

## Pharmacology

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### SCHOOL OF MEDICINE

**Arai, Amy C.**, Associate Professor, Ph.D., (Springfield), Chiba University, 1987; 1999. Molecular and pharmacological modulation of AMPA-type glutamate receptors and its impact on synaptic physiology.

**Browning, Ronald A.**, Professor, Ph.D., University of Illinois Medical Center, Chicago, 1971; 1973. Neuroanatomy and neurochemistry of seizures.

**Casparly, Donald M.**, Professor, Ph.D., (Springfield), New York University, 1971; 1973. Sensory physiology, neurophysiology, neuroanatomy, comparative physiology.

**Dunaway, George A.**, Professor, Ph.D., (Springfield), University of Oklahoma, 1970; 1975. Regulation of energy metabolism, endocrinology, physiology and pharmacology of inner ear.

**Faingold, Carl L.**, Professor and *Chair*, Ph.D., (Springfield), Northwestern University, 1970; 1972. Convulsive seizure mechanisms and effects of anticonvulsants; pharmacological alterations of cerebral evoked potentials.

**Helfert, Robert**, Associate Professor, Ph.D., (Springfield), University of California, 1987; 1990. Cytoarchitecture, connections and transmitter specificity of the central auditory system; age-related changes in the cytoarchitecture and synaptic organization of the auditory and vestibular systems.

**Lee, Tony, J-F.**, Research Professor, *Emeritus*, Ph.D., (Springfield), West Virginia University, 1973; 1975.

**Naritoku, Dean**, Associate Professor, M.D., (Springfield), Chicago Medical School, 1981; 1987. Mechanisms of epilepsy and seizure susceptibility, functional neuroanatomy of seizures, GABA receptor function, clinical pharmacology.

**Premkumar, Louis S.**, Associate Professor, Ph.D., (Springfield), Australian National University, 1992; 1999. Molecular neurobiology, molecular mechanism(s) underlying pain perception; structure and function of ion channels.

**Ramkumar, Vickram**, Associate Professor, Ph.D., (Springfield), University of Maryland, 1986; 1992. Molecular pharmacology of adenosine receptors in cardiovascular system and central nervous systems.

**Rybak, Leonard P.**, Professor, M.D., Ph.D., (Springfield), University of Minnesota, 1973; 1981. Investigation of mechanisms controlling ionic composition and resting potentials in the peripheral auditory apparatus using chinchilla model.

**Toth, Linda A.**, Professor, Ph.D., D.V.M., (Springfield), University of Pittsburgh, 1980; Purdue University, 1986. Sleep, genetics, neuroimmunology.

**Turner, Jeremy**, Research Assistant Professor, Ph.D., Northern Illinois University, 1999; 2002.

Graduate courses of study leading to the Master of Science and Doctor of Philosophy degrees in pharmacology are offered by Southern Illinois University School of Medicine, Department of Pharmacology. Course offerings in the graduate program have been designed so that graduate students may acquire a broad basic knowledge as well as research experience in different areas of pharmacology. Graduate students may choose from a diversity of specializations when selecting a research adviser and a research topic. Well equipped research facilities are available.

The minimum requirements for admission to an advanced degree program in pharmacology are that all students must have an undergraduate degree in one of the biological sciences. Students may be admitted with deficiencies in these prerequisites, but they must remedy them at an accredited University which is approved by the Graduate School prior to completion of PHRM 550 a and b. Students with undergraduate training in related areas, such as chemistry, physics, mathematics, computer science, psychology, or engineering are strongly encouraged to consider graduate work in pharmacology.

Unrestricted admission into the master's program requires an undergraduate grade point average (GPA) of 3.0 ( $A = 4.0$ ). For unrestricted admission into the doctoral program, a GPA of 3.25 ( $A = 4.0$ ) on all course work is required. Specific requirements are described in the sections, "Specific Requirements for a Master of Science Degree in Pharmacology" and "Specific Requirements for a Doctoral Degree in Pharmacology."

In addition to the above general requirements, each applicant must submit *directly to the Department of Pharmacology*:

1. A completed application.
2. Original official transcripts for all undergraduate and graduate coursework sent directly from each university or college attended by the applicant.
3. A brief (300-600 words) typed statement outlining career goals and explaining why the applicant wishes to do graduate work in pharmacology.
4. Scores of the Graduate Record Examination (GRE) sent directly from testing agency on University stationary.
5. Three letters of recommendation from faculty who know the applicant's potential, written on forms supplied by the Department of Pharmacology.
6. International students must submit or request a copy of the TOEFL scores to be sent directly to the Pharmacology Program Director in Springfield.
7. A resume or curriculum vitae.

Equivalent course work completed at other institutions or in other collegiate units may be substituted for certain course requirements for graduate course work in Pharmacology if approved by the Pharmacology Graduate Program Committee and the Graduate School.

**Performance Requirements to Maintain Student Status**

*Master's Degree.* An overall GPA of 3.0 ( $A = 4.0$ ) in all graduate work in the program is required to remain in the program. Any grade below *B* in a Pharmacology core course must be compensated for by retaking the course and earning an *A* or *B* grade.

*Doctor of Philosophy Degree.* An overall GPA of 3.0 ( $A = 4.0$ ) in all graduate work in the program is required to remain in the program. Any student who makes a grade below *B* in a Pharmacology core course will not be allowed to remain in the Ph.D. program of the Department of Pharmacology, but may be considered for a master's degree

**Financial Assistance**

The Pharmacology Graduate Program offers financial assistance that includes tuition waivers. Research assistantships and departmental fellowships are available; application for this support is made directly to the Department of Pharmacology. The Graduate School governs limits on support.

Graduate students should be aware that renewal of support in the form of a research assistantship or fellowship is contingent upon satisfactory performance evaluations and time limits for support. Failure to meet the requirements in either of these areas may lead to termination of support. The performance evaluation considers both assigned duties relevant to graduate assistantships and progress in coursework and research.

**General Curriculum Requirements Common to the Master's and Ph.D. Degrees in Pharmacology**

All graduate students are required to complete formal course work in 2 areas: (1) core courses and (2) electives.

The core courses are PHRM 500 (Pharmacology Seminar; all graduate students are required to participate every Fall and Spring semester), PHRM 550A and B (Principles of Pharmacology); and one advanced course of three credit hours for a Master's degree, or two advanced courses of three credit hours each for a Doctoral degree. Maximum coursework for full-time graduate students is 16 hours per semester; 12 hours is considered average. For a student with a half-time assistantship, 12 hours is the maximum, and 6 hours is the minimum.

All graduate students must acquire training in the use of appropriate research tool(s) as required by the Graduate School and determined by the graduate student's Advisory and Research Committee (ARC). Master's students are encouraged, but not required, to attain competence in at least one research tool. Doctoral students are required to attain competence in at least two research tools.

Students may fulfill the requirements for a research tool by taking any of the following courses: Statistics (PHRM 552), Research Methods (MBMB 504), or Methods in Pharmacology (PHRM 551). Students may also attain competence by formal training, or by demonstrating competence in another manner acceptable to the graduate student's ARC.

An advisory system in Pharmacology will help students in planning their program. Upon their admission to the Master's or Doctoral program, the Pharmacology Graduate Program Director will advise students until the student chooses a research advisor. The programs outlined by students, their advisors and their advisory committees are subject to approval by the Pharmacology Graduate Program Committee. The choice of advisor and the formulation of the ARC is an important step and should be carefully considered. Students are encouraged to choose an advisor as soon as possible.

As soon as a graduate student has selected a research advisor, a graduate ARC should be formed. The committee for a student in the Master's program will consist of a minimum of four members: the student's research advisor (chair), two faculty members from Pharmacology and one faculty member for an outside department. The committee for a student in the Doctoral program will consist of a minimum of five members: the student's research advisor (chair), two or three faculty members from Pharmacology, and one or two faculty members from outside the Department of Pharmacology. Members of this committee should be able to contribute significantly in the area of the student's research program. The student's research advisor, acting through the Graduate Program director and Chair of the Department of Pharmacology, will request approval of this committee from the Dean of the Graduate School. The Chair of the Department of Pharmacology and the Graduate Program Director are ex-officio members for all ARCs of which they are not formal members.

**Specific Requirements for a Master of Science Degree in Pharmacology****GENERAL REQUIREMENTS**

1. A minimum of 2 years of full-time study (1 year in residence) is required for a master's degree.
2. A total of 30 semester hours at the 400 and 500 level is required for a master's degree. At least 15 of these hours must be in 500-level courses, 6 hours which should be of PHRM 599.
3. A written comprehensive examination must be passed with at least a grade of *B*. It will be prepared, conducted, and evaluated by the pharmacology graduate program committee and will be given each fall and spring semester, as needed. This examination will become a part of the student's permanent file.
4. Before significant research has begun, a thesis proposal is required. The thesis proposal will be presented in a pharmacology seminar. Immediately following the seminar, the proposal will be defended orally before the student's thesis committee. The cover sheet for the graduate student's thesis proposal must be signed by all members of the student's thesis committee and filed with the graduate program director.
5. A thesis must be completed in the student's research area of interest and receive approval of the student's thesis committee. The thesis is expected to be a competent, original research project carried out in a selected

area under the research adviser's supervision. It should include a statement of the problem, an adequate review of literature, a careful analysis of results by whatever methods are appropriate, and an interpretation of the findings. The student must submit a preliminary draft of the thesis to the adviser at least 10 weeks prior to graduation. A corrected copy must be submitted to other members of the thesis committee no later than 8 weeks before graduation.

6. Results of the thesis research must be defended in a pharmacology seminar which must be announced at least 4 weeks in advance by sending out proper notices. Immediately following the seminar, an oral examination will be conducted by the student's thesis committee. Any member of the university community may attend this examination and may participate in the questioning and discussion, subject to reasonable time limitations imposed by the committee chair. Only committee members may vote or make recommendations concerning acceptance of the thesis and the oral examination.
7. The student will be recommended for the degree if members of the student's thesis committee judge both the thesis and the performance at the oral examination to be satisfactory. Evaluation forms will be completed by the student's thesis committee. If approved, a thesis approval form will be completed, signed by the student's major adviser and the chair of the Department of Pharmacology, and transmitted to the Graduate School. The examination may be repeated once, at least 3 months after the first examination. A second failure will result in dismissal from the pharmacology graduate program.
8. Each student is required to have 6 semester hours of PHRM 599, Thesis Research. Each student who has completed all course work and registered for the minimum of thesis research hours is required to register in PHRM 601 (Continuing Research) until completion of the degree.
9. It is the student's responsibility to give 2 appropriate unbound copies of the thesis to the Graduate School. One bound copy should be provided to the Graduate Program Director and 1 to the adviser at least 3 weeks prior to graduation.
10. Below is a representative schedule for completion of the requirements for the Master's Degree in Pharmacology. Students are strongly encouraged to begin research as soon as possible by taking PHRM 590. In addition to the core courses, the following advanced and elective courses will be offered. Students should take at least one advanced course and one elective course.

*Advanced courses:*

PHRM 555 Advanced Cardiovascular Pharmacology (Spring)	3
PHRM 574 Advanced Neuropharmacology (Spring)	3

*Elective courses:*

PHRM 590 Readings or Research in Pharmacology (entire year)	1-24
MBMB 530 Molecular and Cellular Biology (Spring)	3
PHRM 560 Geriatric Pharmacology	3
PHRM 565 Principles of Toxicology	3
MBMB 551 Advanced Immunology	3
MBMB 552 Cellular Immunology	3
MBMB 553 Advanced Medical Microbiology & Immunology	3

*Research Tools:*

PHRM 552 Applied Statistics	3
MBMB 504 Research Methods (Fall)	3

**First Year**

***Credits***

**Fall Semester**

PHRM 550a – Principles of Pharmacology	4
PHRM 550b – Principles of Pharmacology	4
PHRM 501 – Introduction to Seminar	1
MBMB 504 – Research Methods	<u>3</u>
Total	12

**Spring Semester**

*Choose Advisor*

Select 1 from advanced courses (indicated with asterisks):

*PHRM 555 – Cardiovascular Pharmacology <b>or</b>	
*PHRM 574 – Neuropharmacology	3
PHRM 590 – Research in Pharmacology	2
PHRM 501 – Introduction to Seminar	1
MBMB 531 -- Molecular and Cellular Biology	<u>3</u>
Total	9

**Summer Session**

PHRM 551 – Methods in Pharmacology	4
PHRM 590 – Readings or Research in Pharmacology	<u>2</u>
Total	6

*Preliminary Examination - Written Comprehensive Exam*

**Second Year****Fall Semester**

<i>Formulate Advisory and Research Committee/Proposal Defense</i>	
PHRM 501 – Introduction to Seminar	1
PHRM 552 – Applied Statistics	3
PHRM 590 – Readings or Research in Pharmacology	5
PHRM 599 – Thesis Research	<u>3</u>
Total	12

**Spring Semester**

PHRM 501 – Introduction to Seminar	1
PHRM 590 – Readings or Research in Pharmacology	8
PHRM 599 – Thesis Research	<u>3</u>
<i>Thesis Defense</i>	
Total	12

## SUMMARY OF REQUIREMENTS FOR MASTER OF SCIENCE DEGREE

1. Achievement of a grade point average of at least a 3.0 ( $A = 4.0$ )
2. Completion of a research tool as required by the thesis committee
3. Comprehensive written exam of course work
4. Oral defense of thesis proposal
5. Interim meeting with committee to review progress
6. Submission of thesis to advisor (10 weeks prior to graduation)
7. Corrected thesis to thesis committee (8 weeks prior to graduation)
8. Announcement of thesis defense (4 weeks prior notice)
9. Oral defense of thesis
10. Submission of approved thesis to Graduate School (2 copies), graduate program director (1 copy), and advisor (1 copy) 3 weeks prior to graduation
11. Submission of department clearance form

**Specific Requirements for a Doctor of Philosophy Degree in Pharmacology**

## GENERAL REQUIREMENTS

1. Students entering the Ph.D. program in Pharmacology should meet the minimum requirements listed for the Master's degree program. Students entering the doctoral program in Pharmacology may be admitted directly from a master's program.
2. The *Accelerated Entry* (from a master's program) is designed for students who make an early commitment to pursuing a doctoral degree. The master's student's thesis committee may recommend this option after the student's credentials, eligibility, and performance have been established. To be eligible for this option, the committee must establish: that the student has attained a 3.25 ( $A = 4.0$ ) GPA in graduate course work, that the student is prepared and able to conduct research at the doctoral level as evidenced through publications, presentations at meetings and seminars, or preparation and oral presentation of the research proposal, and that the student has letters of reference attesting to the student's ability and potential to perform doctoral research. Upon establishing the student's eligibility, the student's thesis committee will prepare a written review of the student's qualifications. Approval of the review must be given by the Pharmacology Graduate Program Committee and the Chair of the Department of Pharmacology. The Chair will then request from to the Graduate School a waiver of the master's degree or master's equivalency before entry into the doctoral program. The student's ARC will establish specific course work requirements for the Ph.D. degree in accordance with the requirements of the program.
3. The Ph.D. degree may not be conferred fewer than 6 months nor more than 5 years after admission to candidacy, except upon approval of the Dean of the Graduate School. The student is admitted to the Ph.D. candidacy after having completed the residency requirement, the research tools requirement, and the comprehensive written preliminary examination.
4. A comprehensive written preliminary examination of course work must be passed with a grade of *B* or better. It will be prepared, conducted, and evaluated by the pharmacology graduate program committee and will be given each fall and spring semester as needed. This examination will become a part of the student's permanent file. The preliminary examination may be repeated only once, no sooner than 3 months after the initial

- examination. Most course work should be completed prior to this examination, but this examination should precede the greater part of the dissertation research.
5. A dissertation proposal is required before the student begins significant research. The dissertation proposal will be presented as a Pharmacology seminar. Immediately following this seminar, the proposal will be defended orally before the students dissertation committee. The cover sheet for the graduate students dissertation proposal must be signed by all members of the student dissertation committee and filed with the Graduate Program Director. The student is required to meet formally with the ARC at least once between defense of the proposal and the dissertation. The purpose of this interim meeting will be to review progress and to modify the planned experiments, if deemed necessary based on assessment of data collected as of that date. Results of the dissertation research should be published in peer-reviewed journals with the doctoral candidate as first author. Students must have at least one paper submitted for publication and are encouraged to obtain two or more publications from the graduate research work. The students ARC may ask the student to delay the defense if this requirement is not fulfilled. The dissertation is expected to be a competent, original research project that will make significant contribution to the body of scientific knowledge. As such, it should be of sufficient quality to merit publication in a peer-reviewed journal. It should include a statement of the problem, an adequate review of literature, a careful analysis of results by whatever methods are appropriate, and an interpretation of the findings.
  6. The residency requirement for the doctorate must be fulfilled after admission to the doctoral program and before formal admission to doctoral candidacy. The residency requirement is satisfied by completion of 24 semester hours of graduate credit on campus as a doctoral student within a period of not to exceed 4 calendar years. A doctoral student will be permitted to count no more than 6 hours of Dissertation Research (PHRM 600) towards achieving the 24 semester hour residency requirement. To meet the residency requirement, students may enroll in any other course that they have not taken and meets with the approval of their adviser and dissertation committee, e.g. any formal departmental or non departmental courses, and Readings or Research in Current Pharmacological Topics (PHRM 590).
  7. The Graduate School requires completion of the residency requirement before making application to candidacy. Admission to candidacy is granted by the dean of the Graduate School upon recommendation of the student's dissertation committee after the student has fulfilled the residency requirement for the doctoral degree, passed the comprehensive written preliminary examination and met the research tool requirement. The candidate must fulfill all degree requirements within a five-year period after admission to candidacy otherwise, the student may be required to take another preliminary examination and be admitted to candidacy a second time.
  8. After admission to candidacy, the student must complete 24 hours of dissertation credit, (PHRM 600), complete their dissertation research project, and prepare the dissertation document to meet the requirements of their dissertation committee and the Graduate School. A student who has completed all formal course work, dissertation and candidacy credit requirements but has not completed and defended the dissertation must register for PHRM 601 (Continuing Research) until completion of the degree.
  9. A preliminary draft of the dissertation should be given to the adviser at least 10 weeks prior to graduation, a corrected copy should be submitted to other committee members no later than 8 weeks before graduation.
  10. Results of the dissertation research must be defended in a pharmacology seminar which must be announced at least 4 weeks in advance by sending out proper notices. Immediately following the pharmacology seminar, a final oral examination will be conducted covering the dissertation subject and other discipline related materials. Any member of the university community may attend the final oral examination and may participate in the questioning and discussion, subject to reasonable time limitations imposed by the committee chair. Only members of the committee may vote or make recommendations concerning acceptance of the dissertation and final examination. A student will be recommended for the degree if members of the dissertation committee judge both the dissertation and the performance at the final examination to be satisfactory. Evaluation forms will be completed by the committee. If approved, a dissertation approval form will be completed, signed by the student's major adviser and the Chair of the Department of Pharmacology, and submitted to the Graduate School. The examination may be repeated once, at least 3 months after the first examination. Failure of the second examination will result in dismissal from the pharmacology graduate program.
  11. It is the student's responsibility to give 2 unbound copies of the dissertation to the Graduate School, along with an abstract of 600 words or less. One bound copy should be given to the graduate program director and one to the student's adviser at least 3 weeks prior to graduation. All dissertations will be microfilmed. The student will be charged for this service. The student will be charged for this service.
  12. Below is a representative schedule of the requirements for the Ph.D. degree in Pharmacology (accelerated entry from master's course). Note that alternative scheduling is available for those students who already have a Master of Science degree in Pharmacology. In addition to the core courses, the following advanced and elective courses will be offered. Students should take two advanced pharmacology courses and one elective course. Students are also strongly encouraged to start research as soon as possible by taking PHRM 590.

*Elective courses:*

PHRM 590 Readings or Research in Pharmacology (entire year)	1-24
MBMB 504 Research Methods (Fall)	3
MBMB 531 Molecular and Cellular Biology (Spring)	3

**First Year****Credits****Fall Semester**

PHRM 550a Principles of Pharmacology	4
PHRM 550b Principles of Pharmacology	4
MBMB 504 Research Methods	3
PHRM 501 Introduction to Seminar	<u>1</u>
Total	12

**Spring Semester***Choose Adviser*

PHRM 555 Cardiovascular Pharmacology	3
PHRM 574 Neuropharmacology	3
PHRM 590 Research in Pharmacology	2
PHRM 501 Introduction to Seminar	1
MBMB 531 Molecular and Cellular Biology	<u>3</u>
Total	12

**Summer Session**

PHRM 551 Methods in Pharmacology	4
PHRM 590 Readings or Research in Pharmacology	<u>2</u>
<i>Preliminary Exam</i>	
<i>Accelerated entry to Ph.D. track</i>	
Total	6

**Second Year****Fall Semester***Formulate Advisory and Research Committee*

PHRM 552 Applied Statistics	3
PHRM 590 Research in Pharmacology	5
PHRM 600 Dissertation Research	3
PHRM 501 Introduction to Seminar	<u>1</u>
Total	12

**Spring Semester**

PHRM 500 Pharmacology Seminar	1
PHRM 590 Research in Pharmacology	8
PHRM 600 Dissertation Research	<u>3</u>
<i>Admission to Candidacy when eligible</i>	
Total	12

**Summer Session**

PHRM 590 Research in Pharmacology	3
PHRM 600 Dissertation Research	<u>3</u>
Total	6

**After Second Year****Fall Semester**

PHRM 600 Dissertation Research	9
PHRM 500 Pharmacology Seminar	<u>1</u>
Total	10

**Spring Semester**

PHRM 600 Dissertation Research	11
PHRM 500 Pharmacology Seminar	<u>1</u>
<i>Requirements complete for Ph.D.</i>	
Total	12

**Summer Session**

PHRM 590 Readings or Research in Pharmacology <b>and/or</b>	
PHRM 600 Dissertation Research	6
Total	6

**SUMMARY OF REQUIREMENTS FOR DOCTOR OF PHILOSOPHY DEGREE**

1. Achievement of a grade point average of at least 3.00 (A = 4.0)
2. 24 semester hours residency
3. Completion of research tools required by Dissertation Committee
4. Comprehensive written preliminary exam of course work
5. Completion of 4 semester hours of PHRM 501 with a grade of B or better
6. Admission to candidacy
7. Oral defense of dissertation proposal
8. Interim meeting with committee to review progress
9. Submission of dissertation to advisor with copies of publications or submitted manuscripts (10 weeks prior to graduation)
10. Corrected dissertation to dissertation committee (8 weeks prior to graduation)
11. Completion of an approved dissertation with 24 hours of dissertation credit
12. Announcement of dissertation defense (4 weeks prior notice)
13. Oral defense of dissertation
14. Submission of approved dissertation to Graduate School (2 copies), graduate program office (1 copy), and advisor (1 copy) 3 weeks prior to graduation
15. Submission of departmental clearance form
16. All dissertations shall be microfilmed and a fee is required

**COURSES (PHRM)**

**500-1 to 16 Pharmacology Seminar.** Presentation of research and current literature in pharmacology. Required of all graduate students in pharmacology after completion of four credit hours of 501. Requires presentation at a Journal Club session each fall semester and a formal seminar each spring semester for duration of registration. Graded *S/U* only. Prerequisite: 501. (Springfield Only.)

**501-1 to 4 (1 per semester).** Training in interpretation of research and current literature in order to enhance quality of seminar presentation. Enrollment for the initial four semesters is required of all beginning pharmacology graduate students. All other pharmacology graduate students must enroll in 500. (Springfield Only.)

**550-8 (4,4) Principles of Pharmacology.** A study of chemistry, pharmacodynamic actions, mechanisms of action, absorption, distribution, metabolism, elimination, adverse effects, interactions and toxic effects of drugs currently used in therapeutics. Three to five hours lecture, one to four hours discussion per week. Must be taken in sequence. Prerequisite: organic chemistry, biochemistry, basic courses in physiology, and Physiology 420a, b or equivalent are highly recommended, or consent of coordinator. (Springfield Only.)

**551-4 Methods in Pharmacology.** The main objective is to acquaint the student with various sophisticated laboratory equipment, basic techniques/principles of pharmacological experiments. One hour lecture and three hours laboratory twice weekly. This course is prerequisite to all advanced pharmacology courses. (Springfield Only.)

**552-3 Applied Statistics for the Basic Sciences.** This course reviews introductory statistics and focuses on advanced statistics, linear and nonlinear modeling, applicable to basic biomedical sciences. The course will also provide students with experience in the use of statistical package computer programs for data analysis. Prerequisite: a college level introductory statistics course or permission from the instructor.

**555-3 Cardiovascular Pharmacology.** A study of structure, biochemistry, electrophysiology, and neurogenic and humoral regulation of the cardiovascular system in normal and diseased states. Three hours of lecture per week. Prerequisite: 550a,b or equivalent, or consent of course coordinator. (Springfield Only.)

**560-3 Geriatric Pharmacology.** A study covering age-related changes in the physiology of particular organ systems which lead to the prevalence of many diseases and to altered drug action in the elderly. Research issues in aging will be discussed emphasizing the biological substrates of altered pharmacodynamics and pharmacokinetics in the aged. Prerequisite: 550a,b and consent of course coordinator. (Springfield Only.)

**565-3 Principles of Toxicology.** This course deals with principles and understanding of phenomena of chemical-biologic interactions; a study of adverse chemical effects on living organisms and risk that chemical exposure poses to man/environment; deleterious, acute, chronic chemical effects on specific organs, tests to predict risks, facilitate search for safer chemicals and drugs and means of rational treatment of manifestations of toxicity; prominent discussion on drugs, medical devices, food additives, pesticides; regulation of toxic chemicals, hazardous wastes, toxic pollutants in water and air; and emphasis on diseases caused by and uniquely associated with drugs, diagnosis and treatments of such intoxicants. (Springfield Only.)

**574-3 Neuropharmacology.** (Same as Physiology 574.) A detailed examination of the biochemical aspects of neuropharmacology with emphasis on neurotransmitters; their synthesis, storage, release and metabolism in the central and peripheral nervous system. Considerable emphasis is placed on major research developments (both past

and present) that influence how one studies the action of drugs on the nervous system. Prerequisite: Physiology 410 and Chemistry 451.

**590-1 to 24 Readings or Research in Current Pharmacological Topics.** By special arrangement with the instructor with whom the student wishes to work. Graded *S/U* only.

**599-1 to 6 Thesis Research.** Research for thesis for a Master's degree. Hours and credit to be arranged by chair and adviser.

**600-1 to 32 (1 to 12 per semester) Dissertation Research.** Research for dissertation for the Ph.D. degree. Hours and credit to be arranged by chair and adviser.

**601-1 per semester Continuing Enrollment.** For those graduate students who have not finished their degree programs and who are in the process of working on their dissertation, thesis or research paper. The student must have completed a minimum of 24 hours of dissertation research, or the minimum thesis, or research hours before being eligible to register for this course. Concurrent enrollment in any other course is not permitted. Graded *S/U* or *DEF* only.