

# **PHARMACEUTICAL SCIENCES GRADUATE PROGRAM HANDBOOK**

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## I. Introduction

This manual describes the policies and procedures of the Department of Pharmaceutical Sciences graduate programs. The Department offers programs leading to the M.S. or Ph.D. degree. M.S. degree programs follow the Plan A (research) approach outlined in the Graduate Bulletin ([www.grad.uconn.edu](http://www.grad.uconn.edu)). The graduate programs of the Department are represented by three areas of concentration: Medicinal Chemistry, Pharmaceutics, and Pharmacology and Toxicology. The Graduate Affairs Committee coordinates the efforts of the three areas of concentration.

Now that you have become a graduate student the major question you should ask is, "How do I go about obtaining my graduate degree?" That question is answered in the University of Connecticut Graduate Catalog, which contains the rules and regulations concerning graduate education at the University. It is your responsibility to obtain a copy of, and to read, the University of Connecticut Graduate Catalog, and to be aware of all the graduate requirements and their respective deadlines. This manual is prepared to supplement the Graduate Catalog and to explain in detail the policies of the Departmental graduate program.

Graduate degrees granted in our program require that you demonstrate proficiency in: 1) the basic concepts of the discipline in which you are enrolled, 2) graduate course work, and 3) the conduct of original research. Demonstration of proficiency in the basic concepts of your discipline is accomplished by successful completion of the **Qualifying/General Exam Sequence** (Section IV). The graduate course work you must successfully complete includes both required (core curricula) courses as well as elective courses which are selected on the basis of your research interests. Your **major advisor and advisory committee** (Section II), as well as the Graduate School must approve your selection of courses for your graduate program. This is accomplished through submission of a **Plan of Study** to the Graduate School (Section III). Your major advisor and advisory committee also oversee the design and progress of the research project that you must complete as part of the requirements for your degree. This is accomplished via the **Thesis Defense** at the masters level (Section V) or by completion of a **Dissertation Proposal and Dissertation Defense** at the doctoral level (Section V).

Since the advisory committee plays a critical role in all stages of your graduate study, you are strongly encouraged to select an advisory committee at the earliest possible date, but no later than the end of your first year in residence. This is necessary to expedite timely completion of the Plan of Study and the Dissertation Proposal. Completion of the research component of your education will generally be the "rate-limiting" determinant of your date of graduation. Thus, you should begin your research at the earliest possible date rather than waiting until most of your course requirements are completed.

## II. The Major Advisor and Advisory Committee

You were assigned an advisor upon entry into the graduate program and he/she is the person with whom you should meet upon your arrival at the University of Connecticut. Your assigned advisor will be available for counseling throughout the early stages of your graduate career.

Within your first academic year, you should speak personally with each faculty member of your area of concentration to learn about the specific research areas in which he/she is interested and to determine his/her philosophy on education of graduate students. You are also advised to meet with your graduate student colleagues to discuss their experiences in graduate school. After familiarizing yourself with the faculty, you should be in a position to select a permanent major advisor. Your choice of major advisor is a critical one. While the common interests shared by you and your assigned advisor may lead you to retain him/her as your permanent thesis advisor, you are not obligated to do so. You may change advisors if a mutually acceptable alternative can be identified; it is your responsibility to carefully consider such options. To change major advisor, you must: 1) have the consent of the new advisor, 2) inform your assigned advisor, and 3) file a change of advisor form with the Graduate School. You should be aware that, as stated in the University of Connecticut Graduate Catalog, your major advisor also has the right to initiate a change of major advisor.

Your major advisor contributes in a critical way to your graduate education. He/she will help design your Plan of Study (the listing of the courses you will complete as part of your degree program), and more significantly, will teach you how to approach a scientific problem, how to communicate with the scientific community, how to establish your career, etc. You will work very closely with this person, so you must have a good working relationship with him/her.

In addition to a major advisor, you must have an advisory committee. This committee must include at least three members: the major advisor, an associate advisor from within the tenure-track graduate faculty of your area of concentration, and another associate advisor from outside the field of study. You should select your associate advisors on the basis of their expertise in your area of research. You should draw on their knowledge by consulting with them at regular intervals during the course of your graduate program. Your thesis advisory committee must approve your Plan of Study (Section III). Since the Plan of Study is due before the completion of 12 credits of graduate course work, it is important that your Advisory Committee be appointed early in your graduate studies.

It is possible to change the membership of your Advisory Committee. Such changes in the committee will require the submission of a "Request for Changes in the Plan for Graduate Study" form which can be obtained from the Graduate School. Letters informing the original members of the advisory committee should also be sent with copies to the Department Head and the Graduate Affairs Committee.

### **III. Plan of Study**

The Plan of Study is a listing of the course work you will complete to fulfill the didactic component of your graduate studies. The Graduate School recommends a minimum of 24 credit hours of post-baccalaureate course work for the M.S. degree and 30 credit hours for the Ph.D. degree which includes 15 credits of GRAD 6950 and 15 credits of GRAD 6950 respectively. With the help of your committee, a Plan of Study will be prepared and submitted to the Graduate School. This should be done before the beginning of your second year of graduate work. On the form provided by the Graduate School you will be asked to provide a listing of all of the graduate courses that you anticipate taking and also to identify the courses to be used to fulfill the Language or Related

Areas of Knowledge requirement (see below). The course work shall consist primarily of courses at the 5000 level or above. A limited number (not more than 6 credits) of courses at the 4000 level, if not open to sophomores, may be accepted.

Each area of concentration has a "core curriculum" (see Appendices). In addition to courses in the core curriculum, you will need to select elective courses whose content is consistent with your research objectives. You must also participate in the weekly seminars offered by your area of concentration (See section VI). The seminar program is considered to be an integral part of your graduate education.

A certain number of transfer credits is allowed as part of the degree program. The Graduate Catalog contains detailed information on transfer credits.

#### **IV. Qualifying/General Examination Sequence**

To maintain a level of performance commensurate with modern pharmaceutical science education, the program requires all M.S. and Ph.D. students to prepare for and successfully complete a series of examinations. The first examination is the qualifying examination, required by some but not all disciplines, which is typically taken by fulltime students in the first year. In extraordinary circumstances this examination may be delayed until the second year subject to prior approval by the Department Head. Doctoral, but not M.S. students, must also successfully complete the General Examination. This examination is ordinarily taken during the third year by full-time students. Failure to successfully complete the examination by the end of the fourth year will ordinarily be grounds for dismissal from the graduate program. All exemptions from these deadlines must be approved by the Department Head.

##### **Qualifying Examination**

The qualifying examination is required of both masters and doctoral students in some disciplines. The objective of the qualifying examination is to permit you to demonstrate that you are capable of understanding the basic concepts of your area of concentration (Medicinal Chemistry, Pharmaceutics or Pharmacology/Toxicology). You may gain the necessary knowledge base for these examinations by independent readings, discussions with the faculty, and/or by attending appropriate Pharmacy classes. The details regarding qualifying examinations in each discipline can be found in each respective appendix.

##### **General Examination**

The general examination is required of all doctoral students and consists of both an oral and written portion. The format of the general examination is given in the Appendix for each discipline.

The thesis advisory committee plus the full-time members of the area of concentration graduate faculty who are present at the oral general examination shall constitute the examining committee and shall be responsible for determining (by vote) the outcome of the examination. The final

decision must be by consensus of the majority of the voting faculty present, with in no case more than two dissenting votes. If only five voting faculty are present, then only one dissenting vote is allowed.

Three outcomes are possible: an unconditional pass, a conditional pass (requiring supplemental work or revision, as assigned by the examining committee), or a failure. If you fail the oral examination, you will be required to either submit a new proposal or strengthen the original proposal appropriately, as directed by the examining committee, as well as successfully complete an oral reexamination. Only one reexamination will be allowed, and the oral portion of the reexamination must take place **no later than three months** following the date of the original examination. After the examination your major advisor shall communicate the results both to you and to the Department Head and send a report to the Dean of the Graduate School as prescribed by the Graduate Catalog.

The procedure for scheduling the general examination is as follows: All members of your advisory committee must be present for the oral examination. With the advice and consent of your advisory committee, you will select a **minimum of three tentative dates** and times for the examination. You will then circulate a memo to the discipline faculty to determine the availability of each faculty member on the tentative dates **at least four weeks prior** to the first tentative date. In conjunction with your major advisor, you will select the date and time of the examination and notify the faculty by memo, giving at least three weeks' notice. An announcement stating the date, time and place shall also be posted on the department bulletin board. It is expected that every effort will be made to maximize attendance by the discipline faculty. The examination must be scheduled at a time which the majority of the graduate faculty of your discipline has indicated their availability. Under no circumstances may an oral defense be held in the presence of fewer than five graduate faculty. Copies of your proposal must be given to each member of your advisory committee and another copy placed in the Departmental office **at least one week prior** to the examination.

## **V. Thesis Research: Dissertation Proposal and Defense**

The single most consuming set of activities during your graduate studies is the performance of the thesis research and preparation of the dissertation. You must continuously bear in mind that the research project is not a laboratory exercise designed to obtain a specific result. Rather, research is an exploration. The thesis research should be original and should offer new information of substantial value to the pharmaceutical sciences. Appropriate interactions with the major advisor and advisory committee will help to ensure that your research is of sufficient originality, scope and quality so as to ultimately be acceptable to the University and scientific community. It is highly recommended that you meet with your committee on a regular basis (at least annual) so that they are informed of your progress and that you may benefit from their insights.

### **Dissertation Proposal**

Doctoral, but not MS, students are required to prepare a Dissertation Proposal. By the end of the second year of class work, you should be seriously considering the nature of your research project. After discussing possible Dissertation topics with your major advisor and advisory committee,

you will write a Dissertation Proposal consisting of a) the purpose and importance of the study, b) the methods and techniques to be used and c) the availability of research facilities. A Ph.D. candidate must submit his/her Dissertation Proposal 1) at least one year before graduation or 2) by the end of the semester that follows the semester in which he/she completes the general exam requirements, whichever comes first. The Dissertation Proposal is to be signed by the student and the members of the advisory committee and submitted to the Head of the Department to which the student was admitted. If the proposal was presented in front of the entire discipline, then there is no need for additional review. If not, the Head shall appoint reviewers from outside the advisory committee to conduct a critical evaluation of the Dissertation Proposal. The Head's signature on the Proposal confirms that the results of this review were favorable. A copy of the approved Proposal shall be delivered to the Graduate School when the review process has been completed.

**Notes:**

1. It is expected that the student will meet with the thesis committee for data review sessions periodically during the conduct of the thesis research to receive advice/comments on progress of the research.
2. Major deviation from the Dissertation Proposal requires written approval of the thesis committee. A modified Dissertation Proposal is not required.

**Candidacy**

You will become a candidate for the doctoral degree after the following requirements have been fulfilled: passing the general examination, completing all courses in the Plan of Study, fulfilling the language requirement or related area requirement, and having had the Dissertation Proposal approved by the Graduate School. A letter of candidacy is sent to each student when these requirements are fulfilled.

**Thesis/Dissertation Defense**

When the research is completed, it is highly recommended that you arrange for a formal committee meeting to present the results and findings and to obtain the committee's approval to write the M.S. thesis or doctoral dissertation. This meeting is part of the ongoing interactions between you and your committee. The thesis or dissertation must be written according to the rules and regulations set down by the Graduate School. A copy of these rules is available from the Graduate School. It is in your best interest to remain at the University until your thesis or dissertation is written in its final form.

The defense of the thesis or dissertation is considered to be the final examination for the degree. The procedures for scheduling the defense are as follows:

- a) Schedule the defense at a date and time suitable to the faculty by following the same procedure used for the general examination (see above).
- b) Copies of your thesis or dissertation must be given to each member of your advisory committee and another copy must be placed in the Departmental office at least one week before the scheduled date for the examination
- c) The completed thesis or dissertation must be submitted to the Graduate Records Office at least one week before the date scheduled for the examination.

You will prepare a half-hour seminar describing the work and present this at the defense. This seminar shall include a discussion of the purpose of the research, the results and the significance of these results. The presentation will be open to all interested persons, faculty or students. After the formal presentation a question and answer period, open to any interested faculty members, will complete the examination. Naturally, the expected level of performance of a doctoral student is greater than that expected of a master's student.

The decision as to whether a student has passed or failed the examination rests with your Advisory Committee. The Advisory Committee will take into account the opinions of other participating faculty members. Immediately following the examination, the major advisor will communicate the results to you and to the Department head and send a report on an official form to the Graduate Records Office.

## **VI. Other Policies**

### **Student Progress**

The progress of each graduate student will be constantly evaluated. You are expected to maintain a B average or better in your course work. In addition to performance in course work, you will be evaluated on the basis of the qualifying examinations, research activities and general attitude. You should understand that good course grades are not enough to guarantee continuation in the graduate program.

A formal year-end review of each student's progress will be held once a year. You will meet individually with the discipline faculty at that time to discuss the progress of your program. You are encouraged to use this meeting as a forum to make suggestions to the faculty regarding potential or actual changes in the graduate program.

### **Registration for Research**

Those graduate students who must be full-time including international students on F1 and J1 Visas, anyone with an Assistantship (half or full) and anyone who has work study money must register for 9 credits or more per semester. You may register for 6950 (Dissertation Research -Doctoral) or 5950 (Thesis Research -Masters) to complete your 9 credits.

If you register as a part-time student, any student loans that you may have will go into repayment. To avoid this, you must register for at least 5 credits (half-time status). These 5 credits may be any combination of course and research credits (6950 and 5950, as above).

Students who are not in residence during a semester and wish to keep their registration status current should register for 6998 (Special Readings - Doctoral) or 6999 (Doctoral Dissertation Preparation). Master students should register for 5998 (Special Readings - Masters) or 5999 (Thesis Preparation). This allows for continuous enrollment in the graduate program. These are non-credit courses. Details on the continuous registration requirement are provided in the Graduate Catalog.

## Seminars

All students are required to participate in the scheduled seminars of the discipline in which they are enrolled and to attend the dissertation research seminars required of graduating students. Students are also strongly encouraged to attend the seminars of the other disciplines in the Department when appropriate. To be informed of major developments in other scientific disciplines is desirable for a well-educated researcher.

It is a requirement that each doctoral student present his/her research in a special seminar prior to completion of the degree requirements. The seminar should be scheduled for a Wednesday at 3 pm when NO Faculty Meeting or Department Meeting is scheduled. An announcement including an abstract of the presentation should be posted **at least one week prior** to the scheduled presentation.

### Types of Seminars:

All students should gain experience in preparing and presenting several different types of seminars as follows:

- ***Review of a Recent Journal Article Describing Original Research:*** This should take the form of a detailed presentation of a recent original research paper on a topic of interest to the discipline. It is helpful to provide a background introduction prior to presentation of the paper's objectives, methods, results and conclusions. A thoughtful critique of the paper should be prepared, and the presenter should be prepared to lead the group in a thorough discussion of the paper's merits and faults. All participants should study the paper prior to the seminar. The presenter should also post a citation for a general reference article which participants may review for background if desired.
- ***Review of a General Topic or Instrumental Method of Current Interest:*** This seminar should provide participants with a solid introduction to the topic being covered. It should include a general overview which provides background and states the importance of the topic. The presenter should not just paraphrase review articles. Rather he/she should go to original research papers which are important to the review and present some of the original data for discussion. Overall, the review seminar should provide all participants with a solid understanding of the topic.
- ***Student's Personal Research:*** A formal presentation of one's dissertation research project. This should be in the form of a detailed progress report with presentation of background, hypothesis, methods, results, conclusions and future plans. This seminar offers the student the opportunity to get significant feedback on his/her research ideas and results which may be very helpful.

## Vacation Policies

To establish a definite policy for graduate students holding teaching or research assistantships, the following facts should be understood: University vacations for undergraduates are in no way related to the duties of graduate assistants. For example, in the month of December, the undergraduate student body has only a little more than two weeks of classes. An assistantship, however, calls for one month's work. Only legal holidays permit time off. Academic year

appointments for graduate assistants are nine months in duration, which means that an individual may have three months' vacation without pay. It is, however, the policy of the Department to provide for twelve months employment whenever the funds are available. Assistants do not have time off during school vacations or between semesters. This is time for research. If a vacation is desired, the major advisor should be notified well in advance of the time. It is general practice to take off no more than two weeks for each year's work.

### **Outside Work**

It is assumed that all graduate students provided with financial assistance of any kind will be spending their time on either research or studies. Outside jobs are not permitted for people with full-time assistantship appointments, unless prior permission is obtained from the Department Head. You should also be aware that the University has policies regarding the maximum number of work hours per week. See the Graduate Catalog for details.

### **Waivers**

The policies and/or rules contained herein can only be waived or given a special interpretation by written petition to the Department Head for his/her approval or denial. The Department Head will seek input from your major advisor and advisory committee regarding such a petition.

### **Financial Support**

“Basic full support” of a graduate student for the **calendar year** is defined as the stipend amount stipulated by the University for a 9-month appointment at Level I (Beginner Level).

Financial support through school funds will be awarded by the Department Graduate Affairs Committee based on availability of funds and the qualifications of the student. The Department Head is responsible for approving the final decisions regarding student support. Note that University policy requires that all graduate students (both foreign and domestic) who will be employed as teaching assistants or lecturers must demonstrate oral proficiency in the English language. Please contact the ITA [ita.uconn.edu](http://ita.uconn.edu) (International Teaching Assistant Services) for further information on this policy.

## Appendix I - Pharmacology/Toxicology Curriculum

### **I. PREREQUISITES EXPECTED OF INCOMING STUDENTS**

An exposure to general physiology, biochemistry, and organic chemistry at the undergraduate level is ordinarily required of all incoming graduate students. Any deficiencies in these areas should be remedied during the first year of graduate studies. It is also strongly recommended that all doctoral candidates have a mathematics background at least equivalent to Math 1120, 1121 (first year calculus). Other background courses may also be required by individual faculty members, depending upon the nature of the student's prior training and research expectations.

### **II. CURRICULUM**

#### **A. Core Courses Required for All Students (12 -16 Credits)**

PHAR 5471	Advanced Pharmacology I	3 cr
PHAR 5472	Advanced Pharmacology II	2 cr
PHAR 5454	Principles of Safety Evaluation	1 cr
PHAR 5240	Drug Discovery and Development	2 cr
PNB 5302	Fundamentals of Physiology <sup>1</sup>	3 cr
GRAD 5910	Responsible Conduct in Research	1 cr
PHAR 5403	Current Literature in Pharmaceutical Sciences <sup>2</sup>	1 cr

<sup>1</sup> This course may be waived for students who have received an M.D., D.V.M., or Pharm. D. degree from an accredited U.S. institution. Students with a B.S. degree in Pharmacology and Toxicology and/or relevant course work from a U.S. institution may receive a comparable waiver.

<sup>2</sup> Must be taken twice, ordinarily in first and second years.

#### **B. Additional Required Courses (9-15 Credits)**

GRAD 5950	MS Thesis Research	9 cr
GRAD 6950	PhD Thesis Research	15 cr

#### **C. Additional Core Courses Required for Toxicology Students (8 Credits)**

PVS 3100	Histologic Structure and Function	4 cr
PHAR 6455	Advanced Toxicology*	4 cr

\*Students for the Pharmacology program may take Advanced Toxicology as a Pharmacology Elective course to meet the requirement for category E.

#### **D. Seminar Courses (2 - 4 credits)**

Seminars meet on a regular schedule (weekly or as announced) throughout the academic year and are required of all students. Students are expected to attend and to present seminars in every year of their graduate program. Up to 4 credits of seminar may be earned toward the Ph.D. PHAR 5493 is required for all students.

PHAR 5493	Seminar in Pharmacology and Toxicology	1 cr
PHAR 5475	Toxicology Scholars Colloquium <sup>2</sup>	1 cr

### **E. Pharmacology/Toxicology Electives and Special Topics Electives (4 credits)**

Each faculty member offers one or more specialty courses in his or her area of research specialization. The courses are typically offered in alternate years. Specialty courses routinely offered include:

PHAR 5498	Toxicology of Transport Proteins and Multidrug Resistance	2 cr
PHAR 5XXX	Pharmacogenomics and Personalized Medicine	2 cr
PHAR 5497	Personalized Medicine with Graduate Writing	4 cr
PHAR 6484	Cutaneous Differentiation: Molecular Mechanisms and Cellular Processes	2 cr

The following courses are offered from time to time for variable credits by special arrangement with the faculty to provide a means to cover new topics not otherwise available in the regularly scheduled courses. These courses may be repeated for credit, as long as the content is changed.

PHAR 5495	Special Problems in Pharmacology	variable cr
PHAR 5497	Special Topics in Pharmacology	variable cr
PHAR 5498	Special Topics in Toxicology	variable cr
PHAR 5496	Special Problems in Toxicology	variable cr

As may be met from the courses listed above or other courses approved by the student's advisory committee after student consultation with the Pharmacology and Toxicology program faculty, PhD-track students\* will take a minimum of 4 credits of electives from at least 2 additional courses (not including seminar-type credits even if letter graded).

### **F. Statistics Requirement (3 credits)**

A working knowledge of statistical analytical procedures is essential for students in the Pharmacology/Toxicology discipline. Students must complete a graduate level course in statistics. Ordinarily this requirement will be met by completing a course in the Statistics Department. STATS 5605, STATS 5625, or ANSC 5601 are statistic courses taken most commonly by graduate students in the program.

### **G. Biochemistry Electives (6 credits)**

It is expected that all Ph. D. students will choose to take some electives from other departments on campus, with at least 6 credits in courses with significant biochemistry content. This requirement is typically met by courses offered through Molecular and Cell Biology and/or other Biology/Chemistry Depts. MCB 5217 (Biosynthesis of Nucleic Acids and Proteins), MCB 5280 (Advanced Cell Biology) and MCB 5427 (Functional Genomics) are recommended.

### **H. Academic Standards:**

All graduate students are required to maintain a cumulative GPA of 3.0 or they will be placed on academic probation by the Graduate School. A student on academic probation is not eligible for financial aid. In addition, all graduate students in the Pharmacology/Toxicology program are expected to achieve a grade of B or better in all core courses. (Core courses are those listed above

under Section II.A.) A grade below B in one or more core course may subject the student to dismissal from the program.

### **III. EXAMINATIONS**

#### **A. Qualifying Exam**

The qualifying examination for Pharmacology/Toxicology covers basic concepts in mammalian pharmacology. The written examination in Pharmacology is given in May immediately after the Spring semester of the student's second year and is based on Pharmacology (and related pathophysiology) in the relevant pharmacy professional course modules. The examination is written and will be given on the Monday immediately following finals week. Topics include: cardiovascular, respiratory, endocrine and diabetes, neurological, gastrointestinal, immunological, oncology, and infectious disease. Students may prepare by independent readings, discussions with the faculty, reviewing course handouts, and/or by attending selected class sessions. Students must achieve a score of at least 70% in all topic areas. Failure to obtain a 70% on each section of the qualifying will necessitate taking a make-up exam within two weeks of notification of the grade. Failure to achieve a grade of at least 70% on the make-up exam will ordinarily be grounds for dismissal from the program.

The relative amount of material on the examination for each content area is described in the following table:

<b>Content Area</b>	<b>Percentage</b>
Cardiovascular	15
Respiratory	5
Endocrine and Diabetes	15
Neurological	25
Gastrointestinal	10
Immunological	10
Oncology	10
Infectious disease	10
<b>TOTAL</b>	<b>100</b>

#### **B. General Exam in Pharmacology/Toxicology**

The written portion of the examination will consist of the preparation of a research proposal using the NIH "R01" format, as described below. The oral portion will consist of an oral defense of that proposal, as well as an opportunity for you to indicate your mastery of the basic concepts intrinsic to your area of concentration. The overall objectives of the general examination are for you to:

- a) demonstrate that you are capable of designing an independent and novel research project
- b) demonstrate mastery of writing skills
- c) demonstrate ability to orally defend the written proposal
- d) demonstrate the ability to orally answer questions concerning fundamental concepts in your area of concentration.

The general examination is required for Ph.D., but not M.S. students. The written portion of the general examination will consist of the preparation of a novel grant proposal in an area *unrelated* to your immediate dissertation research area. This is intended to be an independent exercise. You are expected to prepare the examination without specific advice from the faculty relative to the details of the proposal. As discussed below, general advice relative to the suitability of the subject area can be obtained from your advisory committee or other faculty.

You will select the topic for the examination, subject to approval by a majority of the faculty within your discipline. A general outline consisting of no more than two pages may be submitted to the faculty of your discipline for their general comments. The faculty, at their discretion, may provide comments relative to the suitability of the subject area. It is, of course, understood that favorable faculty comments do not provide a guarantee of success for the examination and that any negative comments will be focused on identifying potential problem areas, not on providing solutions to these problems. You may present a discipline seminar on the subject of your general examination topic as part of the weekly seminar series of your discipline. This seminar, however, should not cover the details of the research proposal (e.g., hypothesis to be tested, experimental designs, etc.), but rather, should focus on a review of the general background information of the topic area.

Before starting on the written part of the examination you should discuss the mechanisms of actual grant submission and approval with a faculty member familiar with the process as well as refer to informational material published by the NIH. To reiterate, as this is intended to be an independent exercise, you may only seek *general* help from the faculty. The actual NIH forms can be obtained from the Research Foundation office (Graduate School, Room 117). In addition, it may be helpful to examine an actual NIH proposal as a sample of the expected format or to view previous students' successful NIH proposals.

You must submit the completed written proposal to all members of your thesis advisory committee and to each faculty member of your discipline at least two weeks prior to the scheduled oral examination.

The oral examination shall begin with you presenting a brief description (20-30 min) of the proposed research project (your graduate student colleagues may attend this portion of the examination only). This will be followed by an oral defense of the proposal. You should be prepared to orally defend the proposal from several perspectives including the following.

- a) Is the research worth doing?
- b) Will the procedures outlined yield the desired results?
- c) Are the procedures outlined the best for solving the stated problem?
- d) Is the cost of the research appropriate, and if included, is the use of animals appropriate?

The questioning will not necessarily be limited to the contents of the written portion of the examination. Areas of questioning may relate to fundamental biomedical, pharmaceutical science, and/or technical information at the examiners' discretion. The defense shall be open to all faculty of the University. Each faculty member who attends may participate in the defense, however, only members of the thesis advisory committee and members of the graduate faculty of the area of concentration shall vote on the outcome. Successful completion of the general examination is

defined as satisfactory performance with both the written document and its oral defense. Students who fail to perform satisfactorily in the general examination (written and/or oral components) have the opportunity to modify and re-defend the proposal no later than two weeks after the first attempt. Failure to complete the examination during the re-defense stage will be dismissed from the Ph.D. program. Failure to successfully complete this examination before the end of the sixth semester (end of the third academic year) may constitute grounds for dismissal from the program.

#### **IV. PUBLICATIONS**

Publishing in appropriate peer reviewed scientific journals is an ideal way to demonstrate that PhD research is of sufficient originality, scope and quality to satisfy degree requirements. Peer reviewed publications are important not only for the professional development of each graduate student, they are important for maintaining an active Graduate program. Ordinarily, it is expected that each student will have one or more publications accepted and one or more publications submitted at the time of the PhD defense. In cooperation with the student's major advisor, the graduate student's PhD committee should be directly involved in evaluating each student's publication goals. Accepted and submitted publications are often included as chapters in the graduate student's PhD Dissertation.

#### **V. INTERNSHIPS**

Certain students in the Pharmacology and Toxicology graduate program have an interest in employment in the private sectors or in governmental positions following completion of a graduate degree. Summer internships with such entities can be a valuable component of the graduate experience for such students. The faculty of the Pharmacology and Toxicology graduate program and/or graduate committees of students with such interest may require participation in a summer internship as a component of their graduate studies. However, the completion of an internship is in no way a required general component for completion of graduate studies in the Pharmacology and Toxicology graduate program, and students are under no obligation to complete an internship position. Students who participate in summer internships ordinarily forfeit summer stipends provided by the Department of Pharmaceutical Sciences or P.I. research grants. In addition, students will be required to complete 1 credit of graduate independent study, in which they write a summary of research findings and the educational content of their internship experience.

## **Appendix II - Pharmaceutics Curriculum**

All students in the Ph.D. program are expected to complete at least 44 credits beyond the baccalaureate or its equivalent including at least 15 credits of GRAD 6950 (Doctoral Dissertation Research). Students are placed in industrial internship sites for one or two summers. In addition, students must pass the qualifying exam in their first year, submit a plan of study in their second year, and pass a general exam in their third year. The final requirements for graduation are the completion of original research normally leading to the publication of several manuscripts and defense of a doctoral dissertation comprised largely from the manuscripts describing the original research.

### **Prerequisites Expected of Incoming Students**

Students have succeeded in the Pharmaceutics Graduate program with backgrounds in Pharmacy, Chemistry, Chemical Engineering, Bioengineering, Polymer Science, Biology, Biochemistry and related fields. Students entering without four semesters of calculus and two semesters of physical chemistry are expected to complete these within their first year of graduate study. Other background courses may also be required by individual faculty members depending upon the nature of the student's prior education and future research direction.

### **Industrial Internships**

Students are placed in industrial internship sites for at least one summer, usually the summer between their first and second years in the program.

### **Seminars**

While students are expected to attend the Pharmaceutics seminar each semester, students are only required to register for the seminar (PHAR 5293) in the Spring of their 2<sup>nd</sup> and 4<sup>th</sup> year in the program. Students are placed in industrial internship sites for one or two summers.

### **Qualifying Examination in Pharmaceutics**

The qualifying examination will be administered to all incoming pharmaceutics graduate students, regardless of previous educational or professional background. This examination is intended to serve as a diagnostic tool for assessing each student's preparation for the pharmaceutics graduate curricular requirements at the University of Connecticut School of Pharmacy. It will be administered prior to the start of both the Fall and Spring semesters. It consists of a 3-part examination with sections on solid/solution dosage forms, disperse systems, and biopharmaceutics/pharmacokinetics.

The disperse systems, and biopharmaceutics/pharmacokinetics sections will be offered before the start of the Fall semester and the solid/solution dosage forms will be offered before the start of the Spring semester. A list of source materials for review will be provided to each incoming student not less than one month prior to the examination.

Exemption from taking the examinations will be granted only to those who, upon verbal discussion with their major advisor and approval by the department head, are instructed not to attempt selected sections of the examination, but rather to take the corresponding course(s) covering one or more of the three examination sections.

The passing grade on each of the qualifying examination is 70%. Students who do not achieve passing grades on specific sections of the examination will be required to earn a “B” or better in the course covering that section for which their background was inadequate. Failure to pass any part of the exam or earn a “B” or better in the corresponding course(s) will ordinarily be grounds for dismissal from the program. Any exceptions from dismissal will be the decision of the Department Head.

### **General Examination in Pharmaceutics**

The general examination in Pharmaceutics will be comprised of evaluation of the written Dissertation Proposal and an oral defense thereof. The scope of the oral defense will include questions on the proposal and questions on the coursework directly relevant to the proposal. It is suggested that the written proposal should be 10 in length, not including references and appropriate appendices. Please refer to the following Guidance on Writing the Dissertation Proposal in Pharmaceutics (Appendix IIA).

### **Academic Standards**

Wherever a student’s cumulative average falls below a 3.00 or if he/she receives a grade of C more than once, the student’s progress will be reviewed by the Pharmaceutics faculty to determine whether or not the student shall be permitted to continue graduate study.

### **Publications**

Publishing in appropriate peer reviewed scientific journals is an ideal way to demonstrate that Ph.D. research is of sufficient originality, scope and quality to satisfy degree requirements. Peer reviewed publications are important not only for the professional development of each graduate student, they are important for maintaining an active Graduate program. Ordinarily, it is expected that each student will have one or more publications accepted and one or more publications submitted at the time of the Ph.D. defense. Accepted and submitted publications are often included as chapters in the graduate student’s Ph.D. Dissertation.

## **COURSE REQUIREMENTS FOR THE Ph.D. DEGREE IN PHARMACEUTICS**

### **A. FUNDAMENTAL COURSES**

Prerequisites if not previously completed: Calculus MATH 1131\* (Calculus I) 4 cr. and 1132\* (Calculus I) 4 cr., 2110\* (Multivariable Calculus) 4 cr., and 2410\* (Elementary Differential Equations) or 3 cr equivalent.

CHEM 3463	Physical Chemistry I	4 cr.
PHAR 5293**	Pharmaceutics Seminar	1 cr.
PHAR 5240	Drug Discovery and Development	2 cr.

### **B. PHARMACEUTICS CORE COURSES (choose at least 4 of 5)**

PHAR 6234	Advanced Biopharmaceutics	3 cr.
PHAR 6285	Complex Equilibria	3 cr.
PHAR 6286	Transport Processes	3 cr.
PHAR 6288	Kinetics and Mechanisms of Drug Degradation and Stability	3 cr.
PHAR 6290	Interfacial Phenomena	3 cr.

\* students will not receive graduate credit for this course

\*\* students should register for Seminar in the semester they present

### **C. PHARMACEUTICS ELECTIVE COURSES**

(In addition to those listed below, students regularly take other electives outside of the discipline)

PHAR 6242	Freeze Drying of Pharmaceuticals
PHAR 5297	Special Topics in Pharmaceutics: Pharmaceutical Powder Technology

### **Timeline Guidance for Graduate Students**

First year	Complete Qualifying exams and/or prerequisites, submit Plan of Study
Second year	Present first seminar
Third year	Complete general exam, data review session with committee and present research seminar
Fourth year	Present research seminar and schedule additional committee meetings
Fifth year	Seminar and dissertation defense

## Appendix IIA -Guidance on Writing the Dissertation Proposal in Pharmaceutics

Your dissertation proposal is a part of the general exam. The written proposal and your 30-50 minute presentation of the proposal provide a jumping off point for a series of questions directly or at least tangentially related to your proposal. Your answer to the questions posed during and after your presentation will allow the faculty to assess your general knowledge of the pharmaceutics curriculum as well as the details and fundamentals of your research project.

The proposal text should not exceed 10 single-spaced pages or 20 double – spaced pages using 12-point font and one-inch margins all around on 8 ½ x 11-inch paper. The 10-page limit includes the proposal parts listed below and does not include references and appendices. An optional title page containing an optional summary may be added. Appendices may be used to include fundamentals or details of methods; the page limit for all appendices is 2. The reviewers may not read the appendices prior to the exam, unless they have particular expertise or interest in the subject of an appendix. The essence of the proposal must be contained in the 10-page limit.

As guidance for writing your proposal, you may refer to the “Quick Guide for Grant Applications” <http://deainfo.nci.nih.gov/extra/extdocs/gntapp.pdf> . The parts of the format that apply to your proposal are listed below. The budget and description of facilities described in the “Quick Guide” are NOT required for your dissertation proposal.

1. Specific Aims ○ Purpose: To describe concisely and realistically the goals of the proposed research and summarize the expected outcome(s), including the impact the proposed research will exert on the research field.
  - Specific aims should include:
    - broad, long-term goals to which the proposed project contributes
    - overall object(s) of the proposed project
    - specific aims (including hypotheses to be tested or research questions to be addressed) and how they relate to the larger objective(s)
    - a summary of expected outcomes or discussion of potential outcomes; and
    - the impact on the research field
2. Significance ○ Purpose: To explain the importance of the problem or describe the critical barrier to progress in the field that is being addressed. Explain how the proposed research project will improve scientific knowledge, technical capability, and/or treatment in one or more broad fields. Describe how the current concepts, methods, technologies, treatments, or interventions will be changed if the proposed aims are achieved. ○ Significance should include:
  - the state of existing knowledge, including literature citations and highlights of relevant data (what we traditionally call “background”)
  - rationale of the proposed research
  - explanation of the gaps that the project is intended to fill
  - potential contribution of this research to the scientific field(s), the pharmaceutical industry, and/or public health
3. Innovation ○ Purpose: To explain how the proposal challenges and seeks to shift current research or therapeutic paradigms. Describe any novel theoretical concepts, approaches or

methodologies, instrumentation or interventions to be developed or used, and any advantage over existing methodologies, instrumentation, or interventions. Explain any refinements, improvements, or new applications of theoretical concepts, approaches or methodologies, instrumentation, or interventions.

○ Innovation should include:

- explanation(s) for why concepts and methods are novel to the research field
- a clear description of the innovation in study design and outcomes
- a summary of novel findings to be presented as preliminary data in the Approach section

4. Approach ○ Purpose: To describe how the research will be carried out in the laboratory, *in silico*, in the clinic, *etc.* ○ Approach should include:

- any preliminary studies, data, and experience relevant to the proposal and the experimental design
- the overview of the experimental design
- a description of methods and analyses to be used to accomplish the specific aims of the project
- a discussion of potential difficulties and limitations and how these will be overcome or mitigated; particularly if the project is in the early stages of development, describe any strategy to establish feasibility, and address the management of any high-risk aspects of the proposed work
- expected or potential results, and alternative approaches that will be used if unclear results are found
- a projected sequence or timetable (work plan)
- a detailed discussion of the way in which the results will be collected, analyzed, and interpreted
- a description of any new methodology used and why it represents an improvement over the existing ones

Additional suggestions and questions worth considering in writing the proposal

Specific aims

- Generally, the Specific Aims section should begin with a brief narrative describing the long-term goals or objectives of the research project and the hypothesis to be tested or research questions to be answered. This is followed by a numbered list of the Aims.
- List succinctly the specific aims of the research proposed, e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology.
- Make sure each specific aim or hypothesis or question is clearly stated, is addressable, testable, or answerable, respectively. Use supporting citations and optionally include preliminary data. Be sure to explain how the results to be obtained will be used meet the objective, to test the hypothesis, or answer the question.
- Include a time frame for each specific aim, to show the overall project is not overly ambitious or insufficient for a doctoral dissertation.

- Be as brief and specific as possible. For clarity, each aim should consist of only one sentence. Use a brief paragraph under each aim if detail is needed. Most successful proposals have 3-5 specific aims.
- Be certain that all aims are related and address the overall objective.
- Include a brief statement of the overall impact of the research studies.

#### Significance

- Make a compelling case for your proposed research project. Why is the topic important? Why are the specific research questions important?
- Establish significance through a careful review of published data in the field. Use citations not only as support for specific statements, but also to establish your knowledge of the relevant publications and points of view.
- Demonstrate awareness of potential barriers and alternative approaches.
- Highlight why research findings are important beyond this specific project i.e., how can the results be applied to further research in this field or related areas.
- Clearly state implications for pharmaceutical development and/or manufacturing, and health.
- Stress any innovations in experimental methods (e.g., new strategies, research methods used, interventions proposed).

#### Innovation

- Describe how the proposed project differs from current research or therapeutic paradigms.
- Provide a careful review of the current literature to support the innovative methodologies, approaches, or concepts of your research.
- Demonstrate your knowledge of novel methodologies by citing relevant publications.
- Summarize novel findings to be presented as preliminary data in the Approach section.

#### Approach

- Number the sections in this part of the proposal to correspond to the numbers of the Specific Aims.
- Preliminary data may be optionally included. Preliminary data often helps establish the likelihood of success of the proposed project.
- Avoid excessive experimental detail by referring to publications that describe the methods to be employed or reserve excessive detail for an appendix. Citing a publication establishes that you know what method to use. Describe how your experimental detail is similar and/or different from the cited publication and from other previous or current students in your research group.
- If relevant, explain why one approach or method will be used in preference to others. This establishes that the alternatives were not simply overlooked. Give not only the "how" but the "why."
- If employing a complex technology for the first time, take extra care to demonstrate familiarity with the experimental details and potential pitfalls.
- Explain how the research data will be collected, analyzed, and interpreted.
- Develop alternative strategies for potential problems.
- Document support that will be provided by others, such as analyses to be conducted by collaborators that will provide key information for your project, access to analyses off-site

under the direction of expert collaborators, and materials to be provided by collaborators to support the project.

- Point out any procedures, situations, or materials that may be hazardous to personnel and precautions to be exercised (i.e., use of Select Agents).
- State whether a protocol has been submitted to or has been approved by the Institutional Review Board and/or the Institutional Animal Care and Use Committee.
- State which safety training(s) are appropriate for the proposed procedures and on what dates the training(s) were completed.

General suggestions from “Quick Guide for Grant Applications”

- Use basic English and avoid jargon, particularly jargon peculiar to your lab.
- Make sure all acronyms are spelled out when used initially.
- Include only those graphs, tables, etc., that are essential to the narrative.
- Make sure all citations are complete: title, authors, book or journal, volume number, inclusive pages, year of publication. When available, include the digital object identifier to allow the reader quick access to the reference.
- Proofread carefully by reading aloud. Do not rely on computer "spell check" to point out mistakes.
- Be consistent with terms, references, and form writing style.

The “2015 AACP New Investigator Award Application Instructions Evaluation Criteria,” lists questions used to evaluate proposals. Adapted from that document are the following questions to consider.

- Does the student present the nature, structure, and scope of the project clearly and in context with previous work in the field?
- Is this overall presentation understandable, well written, and concise?
- Does the student adequately and clearly describe the intent of the project?
- Does the student demonstrate a clear understanding of the project?
- Are the aims clearly defined and are they appropriate to the objective(s) of the project?
- Does the proposal describe the methods to be used in sufficient detail and clarity?
- Are the methods to be employed appropriate to the project’s objective(s) and specific aims?
- Are the methods workable?
- Do the proposed methods represent the most effective way to achieve the results stated in the proposal? If not, is there a justification for the choice of method?
- Can the data be collected in a reasonable period of time?
- Is there adequate discussion on the limitations of the methods and on alternative approaches?
- Is the data analysis appropriate to the objective(s) or specific aim?
- Is it clear how the data will be analyzed and interpreted to address the specific aim, test the hypothesis, or answer the research question?
- Does the proposed research have the impact of adding new knowledge to the discipline?

## Appendix III - Medicinal Chemistry Curriculum

### **I. Graduate Student Curriculum:**

#### Prerequisites Expected of Incoming Students

Medicinal Chemistry students may come from any of a variety of fields in the chemical, biological, or pharmaceutical sciences. Students without a traditional pharmaceutical sciences background may be required to demonstrate an understanding of the fundamentals of Medicinal Chemistry through additional coursework.

#### Courses Required of All Students (9 Credits)

PHAR 5240	Drug Discovery and Development	2 cr
PHAR 5301	Macromolecules in Drug Design	2 cr
PHAR 5302	Chemical Biology and Drug Design	2 cr
PHAR 5303	Small Molecule Structure and Function	2 cr
GRAD 5910	Responsible Conduct in Research	1 cr

#### Seminar Requirement (1 cr/semester, 6 credits minimum, 10 credits maximum)

PHAR 5393	Seminar in Medicinal Chemistry	1 cr
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Each student will register for 5393 each semester and is expected to attend all Medicinal Chemistry and Pharmaceutical Sciences Departmental seminars. Each student will present a seminar once per year. In general, senior students will present during the Fall semester and junior students will present during the Spring semester. A first-year student may present a literature seminar but is encouraged to present their research work to date.

#### Research Credits

GRAD 6950	Doctoral Dissertation Research	15 cr
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#### Elective Courses

These may be chosen at the discretion of the student, advisor and committee. This is a suggested, but not exhaustive list (11-15 Credits).

#### Internal Electives:

PHAR 5471	Advanced Pharmacology I: Basic Principles	2 cr
PHAR 5472	Advanced Pharmacology II: Drug Disposition	2 cr

#### External Electives:

CHEM 5338	Separation Methods	3 cr
CHEM 5340	Electronic Interpretation of Organic Chemistry	1 cr
CHEM 5341	Advanced Organic Chemistry	3 cr
CHEM 5343	Organic Reactions	4 cr
CHEM 5344	Concepts in Organic Chemistry	3 cr

CHEM 5345	Determination of Organic Structures	3 cr
CHEM 5351	Quantum Chemistry I	3 cr
CHEM 5352	Quantum Chemistry II	3 cr
CHEM 5353	Chemical Kinetics	3 cr
CHEM 5360	Biological Chemistry I	3 cr
MCB 5003	Biophysical Chemistry I	3 cr
MCB 5004	Biophysical Chemistry II	3 cr
MCB 5008	Techniques of Biophysical Chemistry	3 cr
MCB 5011	Enzyme Structure and Function	3 cr
MCB 5012	Foundations of Structural Biochemistry	3 cr
MCB 5013	Structure and Function of Biological Macromolecules	3 cr
MCB 5015	X-ray structure analysis	3 cr
MCB 5038	Techniques in Structural biology	2 cr
MCB 5076	Biomolecular NMR Spectroscopy	2 cr
PNB 5302	Fundamentals of Physiology	3 cr
STAT 5625	Introduction to Biostatistics	3 cr

Special Topics Electives:

PHAR 5395	Independent Study in Medicinal Chemistry	var cr
PHAR 5397	Special Topics in Medicinal Chemistry	var cr

These courses are offered periodically for variable credit to provide a means to cover new topics not otherwise available in the regularly scheduled courses. These courses may be repeated for credit, as long as the content is changed.

## **II. Advisory Committee:**

There are a minimum of three permanent members of the advisory committee, including the major advisor (who acts as Chair), another faculty member in Medicinal Chemistry and a faculty member from outside Medicinal Chemistry. The committee should be arranged by the end of the second year and the Division highly recommends the advisory committee meet with the student at least once per year.

## **III. Advancement to Candidacy:**

There are two requirements for advancement to doctoral candidacy: passing the general examination (see below) and satisfying a third-year progress review (see below). A Medicinal Chemistry graduate student who is not on track to complete these requirements by the end of the summer preceding the fourth year must request an extension or be subject to dismissal from the Ph.D. program.

## General Examination

The general examination is a Graduate School requirement. The written portion of the general examination will consist of a research proposal using the NIH “R21” format, as described below. The oral portion will consist of an oral defense of the written proposal, as well as an opportunity to indicate mastery of the basic concepts intrinsic to the area of concentration. The general exam committee will consist of the permanent members of the advisory committee plus additional faculty members as required such that there are no fewer than five faculty members present. It is preferable for a student to complete the general exam by the end of his/her third year, but it must be completed by the end of the summer preceding the fourth year. A student must have written permission from his/her advisory committee to postpone the General Exam beyond the summer preceding the fourth year.

The overall objectives of the general examination are:

- A) Demonstrate the ability to design an independent and novel research project.
- B) Demonstrate mastery of writing skills.
- C) Demonstrate the ability to orally defend the written proposal.
- D) Demonstrate the ability to answer questions concerning fundamental concepts in your area of concentration.

The written portion of the general examination will consist of the preparation of an “R21” style grant proposal. The proposal may cover avenues of exploration related to your dissertation research, but it should not consist of your actual dissertation research plans. The proposal should focus on the general goals of the project and may contain more research than one student can accomplish in the course of his/her dissertation. Although you may have discussed your project with your advisor, the proposal should contain other experiments that you have conceptualized independently. These experiments should be delineated on the first page, the specific aims page.

Before starting the written portion of the examination, you should discuss the proposal format and process of actual grant submission and approval with a faculty member familiar with the process, as well as refer to informational material published by the NIH. To reiterate, as this is intended to be an independent exercise, you may only seek general help from faculty. There are five sections to the proposal and specific form pages do not need to be used

1. Specific Aims (1-page, general background describing the work followed by 3-4 key aims delineating original experiments)
2. Research Strategy (6 pages)
  - a. Significance (includes background)
  - b. Innovation
  - c. Approach (includes preliminary data, research design and methods, expected outcomes, and alternative approaches)
3. References (no page limit)
4. Budget and Justification (1 page, include and justify estimated necessary personnel and their costs, cost of supplies)

These sections should be single spaced, with 0.5 inch margins and 11 point font. You must submit the completed written proposal to all members of the examination committee at least two weeks prior to the scheduled oral examination. In the event that the written proposal is not provided to the advisory committee on time, the oral examination may be cancelled and rescheduled at a later date.

The oral examination shall begin with a presentation including a brief description (~30 min) of the proposed research project. This will be followed by an oral defense of the proposal. Students should be prepared to defend the proposal from several perspectives, including the following:

- A) Why is the research worth undertaking?
- B) Will the procedures outlined yield the desired results?
- C) Are the procedures outlined the best for solving the stated problem?
- D) Is the cost of the research appropriate, and if included, is the use of animals appropriate?

The questioning will not necessarily be limited to the contents of the written portion of the examination. Areas of questioning are likely to relate to fundamental science and/or technical information appropriate to this discipline at the examiners' discretion. The defense shall be open to all faculty of the University. Each faculty member who attends may participate in the defense; however, only members of the advisory committee and members of the graduate faculty of the area of concentration shall vote on the outcome.

### Third Year Review

Before the end of the summer preceding the fourth year, each student shall meet with their advisory committee and the faculty of the Medicinal Chemistry discipline for a research progress review. A student must establish sufficient progress toward work that can be published in a peer-reviewed journal in order to pass the review. A student can be exempt from the progress review criterion by publishing at least one first author (or joint first author) paper before the end of the summer preceding the fourth year. A student who does not demonstrate sufficient research progress during the review is subject to dismissal from the graduate program.

### **IV. Dissertation Proposal:**

The dissertation proposal is due by the end of the second semester of the third year. The proposal should contain a description of the work that the student plans to accomplish and is more focused than the general exam (approximately 10 pages). The proposal should include preliminary evidence for the proposed research. The proposal will be read and critiqued by several faculty members, from both Medicinal Chemistry and other Divisions/Departments. The faculty will return comments on the proposal to the student.

### **V. Dissertation:**

The written dissertation and oral dissertation defense should be completed per the guidelines of the University of Connecticut graduate school.

## **V. Timeline of Progression:**

First and Second Years – Seminar presentations, didactic course work, preliminary laboratory research

Third Year – Seminar presentation, complete general examination, undergo third year review, complete dissertation proposal

Fourth and Fifth Years – Present advanced research seminars, prepare written dissertation, defend dissertation