

## Pharmacology and Neuroscience

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### SCHOOL OF MEDICINE

#### Graduate Faculty:

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

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

**Copello, Julio A.**, Associate Professor, Ph.D., (Springfield), National University of La Plata, 1989; 2005. Physiological and pharmacological modulation of ryanodine receptors/calcium release channels and its impact on excitation-contraction coupling of skeletal muscle and heart.

**Cox, Brandon**, Assistant Professor, Ph.D., (Springfield), Georgetown University, 2008; 2013. Mechanism of auditory hair cell regeneration in the neonatal mouse cochlea and the postnatal maturation of the cochlea.

**Elble, Randolph C.**, Associate Professor, Ph.D., (Springfield), Indiana University, 1986; 2005. Tumor suppression in breast cancer by CLCA family of chloride current regulators.

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

**Premkumar, Louis S.**, 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**, 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.

**Tischkau, Shelley A.**, Associate Professor and *Director*, Ph.D., (Springfield), University of Illinois at Urbana-Champaign, 1995; 2007. Exploring molecular and neurological bases that underlie whole animal physiological processes, neurotoxicity, circadian rhythms and environmental toxicology.

**Toth, Linda A.**, Professor, Ph.D., D.V.M., (Springfield), University of Pittsburgh, 1980; Purdue University, 1986; 2000. Sleep, genetics, neuroimmunology.

**Turner, Jeremy**, Assistant Professor, Ph.D., (Springfield), Northern Illinois University, 1999; 2002. Age-related hearing loss, tinnitus, animal models of hearing loss.

Graduate courses of study leading to the Master of Science and Doctor of Philosophy degrees in Masters of Arts, Pharmacology and Neuroscience 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 in different areas of Pharmacology and Neuroscience. Graduate students in the M.S. and Ph.D. programs may choose from a diversity of specializations when selecting a research advisor and a research topic. Graduate students in the M.A. program are not required to perform laboratory research and write a thesis. M.A. students can select a faculty advisor under whose direction they will complete their capstone project for completion of the degree.

The minimum requirements for admission to an advanced degree program in Pharmacology and Neuroscience are that all students must have an undergraduate degree in one of the biological sciences. Students may be admitted with a deficiency in this prerequisite, but it must be remedied at an accredited university that is approved by the Graduate School prior to completion of PHRM 550A 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 and Neuroscience.

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.

Each applicant must submit directly to the *Department of Pharmacology*:

1. A completed application, including a nonrefundable \$65 application fee that must be submitted with their application for Admission to Graduate Study in Pharmacology and Neuroscience. Applicants must pay this fee by credit card.
2. Original official transcripts for all undergraduate and graduate coursework sent directly from each university or college attended by the applicant.
3. Copies of all diplomas.
4. A Career Statement (250 words or less) describing the career path that the applicant intends to pursue upon completion of the graduate study.
5. A Statement of Area of Research Interest (250 words). This statement should include the names of 2-3 Pharmacology Department faculty members whose research interests are most aligned with those of the applicant, as well as specific reasons for this selection. The faculty research interests can be found on the Department of Pharmacology Website. Applicants for the M.A. program are not required to submit this document.
6. Scores of the Graduate Record Examination (GRE) sent directly from Education Testing Service.
7. Three letters of recommendation from faculty familiar with the applicant's potential.
8. A copy of the TOEFL scores (international students only) sent directly to the Department of Pharmacology in Springfield, as well as the official scores sent directly from the ETS®.
9. A resume or curriculum vitae.
10. A copy of current passport.

11. A copy of current Visa.

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 and Neuroscience if approved by the Pharmacology and Neuroscience 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 and Neuroscience core course must be compensated for by retaking the course and earning at least a *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 grade below *B* in a Pharmacology and Neuroscience core course must be compensated for by retaking the course and earning at least a *B* grade.

### Financial Assistance

The Pharmacology and Neuroscience Graduate Program offers financial assistance that includes tuition waivers. Research assistantships and departmental fellowships are available for M.S. and Ph.D. students; application for this support is made directly to the Department of Pharmacology. The department does not provide financial support to students in the Master of Arts program. The Graduate School governs limits on support.

M.S. and Ph.D. students should be aware that renewal of support in the form of a research assistantship or fellowship is contingent upon satisfactory performance evaluations. Performance is documented in an annual progress report and is evaluated by the student's advisor and the Graduate Program Committee. Failure to make satisfactory progress towards the degree, as documented in the annual progress report, may lead to termination of support. The performance evaluation considers both assigned duties relevant to graduate assistantships and progress in coursework and research.

### Requirements for Master's of Arts Degree in Pharmacology and Neuroscience

All M.S. and Ph.D. students are required to complete formal course work in two areas: (1) core courses and (2) electives.

The core courses are PHRM 501, 500 (Introduction to Seminar, Pharmacology Seminar; all graduate students must enroll in either PHRM 500 or PHRM 501 every Fall and Spring semester), PHRM 550A and B (Principles of Pharmacology), PHRM 577 (Neuroscience). In addition doctoral students are also required to successfully complete PHRM 530 (Advanced Pharmacology and Neuroscience). In accordance with the graduate school, maximum coursework for full-time graduate students is 6 hours per semester; 9 hours is the minimum. For a graduate student with a Graduate Fellowship, up to 6 hours per semester is the maximum; 9 hours is the minimum. After admission into candidacy, 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 thesis/dissertation

committee. All students are required to attain competence in PHRM 540 (Responsible Conduct of Research).

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

An advisory system in Pharmacology and Neuroscience will help students in planning their program. Upon their admission to the Master's or Doctoral program, the Pharmacology and Neuroscience Graduate Program Director will advise students until the student chooses a research advisor. The programs outlined by students, their advisors and their thesis/dissertation committees are subject to approval by the Pharmacology and Neuroscience Graduate Program Committee. The choice of advisor and the formulation of the thesis/dissertation committee is an important step and should be carefully considered. Students are to choose a research advisor immediately after completion of core coursework (including required research tools and PHRM 551) and prelims.

As soon as a graduate student has selected a research advisor, a thesis/dissertation committee should be formed. The thesis 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 the Department of Pharmacology and one faculty member from an outside department. The dissertation 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 the Department of Pharmacology, and one or two faculty members from outside the department. 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 thesis/dissertation committees of which they are not formal members.

### Requirements for a Master of Science Degree in Pharmacology and Neuroscience

1. A minimum of two-years of full-time study (one year in residence) is required for a Master of Science degree.
2. A total of 30 semester hours at the 400 and 500 level is required for a Master of Science degree. At least 15 of these hours must be in 500-level courses, of which a minimum of six hours should be PHRM 599 (Thesis Research).
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 and Neuroscience Graduate Program Committee and will be taken upon completion of the major core course work. This examination will become a part of the student's permanent file.
4. Before significant research has begun, a thesis plan is required. The thesis plan will be presented and discussed

in an informal meeting with thesis committee members. A cover sheet for the graduate student's thesis plan 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 advisor's supervision. It should include a statement of the problem, an adequate review of literature, a careful analysis of results by whatever appropriate methods and an interpretation of the findings. The student must submit a preliminary draft of the thesis to the research advisor at least 10 weeks prior to graduation. A corrected copy must be submitted to other members of the thesis committee no later than four weeks before the formal thesis defense seminar.
6. Results of the thesis research must be defended in a pharmacology seminar that must be announced at least two 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 the seminar and participate on 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. If approved, a thesis approval form will be completed, signed by the student's major research advisor and the chair of the Department of Pharmacology, and transmitted to the Graduate School. The oral examination may be repeated once, no sooner than three months after the first examination. A second failure will result in dismissal from the Pharmacology and Neuroscience Graduate Program.
8. Each student is required to have six 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 Enrollment) until completion of the degree.
9. The student is responsible for electronically submitting the thesis to the Graduate School. The student is responsible for submitting one bound copy to the graduate program curriculum office and one bound copy to the student's research advisor at least three weeks prior to graduation.
10. Below is a representative schedule for completion of the requirements for the Master's of Science Degree in Pharmacology and Neuroscience. Students are strongly encouraged to begin research as soon as possible by taking PHRM 590 (Readings or Research in Pharmacology). In addition to the core courses, the following elective courses will be offered. Students should take at least one elective course.

#### **Elective courses:**

##### **Credits:**

PHRM 590	Readings or Research in Pharmacology (entire year)	1-24
MBMB 530	Advanced Cellular Biology (Spring)	3
PHRM 560	Geriatric Pharmacology	3
PHRM 565	Principles of Toxicology	3
PHRM 577	Neuroscience	4
MBMB 560	Molecular Oncology	3
Or other 500 level courses		

##### **Research Tools:**

PHRM 552	Applied Statistics	3
MBMB 504	Research Methods (Fall)	3
PHRM 551	Methods in Pharmacology	4
PHRM 540	Responsible Conduct of Research	1

##### **Typical Schedule:**

<b>First Year</b>		<b>Credits</b>
<b>Fall Semester</b>		
PHRM 550A	Principles of Pharmacology	4
PHRM 577	Neuroscience	4
PHRM 501	Introduction to Seminar	1
MBMB 504	Research Methods	3
<b>Total</b>		<b>12</b>
<b>Spring Semester</b>		
PHRM 550B	Principles of Pharmacology	4
PHRM 590	Readings or Research in Pharmacology	2
PHRM 501	Introduction to Seminar	1
MBMB 530	Advanced Cellular Biology	3
<b>Total</b>		<b>14</b>
<b>Summer Session</b>		
<i>Choose Advisor and form thesis committee</i>		
PHRM 551	Methods in Pharmacology	4
PHRM 590	Readings or Research in Pharmacology	2
<b>Total</b>		<b>6</b>
<i>Preliminary Examination - Written Comprehensive Exam</i>		
<b>Second Year</b>		<b>Credits</b>
<b>Fall Semester</b>		
PHRM 501	Introduction to Seminar	1
PHRM 552	Applied Statistics	3
PHRM 590	Readings or Research in Pharmacology	4
PHRM 599	Thesis Research	3
PHRM 540	Responsible Conduct of Research	1
<b>Total</b>		<b>12</b>

**Spring Semester**

PHRM 501	Introduction to Seminar	1
PHRM 590	Readings or Research in Pharmacology	10
PHRM 599	Thesis Research <i>Thesis Defense</i>	3
<b>Total</b>		<b>14</b>

**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 Graduate Program and the thesis committee
3. Comprehensive written exam of course work
4. Informal thesis proposal presentation with thesis committee
5. Interim meeting with thesis committee to review progress
6. Submission of thesis to research advisor (10 weeks prior to graduation)
7. Corrected thesis to thesis committee (four weeks prior date of defense)
8. Announcement of thesis defense (four weeks prior notice)
9. Oral Defense of thesis
10. Submission of approved thesis to Graduate School (two copies), Graduate Program Director (one copy), and research advisor (one copy) three weeks prior to graduation
11. Submission of department clearance form
12. All theses will be electronically submitted

**Requirements for a Doctor of Philosophy Degree in Pharmacology and Neuroscience**

1. Students entering the Ph.D. program in Pharmacology and Neuroscience should meet the minimum requirements listed for the Master's of Science degree program. Students entering the doctoral program in Pharmacology and Neuroscience 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 Pharmacology and Neuroscience Graduate Program recommends this option after the student's credentials, eligibility and performance have been reviewed. To be eligible for this option: (1) the student must have attained a 3.25 (A = 4.0) GPA in graduate course work, (2) the student must have successfully completed the core courses with a grade of B or better and (3) a research advisor with whom the student will work toward his/her degree should submit a letter of recommendation attesting to the student's ability and potential to perform doctoral research. Approval of the review must be given by the Department of Pharmacology faculty and chair. The Chair of the Department will then request from the Graduate School a waiver of the

master's degree or master's equivalency before entry into the doctoral program. The student's research advisor and the Graduate Program Committee 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 six months nor more than five years after admission to candidacy, except upon approval of the Dean of the Graduate School. The student is admitted to 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 and Neuroscience Graduate Program Committee and will be given after completion of the core courses, typically during the summer session. This examination will become a part of the student's permanent file. The preliminary examination may be repeated only once, no sooner than three 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 student's dissertation committee. A cover sheet for the graduate student's dissertation committee must be signed by all members of the student's dissertation committee and filed with the Graduate Program Director. The student is required to meet formally with the dissertation committee at least once between defense of the proposal and the dissertation defense. The purpose of this interim meeting is 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. The dissertation defense presentation will occur no earlier than one year after the dissertation proposal defense and after at least one paper has been submitted for publication. 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. Students must have at least one paper submitted for publication and are encouraged to obtain two or more publications from the graduate research work. Students will not be allowed to defend their dissertation until this requirement has been met.
7. 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 not to exceed 4 calendar years. A doctoral student will be permitted to count no more than 6 hours of Dissertation Research 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 that meets with the approval of their advisor and dissertation committee, e.g. any formal departmental or non-departmental courses and PHRM 590 (Readings or Research in Pharmacology).

8. 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 or the Graduate Program 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.
9. After admission to candidacy, the student must complete 24 hours of dissertation credit PHRM 600 (Dissertation Research) complete the dissertation research project and prepare the dissertation document to meet the requirements of the 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 Enrollment) until completion of the degree.
10. A preliminary draft of the dissertation should be given to the research advisor at least 10 weeks prior to graduation; a corrected copy should be submitted to other committee members no later than four weeks before the dissertation defense seminar.
11. Results of the dissertation research must be defended in a Pharmacology seminar which must be announced at least two 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. If approved, a dissertation approval form will be completed, signed by the student's major research advisor, the Chair of the Department of Pharmacology

and submitted to the Graduate School. The examination may be repeated once, no sooner than three months after the first examination. Failure of the second examination will result in dismissal from the Pharmacology and Neuroscience Graduate Program.

12. The student is responsible for electronically submitting the dissertation to the Graduate School. The student is responsible for submitting one bound copy to the graduate program curriculum office and one bound copy to the student's research advisor prior to graduation.
13. Below is a representative schedule of the requirements for the Ph.D. degree in Pharmacology and Neuroscience (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 and Neuroscience. In addition to the core courses, the 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 (Readings or Research in Pharmacology).

#### Elective courses

##### Credits:

PHRM 590	Readings or Research in Pharmacology (Entire year)	1-24
MBMB 504	Research Methods (Fall)	3
MBMB 530	Advanced Cellular Biology (Spring)	3
PHRM 574	Neuropharmacology	3
PHRM 555	Cardiovascular Pharmacology	3
PHRM 560	Geriatric Pharmacology	3
PHRM 565	Principles of Toxicology	3
MBMB 560	Molecular Oncology	3

##### Research Tools:

PHRM 552	Applied Statistics	3
MBMB 504	Research Methods (Fall)	3
PHRM 551	Methods in Pharmacology	4
PHRM 540	Responsible Conduct of Research (Fall)	1

##### Typical Schedule:

###### **First Year** **Credits**

###### **Fall Semester**

PHRM 550A	Principles of Pharmacology	4
PHRM 577	Neuroscience	4
MBMB 504	Research Methods	3
PHRM 501	Introduction to Seminar	1

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**Total** **12**

###### **Spring Semester**

PHRM 550B	Principles of Pharmacology	4
PHRM 530	Advanced Pharmacology and Neuroscience	3
PHRM 590	Readings or Research in Pharmacology	1
PHRM 501	Introduction to Seminar	1
MBMB 530	Advanced Cellular Biology	3

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**Total** **12**

**Summer Session***Preliminary Exam**Choose Advisor and form Dissertation Committee*

PHRM 551	Methods in Pharmacology	4
PHRM 590	Readings or Research in Pharmacology	2

<b>Total</b>		<b>6</b>
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**Second Year****Credits****Fall Semester**

PHRM 552	Applied Statistics	3
PHRM 590	Readings or Research in Pharmacology	5
PHRM 600	Dissertation Research	3
PHRM 501	Introduction to Seminar	1

<b>Total</b>		<b>12</b>
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**Spring Semester**

PHRM 501	Introduction to Seminar	1
PHRM 590	Readings or Research in Pharmacology	8
PHRM 600	Dissertation Research	3

*Admission to Candidacy when eligible*

<b>Total</b>		<b>12</b>
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**Summer Session**

PHRM 600	Dissertation Research	6
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<b>Total</b>		<b>6</b>
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**After Second Year****Credits****Fall Semester**

PHRM 600	Dissertation Research	5
PHRM 500	Pharmacology Seminar	1

<b>Total</b>		<b>6</b>
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**Spring Semester**

PHRM 600	Dissertation Research	6
PHRM 500	Pharmacology Seminar	1

*Completion of residency requirements for Ph.D.*

<b>Total</b>		<b>6</b>
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**Summer Session**

PHRM 600	Dissertation Research	3
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<b>Total</b>		<b>3</b>
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**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 Graduate Program and Dissertation Committee
4. Comprehensive written preliminary exam of course work
5. Completion of four 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 dissertation committee to review progress

9. Submission of at least one manuscript, based on the student's dissertation research, for publication to a peer-reviewed journal
10. Submission of dissertation to research advisor with copies of publications or submitted manuscripts (10 weeks prior to graduation)
11. Corrected dissertation to dissertation committee (four weeks prior to defense)
12. Completion of an approved dissertation with 24 hours of dissertation credit
13. Announcement of dissertation defense (two weeks prior notice)
14. Oral defense of dissertation
15. Submission of approved dissertation to Graduate School (two copies), graduate program office (one copy), and research advisor (one copy) three weeks prior to graduation
16. Submission of departmental clearance form
17. All dissertations will be electronically submitted

**COURSES (PHRM)**

**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: PHRM 501. (Springfield Only.)

**PHRM 501-1 to 4 (1 per semester) Introduction to Seminar.** 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 PHRM 500. (Springfield Only.)

**PHRM 530-3 Advanced Pharmacology & Neuroscience.** The goal of this course is to understand the process involved in scientific discovery and research by reading, analyzing, criticizing and discussing scientific articles covering the field of Pharmacology and Neuroscience and the related field of cellular and molecular biology. Prerequisites: PHRM 550A Principles of Pharmacology and PHRM 577 Neuroscience. (Springfield Only.)

**PHRM 540-1 Responsible Conduct of Research.** This course will provide information on topics relevant to the ethical conduct of research, including conflict of interest, publication policies, animal and human subjects, peer review, and mentoring. No prerequisite.

**PHRM 542-2 Regulatory Issues in Drug Development.** This course will examine regulatory issues, including clinical trials, the FDA process for drug approval, technology transfer and intellectual property. No prerequisites.

**PHRM 550A-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. No prerequisite required.

**PHRM 550B-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. No prerequisite required.

**PHRM 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.)

**PHRM 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. No prerequisite required.

**PHRM 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: PHRM 550A,B or equivalent, or consent of course coordinator. (Springfield Only.)

**PHRM 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: PHRM 550A,B. Special approval needed from the course coordinator. (Springfield Only.)

**PHRM 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.)

**PHRM 574-3 Neuropharmacology.** (Same as PHSL 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: PHSL 410 and CHEM 451.

**PHRM 577-4 Neuroscience.** This course provides basic neuroscience knowledge covering the fundamental principles of neural cell biology, neurophysiology, neurochemistry, neuroanatomy and behavior. This knowledge is essential to

understand the mode of action of the drugs acting on excitable cells including muscle, autonomic system and central nervous system. No prerequisite.

**PHRM 590-1 to 24 Readings or Research in Pharmacology.** Special arrangements to be made with the instructor with whom the student wishes to work. Graded S/U only.

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

**PHRM 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.

**PHRM 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.

**PHRM 699-1 Postdoctoral Research.** Must be a Postdoctoral Fellow. Concurrent enrollment in any other course is not permitted.