acute Care Clinical Practice Clerkship (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. (Duplicates credit in former PHAR 601.)

**702 Inpatient Psychiatric Pharmacy Clerkship (6, FaSpSm)**

Application of pharmaceutical care principles to the inpatient psychiatric patient. Understanding of the treatment of common psychiatric disorders, patient interviewing skills and health care teams. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 602.)

**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. (Duplicates credit in former PHAR 603.)

**704 Primary Care Clerkship (6, FaSpSm)**

Disease state management and pharmaceutical care in ambulatory care. Modification and design of drug therapy regimens, participation in medical care team and direct patient care. Open to Doctor of Pharmacy students only. (Duplicates credit in former PHAR 604.)

**705 Community Pharmacy Clerkship (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 Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 605.)



**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. (Duplicates credit in former PHAR 606.)

**707 Outpatient Psychiatric Pharmacy Clerkship (6, FaSpSm)** Disease state management and pharmaceutical care in ambulatory mental health care. Modification and design of psychiatric therapy regimens, participation in multidisciplinary teams and patient care. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 604 and PHAR 607.)

**708 Inpatient Clinical Practice Clerkship (6, FaSpSm)** Drug therapy in a variety of inpatient clinical settings. Emphasis: patient monitoring, evaluation of therapeutic response, and provision of drug information. (Duplicates credit in former PHAR 610.)

**709 Pediatric Drug Therapy Clerkship (4-6, FaSpSm)** Clinical therapeutic and pharmacokinetic concepts applied to the pediatric patient. Unique aspects of pediatric clinical pharmacology emphasized in treating a variety of organ system diseases. (Duplicates credit in former PHAR 611.)

**710 Surgery Clerkship (6, FaSpSm)** Drug therapy in clinical situations common to surgical patients. The use of drugs and monitoring for response to treatment in surgical settings. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 612.)

**711 Cardiovascular Drug Therapy Clerkship (6, FaSpSm)** Pharmaceutical care applied to cardiac patients. The use of cardiac drugs with an emphasis on physiologic response, pharmacokinetic principles and desired treatment outcomes. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 613.)

**712 Applied Clinical Pharmacokinetics Clerkship (6, FaSpSm)** Practical experience in applying pharmacokinetic principles to patients in the health care system. A variety of disease states and therapeutic agents will be reviewed. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 614.)

**713 Drug Information Clerkship (6, FaSpSm)** Practical experience and training in the use of information resources and technology to improve patient care. Experience in information retrieval, literature evaluation, problem solving skills and communication skills emphasized. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 615.)

**714 Radiopharmacy Clerkship (6, FaSpSm)** Provides practical and theoretical aspects of radiopharmacy services delivery. (Duplicates credit in former PHAR 616.)

**715 Oncology Clerkship (6, FaSpSm)** Directed experiences in the use and monitoring of oncological drugs. (Duplicates credit in former PHAR 617.)

**716 Ob-Gyn Clerkship (6, FaSpSm)** Provides experiences in disease states common to this area and the drug therapy management employed. (Duplicates credit in former PHAR 618.)

**717 Dermatology Clerkship (6, FaSpSm)** Provides experiences in disease states common to this area and the drug therapy management employed. (Duplicates credit in former PHAR 619.)

**718 Hospital Pharmacy Practice Clerkship (6, FaSpSm)** Practical experience and training in the practice of hospital pharmacy. Administrative, practice-based and therapeutic competencies emphasized. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 620.)

**719 Pain Management Clerkship (6, FaSpSm)** Pharmaceutical care principles applied to patients requiring treatment in pain management. Pharmacology, patient counseling and management emphasized. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 623.)

**720 Critical Care Clerkship (6, FaSpSm)** Drug therapy in a critical care setting. Emphasizes therapeutic management in critically ill patients, often with multisystem failure. (Duplicates credit in former PHAR 624.)

**721 Drug Utilization and Evaluation Clerkship (6, FaSpSm)** Practical experience and training in the design, implementation and evaluation instruments (DUE/MUE) to measure the appropriate use of therapeutic agents and the evaluation of desired therapeutic outcomes. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 625.)

**722 Home Health Care Clerkship (6, FaSpSm)** Practical experience in the provision of comprehensive home intravenous and nutritional support services, including fluid and electrolyte therapy, chemotherapy, antibiotics, pain control and nutrition support. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 626.)

**723 Nutritional Support Clerkship (6, FaSpSm)** Experiential training in the pharmacy specialty of nutritional support. Activities include: patient evaluation, developing treatment plans, formula composition and design, integration with nutritional support team and consult services. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 627.)

**724 Advanced Community Pharmacy Clerkship (6, FaSpSm)** Directed project in community pharmacy. (Duplicates credit in former PHAR 628.)

**725 International Pharmacy Clerkship (6, FaSpSm)** Practical experience and training in the practice of pharmacy in the international setting. Students will visit an international pharmacy practice setting and complete a project. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 629.)

**726 Directed Clinical Clerkship Project I (6, FaSpSm)** Directed educational opportunities not presently offered as electives, e.g., research projects or new and evolving clerkships. (Duplicates credit in former PHAR 630a.)

**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. (Duplicates credit in former PHAR 630b.)

**728 Directed Clinical Clerkship Project III (6, FaSpSm)** Directed educational opportunities not presently offered as electives, e.g., research projects or new and evolving clerkships. (Duplicates credit in former PHAR 630c.)

**729 Directed Clinical Clerkship Project IV (6, FaSpSm)** Directed educational opportunities not presently offered as electives, e.g., research projects or new and evolving clerkships. (Duplicates credit in former PHAR 630d.)

**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 Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 631.)

**731 Advanced Geriatrics Clerkship**

**(6, FaSpSm)** Directed projects and experiences in geriatric drug therapy. (Duplicates credit in former PHAR 632.)

**732 Pharmacy Administration Clerkship**

**(6, FaSpSm)** Principles and practices of hospital pharmacy administration, management and departmental relationships. Practical experiences and projects emphasized. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 633.)

**733 Anticoagulation Therapy Clerkship**

**(6, FaSpSm)** Management of patients requiring anticoagulation. Applied knowledge of disease pathophysiology, anticoagulant pharmacology, and laboratory methods toward safe and effective patient outcomes. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 634.)

**734 Antimicrobial Therapy Clerkship**

**(6, FaSpSm)** Antimicrobial therapy, including antibiotic selection, dosage adjustment, and outcomes assessment of patients in the health care setting. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 635.)

**735 Clinical Pharmacy Research Clerkship**

**(6, FaSpSm)** Drug research administration: research design; ethics; record-keeping; and institutional review. Practical experience and projects are emphasized. Open to Level IV Doctor of Pharmacy students only. (Duplicates credit in former PHAR 636.)

**736 Chemical Dependency Clerkship**

**(6, FaSpSm)** The psychiatric, social, and pharmacological management of chemical dependency. Emphasizes the inpatient, day treatment, and outpatient components of detoxification and recovery. (Duplicates credit in former PHAR 637.)

**737 Clinical Transplantation Clerkship**

**(6, FaSpSm)** Drug therapy to organ transplantation. Emphasizes pre- and post-transplantation therapy designed to minimize organ rejection, prevent infection, and improve survival. (Duplicates credit in former PHAR 638.)

**738 Pharmaceutical Industry Clerkship**

**(6, FaSpSm)** Train within a pharmaceutical company to develop an understanding of the drug development, research, marketing process. (Duplicates credit in former PHAR 639.)

**739 AIDS/Immune Disorders Clerkship**

**(6, FaSpSm)** A multidisciplinary approach to the management of AIDS and other immunocompromised patients. Pharmacologic management is directed toward opportunistic infections, disease modifiers, and adjunctive therapy. (Duplicates credit in former PHAR 640.)

**740 Health Care Systems Administration Clerkship**

**(6, FaSpSm)** Practical experience and training in managed care settings and health care systems. Emphasis on administrative principles, management and health outcomes. Students will complete a project. Open to Doctor of Pharmacy students only. (Duplicates credit in former PHAR 642.)

**741 Advanced Primary Care Clerkship**

**(6, FaSpSm)** Advanced experience in disease state management in the primary care setting. Design drug therapy regimens using a team-based approach at an advanced level of practice. Open to Doctor of Pharmacy students only. *Prerequisite:* PHRD 704.

**PHARMACEUTICAL ECONOMICS AND POLICY (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.

**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.

**529 Risk, Probabilities and Preferences**

**(4, Sp)** Analysis of economic and psychological constructs of risks, probabilities, and health related preferences and utilities.

**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.

**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.

**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.

**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.

**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.

**698 Seminar in Pharmaceutical Economics and Policy (4, max 8, FaSp)**

Current research in pharmaceutical economics and policy presented by outside scholars, faculty and students. Graded CR/NC.

**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.

**794abcdz Doctoral Dissertation (2-2-2-2-0)**

Credit on acceptance of dissertation. Graded IP/CR/NC.

**PHARMACEUTICAL SCIENCES (PSCI)****462 Physiology for the Health Professions**

**(4)** (Enroll in PHBI 462)

**531 Cell Biology (4)**

(Enroll in INTD 531)

**561 Molecular Genetics (4, Sp)**

(Enroll in INTD 561)

**562 Systems and Integrative Physiology**

**(4, Sp)** (Enroll in PHBI 562)

**571 Biochemistry (4, Fa)**

(Enroll in INTD 571)

**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.

**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.

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

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

**613L Radiobiology and Biological Effects of Radiation (4)** Effects on the cellular level and on mammalian systems; their bearing on human exposure criteria. Lecture and laboratory.

**652L Structure Activity Relationship and Drug Design (4, 2 years, Sp)** Computerized correlation of biological activities with molecular structures and physico-chemical properties of drugs and their applications in designing new drugs. Lecture and laboratory.

**653L Spectrometry in Biomedicine (4, 2 years, Sp)** Theory of spectrometry and applications in pharmaceutical and biomedical sciences. Emphasis on structural identification of organic molecules, drugs and their metabolites of pharmaceutical interest. Lecture and laboratory.

**654L Computer Applications in Pharmaceutical Sciences (3, 2 years, Fa)** Introduction to computing facilities and computer applications frequently used in the study of pharmaceutical sciences. Students receive maximal hands-on exposure to computing.

**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.

**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.

**662 Advanced Pharmacokinetics (4, 2 years, Sp)** Principles of pharmacokinetics including mathematical description of drug disposition processes. Emphasis on design and evaluation of pharmacokinetic studies and statistical analysis of parameter estimates.

**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. *Recommended preparation:* college level chemistry and biology; *prerequisite:* PSCI 665.

**664 Drug Discovery and Design (4, Fa)** Principles of drug discovery, design and characterization. Mechanisms of action of major classes of drugs. *Recommended preparation:* college level chemistry and biology.

**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.

**666 Molecular Structural Biology (2, Sp)** Molecular structure of proteins and DNA. Structure-function relationships and structure determination. *Recommended preparation:* college level chemistry and biology.

**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.

**671 Drug Morphology (3, 2 years, Fa)** This course will examine drug metabolism in terms of hepatic and extrahepatic processes. Mechanisms of bioactivation and cellular toxicity will also be covered.

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

**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.

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

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