



School of Graduate Studies in the Health Sciences

PHARMACOLOGY & TOXICOLOGY

PROGRAM DESCRIPTION

The Department of Pharmacology and Toxicology offers a program leading to the Ph.D., with the primary objective of training individuals for a successful career in pharmacology, toxicology or a related biomedical science. That objective is achieved through a combination of formal course work, independent study and both faculty-directed and independent research. Students are exposed to fundamental principles of pharmacology as well as current concepts related to mechanisms of actions of an array of different classes of drugs and modern research techniques. The curriculum provides ample opportunities for students to improve their written and verbal communication skills and to develop skills in critical thinking, problem solving and experimental design.

ADMISSION REQUIREMENTS

Admission to the graduate program in Pharmacology and Toxicology requires an academic degree from an accredited college or university, a superior academic record, and satisfactory performance on post-graduate (GRE or Graduate Record Examination) and English proficiency (TOEFL or Test of English as a Foreign Language) examinations. Although a background in one of the basic sciences (e.g., pharmacy, biology, chemistry, biochemistry) or mathematics is recommended, outstanding students with a background in any discipline will be considered.

PROGRAM OUTCOMES

Graduates of the program in Pharmacology and Toxicology will be able to

Identify gaps in current knowledge of the pharmacokinetics and pharmacodynamics of drugs and other chemical agents.

design, implement and direct basic research aimed at alleviating knowledge gaps applicable to the pharmacokinetics and pharmacodynamics of drugs and other chemical agents.

collaborate with colleagues in the basic and clinical sciences in translational research aimed at identification of novel therapeutic agents and improvement of clinical outcomes for the pharmacological treatment of disease.

relate pharmacological data to their colleagues in the basic and clinical sciences as well as to leaders in the health care and regulatory communities.

participate in the training of basic and clinical scientists and health care providers in the areas of pharmacology and toxicology.

CURRICULUM

Core component

Required Pharmacology and Toxicology Courses

PHARM701 Seminar
PHARM702 Recent Advances in Pharmacology and Toxicology (student journal club)
PHARM703 Orientation to Pharmacological Research
PHARM726 Pharmacology or PH722 Pharmacology and Therapeutics
PHARM723 Mechanisms of Drug Action
PHARM792 Research Rotations (minimum of 2)
PHARM780 series or equivalent from another department (minimum of 2)

Required Support Courses

BIOCH704 Biochemistry
PHYSIO725 Physiology

Required Interdisciplinary Core Courses

ID704 An Introduction to Animal Research
ID709 Responsible Conduct of Research (SOGS)
ID710 Research Tools in Molecular Biology (SOGS)
ID714 Professional Skills for Graduate Students and Postdoctoral Fellows (SOGS)
PM740 Statistical Methods in Research or CHS701 Biostatistics (SOGS)

Elective component

Electives in Pharmacology and Toxicology

PHARM780 CNS Pharmacology
PHARM781 Molecular Toxicology
PHARM782 Drug Abuse
PHARM784 Circulatory Pharmacology
PHARM785 Principles of Modern Drug Design
PHARM786 Autonomic Pharmacology
PHARM790 Special topics, taken in conjunction with PHARM792 (Research Rotation) or offered on request

Recommended Electives offered by other Graduate Departments

ID715 Teaching in Higher Education

Dissertation/Thesis

PHARM798 Dissertation and Dissertation Research
PHARM799 Thesis and Thesis Research

PLAN OF STUDY

Upon entry into the program, students complete the required courses in the Interdisciplinary and Pharmacology & Toxicology programs. A recommended plan of study follows. The sequence of courses and other activities depicted are based on a progression from fundamental to more advanced course work and skills development. Upon completion of fundamental courses, the plan of study can be tailored, through the provision of advanced courses in Pharmacology and Toxicology or other graduate programs, to more closely meet the interests and needs of

individual students. More detailed explanations of the requirements for the Ph.D. are provided later in this document.

Suggested Pre-Candidacy Plan of Study

Yr	Semester	Course	Description	Hours	
1	Summer	Pharm 792	Research Rotation ¹		1
				subtotal ²	
Fall	Biochem	704	Biochemistry	R ³	7
	ID	709	Responsible Conduct of Research ⁴	R	2
	Pharm	701	Seminar ⁵	R	1
	Pharm	703	Orientation to Pharmacological Research	R	2
	Pharm	792	Research Rotation	R	3
				subtotal ² 15	
Spring	ID	704	Introduction to Animal Research ⁶	R	
	ID	710	Research Tools for Molecular Biology ⁴	R	2
	Pharm	702	Recent Advances in Pharmacology ⁷	R	1
	Pharm	726	Pharmacology	R	6
	Pharm	792	Research Rotation (optional)(1-3 h)	R	
	Physiol	725	Physiology	R	9
				subtotal ² 18	
2	Summer	Pharm 792	Research Rotation		1
				subtotal ² 1	
Fall	Pharm	701	Seminar ⁵	R	1
	Pharm	723	Mechanisms of Drug Action	R	4
	Pharm	792	Research Rotation	R	3
	Pharm	7xx	Advanced Elective ⁸		2
	Pharm	7xx	Advanced Elective ⁸ (optional) (2 h)		
	PM	740	Statistical Methods in Research ⁴	R	3
				subtotal ² 13	
Spring	ID	704	Introduction to Animal Research ⁶	R	2
	ID	714	Professional Skills ^{4,9}	R	3
	Pharm	702	Recent Advances in Pharmacology ⁷	R	1
	Pharm	7xx	Advanced Elective ⁸	R	2
	Pharm	792	Research Rotation ¹⁰		3
	Pharm	790	Qualifying Exam ¹¹	R	1
				subtotal ² 11	
				Total⁵ 59	

This proposed pre-candidacy curriculum is based on information available 20 May 2009 and is subject to changes dictated by modifications in the curricula of other programs as well as stipulations imposed by the School of Graduate Studies, the Registrar, the IHL or other accrediting bodies.

Explanations:

Shading indicates that a course is part of the core graduate curriculum. Courses shaded in green are required by the Graduate School, whereas those with yellow shading are pharmacology specific.

1. Applicable only to students entering the program during the summer semester.
2. Totals and subtotals do not include Dissertation Research and Yr 1 Introduction to Animal Research. Also, credit for 1st year summer Research Rotation does not apply to students who enter in the fall semester. A minimum of 30 semester hours is required for the M.S., whereas a minimum of 45 semester hours is required for the Ph.D. In both cases, hours must be for graded courses.
3. Indicates that a course is required as part of the pharmacology and toxicology program.
4. These courses are required as part of the core curriculum for the Graduate School. With the exception of ID714 (Professional Skills), they are required for award of a 'Master of Science in Biomedical Science' degree and are to be completed prior to the qualifying examination. ID714 is required only of Ph.D. candidates.
5. Students participate during both the fall and spring semesters, but only register for PH701 in the fall semester.
6. Offered alternate yrs. A student entering the program in an even year (e.g., 2008) registers for ID704 the 1st year; if entering in an odd year (e.g., 2009), the 2nd year.
7. Students participate during both the fall and spring semesters, but only register for PH702 in the spring semester.
8. A minimum of two advanced (graduate level) courses are required; they can be in any program and taken at any time. They do not necessarily need to be completed prior to the qualifying examination.
9. Required as part of the core curriculum by the Graduate School for the Ph.D.; ID714 may, alternately, be taken after admittance to candidacy. This course is not required for the M.S.
10. Depending on when the Qualifying Examination is taken, either Research Rotation (Pharm792) or Dissertation Research (Pharm798) could be taken.
11. The Qualifying Examination may be taken prior to completion of advanced courses, but after completion of other courses required by the Graduate and Pharmacology & Toxicology programs. A possible exception is ID714, which is required for the Ph.D. but could be taken later in the program. Alternatively, the Qualifying Examination could be taken during the summer term of the third year. In any event, the student must pass the Qualifying Examination before admittance to candidacy for the Ph.D. Note that after successful completion of the Qualifying Examination, Dissertation Research replaces Research Rotation, and hours decrease accordingly from 3 to 1 per semester.

Post-Candidacy Plan of Study

The registration schedule for a Ph.D. candidate might be similar to the one that follows:

Yr	Quarter	Course		Description		Hours
3	Summer	Pharm	798	Dissertation Research	R ¹	1
	Fall	Pharm	798	Dissertation Research	R	1

	Spring	Pharm	798	Dissertation Research	R	1
		ID	715	Teaching in Higher Ed ²	E ³	2
4	Summer	Pharm	798	Dissertation Research	R	1
	Fall	Pharm	798	Dissertation Research	R	1
	Spring	Pharm	798	Dissertation	R	1

1. Required
2. May be taken prior to admittance to candidacy or later in training
3. Elective; a candidate might also elect to take an advanced course if it relates directly to the candidate's dissertation research

DIRECTION AND SUPERVISION

Decisions related to a student's course of study are made under the direction of Pharmacology and Toxicology graduate program director until such time the student identifies a faculty mentor for dissertation research. Thereafter, the mentor will assume primary advisory responsibility for the remainder of the student's graduate training. Selection of a mentor – i.e., a laboratory in which to do dissertation research – occurs through mutual agreement between the student and the faculty, with approval from the Graduate Director or Department Chair.

The student, with approval by the mentor, will also select a faculty committee. That committee will be chaired by the mentor and will include a minimum of four other members of the graduate faculty, at least one of which must be outside the Department of Pharmacology and Toxicology. The committee will function in an advisory capacity for the student – and the mentor – during the research portion of graduate training. It will aid in the definition of objectives, direction, and limits to the dissertation research. The committee is also responsible for the final recommendation as to whether the student has satisfactorily completed the research requirements for the Ph.D.

REQUIREMENTS FOR THE PH.D.

Course Requirements and Credit Hours

A minimum of 60 semester hours of formal training is required for the Ph.D. A minimum of 45 of those credit hours must be derived from graded courses, whereas the remainder can be derived from dissertation research. *[Graded courses are those in which the student receives a numerical or letter grade; pass-fail courses do not apply.]* Course requirements are generally fulfilled within the first two years of the program as outlined above in the Plan of Study.

Descriptions of specific courses available through the Pharmacology & Toxicology program are provided at the end of this document. In addition to the indicated required courses, students must complete a minimum of two advanced, graduate level courses of their choice. This latter requirement can be met, with the prior approval of the Graduate Director, by an advanced graduate course from any basic science department.

Within the total of 45 credit hours of graded course work required for the Ph.D., there are specific requirements defined by the Graduate School which stipulate minimum credit hours needed from courses within and outside a student's major area of study. For a Ph.D. with an

emphasis in Pharmacology and Toxicology, a minimum of 24 credit hours are obtained from completion of courses from this program, whereas a minimum of 15 credit hours must be obtained by completion of courses from a core graduate curriculum and outside the program in which the student is enrolled. The remaining credits hours can be for course work from any graduate program.

Transfer Credit - Although course requirements can be waived at the discretion of the Director of the Graduate Program, generally no more than half the credits for the degree can be transferred. Only hours that were granted by another accredited institution can be transferred, and course content must have been equivalent to the corresponding course taught at UMMC.

Electives

Any course offered by the various schools at UMMC can, in theory, be taken as an elective. However, students are encouraged to choose electives from this or other programs that are most relevant to their interests and, consequently, will provide the most benefit to them. The number and type of electives a student might take will be determined largely by available time. In addition, permission is required from the student's primary advisor, the director of the course, and the directors of the applicable programs. Permission will be granted most readily when a course relates directly to the student's primary area of research.

Although some electives must be taken as part of the pre-candidacy curriculum, a student may choose to take an elective after admittance to candidacy. For instance, a student might take an advanced course that is related directly to the student's dissertation research. Also, a student might take a course that would better prepare him/her for a post-doctoral or academic position near completion of the dissertation.

Masters of Science

The course work completed for partial fulfillment of the requirements of the Ph.D. satisfies requirements for a Master of Science in Biomedical Science degree. Accordingly, all graduate students will be eligible for a Master of Science as an intermediate degree after successful completion of (1) the necessary core courses in both the Graduate School and the Pharmacology and Toxicology curricula and (2) the qualifying examination. When those requirements are met, application must be made to both the Graduate School and the Registrar for receipt of the Master of Science degree.

Other Activities

All students are required to attend and participate in Seminar and Recent Advances in Pharmacology and Toxicology.

Seminar - Participation in Seminar involves attendance at both department and UMMC research presentations and is required for the entire tenure of the graduate student. During the second year, students will be expected to present a formal seminar to the department faculty; during subsequent years, students are required to present at least one formal progress report of their dissertation research to all department faculty.

Recent Advances - Participation in Recent Advances is required for the first three years and involves a combination of informal presentations and participation in discussions. The latter is increasingly more important as tenure within the program increases.

Laboratory Rotations and Selection of a Mentor - Each student must complete a minimum of two research rotations prior to choosing a faculty mentor. It is recommended that initial research rotations be completed in different laboratories. Their selection should be premised on the student's research interests, but approval from the appropriate faculty member is required prior to registration.

Each rotation will last for one semester (approximately 9 weeks during the summer term; approximately 18 weeks during the fall and spring semesters), and both will generally be completed by the end of the first year. At their completion, students are strongly encouraged to identify a faculty mentor. If a student does so, subsequent research rotations can be directed toward definition of a dissertation project. If a student does not identify a mentor by the end of the first year, additional laboratory rotations may be taken to aid in that decision. In any event, a student must declare a mentor after completion of the qualifying examination.

Results of the research performed during each rotation will be presented to the department faculty during seminar within 4 weeks of the end of the semester in which the rotation was completed.

Note that the hours received for Laboratory Rotation (PHARM 792) vary. During the summer term, students typically register for Laboratory Rotation for 1 h, the minimum number of hours required by the Registrar for the student to be considered full-time. During most other semesters, students will register for 3 hours of Laboratory Rotation. However, with prior arrangements between the student, the faculty and the Program Director, credit for Laboratory Rotation can vary from 1-3 hours.

EXPECTATIONS FOR ACADEMIC PERFORMANCE

Pre-Candidacy Requirements

Graduate students should anticipate spending a minimum of 40 hours per week within the department (or on campus) participating in class work, research or other scholarly activity. Students are also expected to exhibit satisfactory performance in these activities, as evidenced, in part, by an overall average of 80% or better. Although students might be given the opportunity to repeat courses, they should strive to perform as well as possible. Failure to achieve a minimum grade of 80% in some required pharmacology or support courses – or to maintain an overall average of 80% or better in all courses – can be grounds for dismissal from the program or loss of stipend support.

Admission to Doctoral Candidacy

General Requirements

All students are required to pass a qualifying examination before they can apply for and be admitted to candidacy for the doctoral degree. There is some flexibility for scheduling the qualifying examination, although a student generally won't be eligible until the end of the second academic year. Prerequisites for the qualifying examination are:

- (1) completion of all required courses or activities in the core graduate curriculum, totalling at least 15 semester hours.
- (2) completion of all required courses or activities in the core curriculum for the Pharmacology and Toxicology program, excluding advanced graduate courses.
- (3) an overall grade point average of 80 or better.
- (4) a grade of 80 or better in Pharmacology (PH725) or Medical Pharmacology (PH722).

- (5) a grade of 80 or better in Mechanisms of Drug Action (PH723).
- (6) no more than two grades below 80.
- (7) approval of the Graduate Director and Department Chair.

Qualifying Examination

The Qualifying Examination consists of a public oral presentation of a research paper, followed by an oral defense to a faculty committee.

For the first part, a student selects and orally presents a critique of a scientific paper. It is anticipated, although not required, that the paper will be related to the student's dissertation proposal. The mentor or another faculty may advise the student on selection of the paper. A faculty member may also provide some advice concerning other aspects of the presentation, but should do so sparingly to ensure that the presentation reflects the efforts of the student. The presentation is to be in the form of a departmental seminar, in which the student is expected to provide appropriate justification and background, critically evaluate scientific content and experimental validity, note limits to interpretation of results and conclusions, and propose additional avenues for further study.

The second part consists of an oral examination by a panel of 6 graduate faculty. One member of the panel, either the mentor or another designee, will serve as chair and moderate – but not directly participate in – examination of the student. The remaining 5 members will examine the student, using the paper presented in part 1 as a platform to further gauge the depth of a student's knowledge of the general principles of pharmacology – particularly as they apply to the student's chosen research topic – and the student's ability to apply those principles to experimental problems.

DOCTORAL REQUIREMENTS - RESEARCH AND DISSERTATION

After admittance to candidacy for the degree of Doctor of Philosophy, the student (candidate) will focus on research leading to a dissertation. Requirements for this to occur are:

- (1) selection of a faculty mentor from among the graduate faculty in the Program of Pharmacology and Toxicology. It is expected that this will have occurred earlier in graduate training, preferably by the end of the first year. If not, the student needs to do so as early as possible.
- (2) definition, with assistance from the mentor, of a research project on which to develop a dissertation.
- (3) selection, with advice from the mentor, of a Research Advisory Committee consisting of at least five members: the mentor who will be the primary research advisor and chair, three members of the graduate faculty from the Pharmacology and Toxicology program, and one outside examiner who is a member of the graduate faculty from another department of UMMC or another accredited institution.

Once the committee is identified and approved by the Dean of the Graduate School, the student must prepare and formally present a research proposal to the committee for its approval. This process: choosing an advisor, choosing an advisory committee and writing a research proposal, should be completed within six months of admittance to candidacy for the doctoral degree. Failure to comply with this requirement is grounds for loss of stipend support or dismissal from the program.

Research Proposal

The proposal is to include

- (1) a short introduction containing the pertinent background material,
- (2) a rationale, hypothesis and specific aims,
- (3) the experiments proposed to test the hypothesis including a brief description of design and proposed methods,
- (4) preliminary results, if there are any, or a description of expected results,
- (5) a discussion that includes interpretation of expected results, and
- (6) a bibliography or pertinent references.

Proposals must be typed and of appropriate length to allow the committee to adequately evaluate the premise, aims, experimental design, and duration of the proposed research. [Note that 10 to 20 pages with 1.5 line spacing, excluding references, is a reasonable length for the proposal].

The written proposal is to be distributed to the committee members a minimum of two weeks prior to the scheduled presentation and committee meeting. The student should be prepared to discuss the proposal, including the experimental design, general feasibility and technical limitations, and time anticipated for completion of the proposed experiments. The student – and the primary advisor - should also be open to recommendations from the committee.

Progress Reports

Students are required to provide at least one progress report to their Research Advisory Committee per year. This progress report must be presented publically to all faculty as a departmental seminar each year. The committee also might require a written report. The student will meet with the advisory committee afterward to discuss progress, problems or other aspects of the student's research.

Dissertation

When the research outlined in the proposal has been completed and a dissertation has been written, the student will schedule an oral presentation for public defense of the dissertation. [NOTE: The announcement for the public presentation and defense must be made through the Graduate School.] The oral presentation can be scheduled no sooner than two weeks following receipt of the dissertation by the Research Advisory Committee.

The public presentation and defense will be followed by a private defense of the dissertation to the Research Advisory Committee. Immediately afterward, the Research Advisory Committee will meet to determine whether the:

- (1) candidate has fulfilled all research requirements for the Ph.D. degree,
- (2) dissertation is complete and appropriately structured, and
- (3) defense of the dissertation is adequate.

The committee can require satisfactory correction of any deficiencies noted in the performance of the candidate. These requirements can include, but are not limited to, further experimentation and revision of the dissertation. After the candidate satisfactorily completes all requirements, members of the Research Advisory Committee will sign the appropriate forms that authorize

awarding of the Ph.D. degree. If requirements are not satisfactorily addressed, the Research Advisory Committee may recommend that the candidate not be awarded the Ph.D.

PUBLICATION REQUIREMENT

Each doctoral candidate must have at least one peer reviewed, 1st author manuscript published or accepted for publication in a national/international scientific journal in order to graduate (i.e., receive the Ph.D.).

REGISTRATION REQUIREMENTS

Prior to candidacy, a graduate student must be registered for a minimum of 9 semester hours to be considered full time during the fall and spring semesters. During the summer semester, a student must be registered for at least 1 semester hour. Tuition for full time graduate students is charged at a flat fee per semester; No additional tuition is charged for hours in excess of the minimum required for full time status.

After admittance to candidacy, students register each semester for Dissertation and Dissertation Research (PHARM798) while they are preparing their research proposal, doing their dissertation research, and writing the dissertation. To maintain full time status, a student must register for a minimum of 1 semester hour (dissertation research/dissertation). Registration for a minimum of 1 semester hour is also required in the semester in which the candidate graduates, even if all other requirements are completed, in order for a diploma to be awarded.

MASTER OF SCIENCE

Every student enrolled in a graduate program leading to the Ph.D. is eligible to receive a Master of Science in Biomedical Science as an intermediate degree after satisfactory completion of requirements set forth by the Graduate School and the specific graduate program in which a student is enrolled. Those requirements generally entail the satisfactory completion of at least 30 semester hours of course work and the Qualifying Examination. A Masters with a thesis requires a minimum of 24 hours of course work and 6 hours for thesis research. Stipulations for credit hours from a core graduate curriculum apply in either case. (see REQUIREMENTS FOR THE PH.D., Required Courses and Credit Hours).

A Master of Science is generally not awarded as a terminal degree by the Pharmacology and Toxicology program, and application specifically for the Master of Science degree requires the explicit permission of the program director or department chair. The desire to pursue a Master's degree must be justified and made clear at the time of application to the Graduate Program in Pharmacology and Toxicology.

Under special circumstances, a student admitted to the doctoral program may receive a Master of Science as the terminal degree. A thesis is required for a Master's degree stipulating an emphasis in Pharmacology and Toxicology. In the absence of a thesis, a Master of Science in Biomedical Science will be granted.

DESCRIPTIONS OF GRADUATE COURSES IN PHARMACOLOGY & TOXICOLOGY

A prerequisite for all courses is approval by the course director and the graduate director of the Department of Pharmacology and Toxicology. Graduate students outside the pharmacology program must also have approval of the graduate director of the program in which they are enrolled. Courses are offered annually unless indicated otherwise.

PHARM. 701. SEMINAR. Students are required to (1) attend presentations by others (both faculty and students) participating in the course and (2) make an oral presentation on their own research or an assigned topic. For the former, students are responsible for completing both a written summary and a critique of the presentation. Students in the pharmacology program participate in seminar as partial requirement for PHARM 702 (Required, 1 semester hour; Fall, Spring; R Duhe, director)

PHARM. 702. RECENT ADVANCES IN PHARMACOLOGY AND TOXICOLOGY. This course comprises reading, informal presentation and discussion of topics in pharmacology, toxicology and related disciplines from the current scientific literature. Critical evaluation of experimental design, data analysis and interpretation are emphasized. (Required; 1 semester hour; Fall, Spring; RE Kramer, director)

PHARM. 703. ORIENTATION TO PHARMACOLOGICAL RESEARCH. This course will introduce students to principles of laboratory research and good laboratory practice. The student will participate in discussions with each graduate faculty in the department concerning current research interests and ongoing research projects. (Required; 2 semester hours; Fall, RW Rockhold, director)

PHARM. 722. PHARMACOLOGY AND THERAPEUTICS. Students are introduced to the principles underlying the use of pharmacological agents in medical practice. Concepts related to drug distribution, drug-receptor interaction and drug metabolism are considered. In addition, the mechanism of action, therapeutic effects, adverse side effects and common clinical applications of various drugs and drug classes are presented through a combination of lectures and clinical correlations. (Elective, 12 semester hours, 6-6; Fall, Spring; RE Kramer and SE Wellman, directors)

PHARM. 723. MECHANISMS OF DRUG ACTION. This course comprises assigned readings, in-class discussions, written assignments and student presentations. Selected aspects of pharmacology are presented with emphasis on the mechanisms of drug action. (Required; 4 semester hours; Fall: S Smith, director)

PHARM 726. PHARMACOLOGY. A basic pharmacology course in which principles underlying the actions of drugs are presented, including pharmacokinetics, drug-receptor interactions, and drug metabolism. In addition, mechanisms of action, therapeutic effects, adverse effects and therapeutic indications are noted for major classes of drugs and for commonly used drugs within each class. (Required; 6 semester hours; Spring; SE Wellman, director) (also listed as Dental 626).

PHARM. 780. CNS PHARMACOLOGY. Drug actions at neuronal targets, the blood-brain barrier and special pharmacokinetics of centrally acting drugs, and the pharmacotherapy of the CNS and neurological disorders are among the topics covered. [Co-listed as Pharmacological Neuroscience, NSCI. 706]. (Elective; 3 semester hours; Fall; W. Woolverton, director)

PHARM. 781. MOLECULAR TOXICOLOGY. This is a reading and discussion-based class. The molecular mechanisms of several toxicant classes are covered. Emphasis is placed on the effects of xenobiotics on cellular processes, including biochemical reactions and signaling pathways. (Elective; 2 semester hours; Spring; offered biennially [even years]; RC Baker, director)

PHARM. 782. DRUG ABUSE. This course describes drugs that are abused, biological aspects of abuse, patterns of abuse, and theories of drug tolerance and dependence. (Elective; 2 semester hours; Fall; offered biennially [even years]; T Ma, director)

PHARM. 784. CIRCULATORY PHARMACOLOGY. This course involves a study of normal circulatory mechanisms and functions and how various drugs and toxic substances modify them. (Elective; 2 semester hours; Fall; offered biennially [odd years]; RW Rockhold, director)

PHARM. 785. PRINCIPLES OF MODERN DRUG DESIGN. This course addresses the basic principles of the modern drug discovery and validation process, with emphasis on applications in cancer therapy. The course begins with the identification and characterization of disease-specific molecular targets using genetic and biochemical techniques. The second section describes the selection of lead drugs through high-throughput screening assays, combinatorial chemistry, and computer-assisted rational drug design. The final section covers preclinical and clinical trials and the potential use of database analysis to ensure that the drugs are safe and effective, and that the chosen therapeutic regimen will yield the best outcome for any given patient. (Elective; 2 semester hours; Spring; offered biennially [odd years]; RJ Duhe, director)

PHARM. 786. PHARMACOLOGY OF SYNAPTIC TRANSMISSION. The course focuses on the mechanisms of synaptic transmission in autonomic ganglia and at peripheral neuroeffector junctions. Emphasis is placed on the pre-and post-synaptic processes regulating neurotransmitter at these peripheral synapses. The roles of synaptic proteins, and classical and non-classical transmitters are explored in detail. As time permits, clinical examples of the effects of failures in peripheral synaptic transmission are presented. (Elective; 2 semester hours; Spring; offered biennially [odd years]; JA Love, director)

PHARM. 790. SPECIAL TOPICS IN PHARMACOLOGY AND TOXICOLOGY. This course may cover any area of interest to at least one student and one faculty member. (Elective; Hours/credit TBA)

PHARM. 792. RESEARCH IN PHARMACOLOGY AND TOXICOLOGY. Students perform research in the laboratory of a faculty member. Students are also required to make a 20-30 present concerning the rotation [including the general premise, experimental approach and results; the latter two may be actual or anticipated] within 4-6 wks of its completion. (Required; 3 semester hours; Summer, Fall, Spring)

PHARM. 798. DISSERTATION AND DISSERTATION RESEARCH (Hours/credit TBA)

PHARM. 799. THESIS AND THESIS RESEARCH. (Hours/credit TBA; maximum of 6 semester hours)

DESCRIPTIONS OF REQUIRED SUPPORT AND INTERDISCIPLINARY COURSES

BIOCH. 704. BIOCHEMISTRY. Fundamental course that presents a broad survey of biochemistry that is suitable for students whose major area of study is outside the discipline. Topics include the chemistry of amino acids and proteins, nucleic acids, carbohydrates and lipids; enzymology; metabolism and metabolic regulation; membrane structure and function; oxidative phosphorylation; hormonal control mechanisms; molecular biology and protein synthesis as well as aspects of oral biology and dental biochemistry. (Fall, 7 semester hours) (also listed as Dental 604)

PHYSIOL 725. PHYSIOLOGY A fundamental course designed to provide students for whom physiology is not their primary area of study with knowledge of the basic functions of the cells, tissues, organs and organ systems, and how they interrelate to accomplish the many and diverse functions of the human body. (9 semester hours) (also listed as Dental 625).

ID 704. AN INTRODUCTION TO ANIMAL RESEARCH. The use of animals as research tools, including characteristics of commonly used species, anesthesia and surgical techniques. (Lecture 2 semester hours; optional laboratory 2 semester hours; Spring Semester; Dr. Andrew Grady, Jr., Course Coordinator)

ID 709. RESPONSIBLE CONDUCT OF RESEARCH. An interactive lecture course designed to provide an understanding of ethics in scientific research and the basic skills important for both oral and written scientific communication. (2 semester hours; Fall semester; Course Coordinator, Dr. I Paul).

ID 710/BIOCH 742. RESEARCH TOOLS IN MOLECULAR BIOLOGY. A course designed to introduce students to contemporary methods in molecular biology including cloning, mutagenesis, transgenic animals, genomics, proteomics, and gene expression. (2 semester hours; Spring semester; Dr. D Sittman, Course Coordinator).

ID 714. PROFESSIONAL SKILLS FOR GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS. A course designed for early to late graduate students and postdoctoral fellows to acquire skills needed to be successful in a scientific work environment, with special emphasis on oral and written communication skills, grantsmanship, career choices, laboratory management, and academic teaching skills. (3 semester hours; Spring semester, Dr. J. Reckelhoff, Course Coordinator).

PM 740. STATISTICAL METHODS IN RESEARCH. An introduction to basic experimental statistics. Application of statistical techniques such as estimation and confidence limits, tests of significance, correlation and regression, sampling, analysis of variance and covariance to experimental data. Fundamental principles of design. (Fall, 3 semester hours).