Revised 12/3/02

INTERDEPARTMENTAL PROGRAM IN MEDICINAL CHEMISTRY

GUIDE TO GRADUATE STUDENT REQUIREMENTS

This brief document provides a summary of the requirements that must be fulfilled to earn the Ph.D. degree in Medicinal Chemistry and the timeline for meeting these requirements.

FIRST-YEAR GRADUATE STUDENTS

New graduate students are assigned an academic advisor for their first-year in the Program. This advisor will help the student with course selection and other aspects of the first-year. Prior to the beginning of the first semester, all new graduate students take the organic and biochemistry qualifying examinations (administered by the Department of Chemistry), to aid in the selection of the appropriate first term courses. Those who pass enroll in Chem. 540 if required, while those whose performance indicates that they are not yet prepared for Chem 540 enroll in Chem 420. (Note: Chem 420 is offered winter term only and will require some modification of the schedule shown below.)

RESEARCH ROTATIONS

In order to help students in their choice of a mentor and research group, all new graduate students are required to register for semester-long lab rotations in both the Fall and Winter terms. This is done in the form of the course, Medicinal Chemistry 573 (see Curriculum section). New students are expected, as soon as possible, to arrange meetings with individual Medicinal Chemistry faculty members in order to choose a lab in which to fulfill the Med Chem 573 requirement for the Fall term (This choice should be made by the end of the first week of the Fall term). In almost all cases, first-year students will elect to do their dissertation research in one of the two labs in which they have done rotations. Students may; however, choose to complete a third rotation during Spring term of their first-year before selecting a mentor. In all cases, first-year students must select a mentor by the end of Spring term.

The students prepare a report (in the style of a *JACS* Communication) at the end of each rotation. The report is reviewed by both the research mentor (who fills out an evaluation form and assigns a grade) and by the entire faculty.

FIRST YEAR REPORT

All first year students are required to complete a written report (in the style of a *JACS* Full Paper) describing their research efforts carried out during their first year. On or before August 1st of the first year of graduate school, a report, consisting of an introduction, a results and discussion section, a conclusion section, cited references, and a full experimental section, must be submitted to the department office. A brief discussion of future work, in particular outlining the immediate goals of the pre-candidacy period, should be included. While the research mentor may be consulted, the report must be prepared independently by the student. Care must be taken to put the research efforts into the broader context of the realm of Medicinal Chemistry. This report, along with the previously submitted written research rotation reports, is reviewed and evaluated by the faculty. Criteria for the evaluation include the following:

- Introduction/background: How well does the student place the project in context? In other words, does the student display sufficient background knowledge of the field at large?
- Experimental design: Do the experiments that the student carried out fit within the context outlined in the introductory section? Were the experiments well-designed and described in sufficient detail?
- Future work - short-term goals: Do the proposed experiments fit within the context outlined in the introductory section? Are the short-term goals realistic?

Students will receive written comments addressing both strengths and weaknesses and will receive a pass or fail grade for the report. Students who receive a failing grade will be required to complete a second report that addresses the concerns of the faculty**. Students must pass this requirement before advancing to candidacy.**

MEDICINAL CHEMISTRY 740: Literature Research Seminar

In addition to the courses listed in the Curriculum section, each student must present a seminar on an area outside his/her dissertation research. This is done as a separate course, Medicinal Chemistry 740, which must be completed before the end of the winter semester of the second-year.

The literature research seminar requirement is designed to provide the student with the experience of researching a medicinal chemistry topic from the literature and presenting it in a seminar format. One key aspect of this requirement is to demonstrate the student's understanding of the breadth of medicinal chemistry. Accordingly, it is critical that the research presented be in an area of medicinal chemistry unrelated to the student's own research. *The students will be evaluated on their understanding of the topic, their critical evaluation of the experiments and the conclusions of the authors, and the overall presentation. The presentation should conclude with a brief discussion of possible future directions for the research presented*.

The procedure is the following:

- At the beginning of their second year, the students meet with the MC 740 Coordinator to schedule a date for their seminar and to review the guidelines and evaluation process. The students will then enroll for MC 740 in the appropriate term (Fall or Winter).

- A committee of three faculty members, chaired by the student's faculty mentor, will guide the student through the process, provide evaluative feedback and assign a grade.

- The student's faculty mentor will largely be responsible for guiding the student in the selection of potential topics and the preparation of the seminar. *The seminar should involve a critical evaluation of one or a very few papers within the broad realm of medicinal chemistry research*.

- The student will submit a brief description (1-2 paragraphs) of each of three potential topics (ranked in order of preference) for their seminar to their MC 740 committee at least 4 weeks prior to the seminar date. This list will be reviewed by the committee, who will rank the topics in order of preference. The topic with the highest overall ranking will be selected.

- A written abstract of the seminar presentation is required and should be submitted by the student to the MC 740 Coordinator and department secretary one week prior to the seminar. The abstract should briefly summarize the main points of the paper and provide a critical evaluation of the paper. The abstract should not be more than 10 double-spaced pages in length including figures and tables (but not including references).

- The paper itself will be distributed by the student to the department faculty and students at least 2 weeks prior to the seminar (preferably via e-mail as a PDF document if available).

- The student should prepare a 40-50 minute presentation. The student may utilize overhead transparencies, 35mm slides, or computer presentations; however, the objective is to focus upon the content of the presentation and the oral presentation skills. Undue emphasis on presentation technology will detract from the focus of this requirement.

- Three Medicinal Chemistry graduate students will be assigned, on a rotating basis, to read the paper and be prepared to ask questions at the seminar.

- Medicinal Chemistry faculty present during the seminar will fill out an evaluation form immediately after the seminar and submit it to the student's MC 740 committee chair.

- The student's MC 740 committee (all required to be present during the seminar) will meet to review the evaluations and assign a grade as soon as possible after the seminar (ideally immediately). The chair will meet with the student within one week of the seminar to give the student a written summary of the faculty evaluations and specific feedback on their presentation.

- In the event that a student's performance is deemed unsatisfactory, the student will be assigned an incomplete grade. In this case, a second seminar must be given during the subsequent term. **A passing grade in MC 740 is a requirement for the Ph.D.**

CANDIDACY REQUIREMENTS

Once course work and other requirements (see below) are met, graduate students are admitted into candidacy by the Rackham Graduate School. This marks the transition from a largely classroom-based experience to one focused on independent research. Under normal circumstances, it is expected that all graduate students complete the requirements for candidacy by the end of their second-year in the program. Specific requirements for admission into candidacy include:

PASS: 36 credit hours of required courses (Rackham Fee Total Hours)
(can only accumulate 9 hrs/semester; 5hrs/half term)

PASS: First Year Report

COMPLETE: all course requirements

MAINTAIN: a minimum G.P.A of 5.0 (B average)

SUCCESSFUL completion of Candidacy Examination (see below)

CANDIDACY EXAMINATION

The candidacy meeting/examination is designed to evaluate the student's preparedness for dissertation studies by examining the student's knowledge in the fundamental scientific disciplines underlying the proposed Ph.D. research. Although many aspects of the exam may focus on the research proposal, this is not meant to be a dissertation committee meeting. Candidacy Committee Chairs are advised to focus the exam on the student's preparation and readiness for embarking upon their dissertation research. The candidacy committee is expected to review the students First Year Report and MC 740 Evaluation. Any deficiencies or weaknesses identified in either of these benchmarks are to be explicitly probed in the candidacy exam.

The procedure is the following:

- In the winter term of the student's 2nd year, the student and faculty mentor submit to the department office a suggested list of faculty to serve as three members (one designated as chair) and one alternate for the committee. The alternate attends the examination only if one of the three members is absent due to extenuating circumstances. The student's faculty mentor also attends the examination, in an *ex officio* capacity, to advise the committee of the student's overall progress but otherwise does not participate in the discussions and does not vote on the outcome. The department chair, or designee, will review the suggested list for appropriateness of expertise and workload on the faculty. (Changes in the committee composition may be made.) Upon approval of the committee composition, the student consults with the committee to arrange a meeting for the candidacy defense.

- A written proposal is required and should be submitted by the student to the entire committee, and to the department office, one week prior to the meeting date. The proposal should describe a research project in the broad area of Medicinal Chemistry. The faculty mentor is responsible for guiding the preparation of this proposal. The proposal should not be more than 15 pages in length including figures and tables (but not including references).

- The candidacy meeting will take the form of an oral presentation and defense of the research proposal. The student may prepare a limited number (10-15) of visual aids but will not be expected to rely entirely on visual aids to answer the questions put forth by the committee. The student should prepare an oral presentation of *ca*. 40 minutes. Given interruptions for questions and answers, it is expected that the exam will take no more than 2 hours.

- Immediately following the meeting, the committee determines whether or not to recommend advancement to candidacy. The committee's recommendation is then submitted to the Medicinal Chemistry Department Chair in a one-page report which is reviewed and voted upon by the Medicinal Chemistry faculty.

CANDIDACY EXAMINATION-continued

- A Candidacy Committee Chair (not the student's faculty mentor) shall be responsible for moderating the pre-candidacy meeting and preparing and submitting the summary of the committee's final recommendation.

- In the event that the committee deems a student's performance unsatisfactory, the student may be granted a second attempt at the exam. In this case, the second attempt must be made during the Fall term of the third year.

POST-CANDIDACY REQUIREMENTS

ENROLL in Med. Chem. 990/995 each term. Students may also elect to take one additional course each term.

DISSERTATION COMMITTEE: A dissertation committee consistent with Rackham guidelines must be proposed within 2 months of admission to candidacy and must be approved by the Medicinal Chemistry Department Chair. Dissertation Committees meeting are required to held on an annual basis. Summary reports (ca. 1-2 pages) are submitted by the student's faculty mentor to the department chair and are kept in the student's file.

DATA MEETING: 4-6 months before the final defense, a Dissertation Committee meeting is held to discuss the data generated and to identify any required, final experiments.

DISSERTATION DEFENSE: (Med. Chem. 940 - must be registered as full time student during the student's last semester). The defense includes a public seminar presentation, usually included within the regularly scheduled Medicinal Chemistry seminar program. This public presentation is followed by a private session with the Dissertation Committee. The Dissertation Committee members are provided with copies of the dissertation at least 2 weeks prior to the defense. See **Rackham Bulletin** for further administrative guidelines.

CURRICULUM
Course Requirements (credits in parentheses)

First Year

Organic Track (Org):

Fall Term	Winter Term
Med. Chem. 532 (2 credits)	Med. Chem. 533 or 534 (3)*
Med. Chem. 573 (3)	Med. Chem. 573 (3)
Biol. Chem. 550 (3)	Pharmacology 611 (2)
Chem. 540 (3)	**Chem. 541 (3)**

Biological Track (Biol):

Fall Term	Winter Term
Med. Chem. 532 (2 credits)	Med. Chem. 533 or 534 (3)*
Med. Chem. 573 (3)	Med. Chem. 573 (3)
Biol. Chem. 550 (3)	Pharmacology 611 (2)
Chem 540 (3)	**Chem. 526 (3)**

Biophysical Track (Biop):

Fall Term	Winter Term
Med. Chem. 532 (2 credits)	Med. Chem. 533 or 534 (3)*
Med. Chem. 573 (3)	Med. Chem. 573 (3)
Biol. Chem. 550 (3)	Pharmacology 611 (2)
Biophysics 520 (3)	**Biophysics 521 (3)**

*MedChem 533 and 534 are offered in the winter term, alternate years.

Second-year (all tracks)

Fall Term	Winter Term
Elective † (**Chem 525 for Biol Track**) (3)	Med. Chem 533 or 534 (3) *
Elective (1-3)	Elective (1-3)
Elective (1-3)	Med. Chem. 990 (6-9)
Med. Chem. 990 (0-2)	

Med. Chem. 740 (Fall or Winter)

†Elective courses (normally 5-8 credits) in the student's area of interest are required in order to have completed 36 Rackham Fee Totals (essentially credit hours, but see Rackham Student Guide for details) by the end of the second year. Your advisor will help you choose among possible electives. Some potential electives are listed in the appendix.

Third and Subsequent Years (all track)

All students who have been admitted to candidacy register for 8 credits of Med. Chem. 995 per term and may take one additional course per term.

Med. Chem. 995 (Fall and Winter, 8 credits)
Elective (option of 1 course per term per Rackham guidelines)

Final Term

Med. Chem. 995 (8 credits)
Med. Chem. 940 (1)

COURSE DESCRIPTIONS: (required courses)

Medicinal Chemistry 532 (2 credits): Bioorganic Principles of Medicinal Chemistry. Prerequisites: Biochemistry 550 (Concurrent); Recommended: Chemistry 540 (Concurrent). A chemistry approach to medicinal chemistry, emphasizing macromolecular targets of drug action.

Medicinal Chemistry 533 (3 credits): Survey of Medicinal Chemistry. Prerequisites: Medicinal Chemistry 532. Credits: 2 A general survey of therapeutic agents in principal use today, with stress upon their origin, chemistry and mechanism of action.

Medicinal Chemistry 534 (3 credits)**:** Modern Techniques in Drug Discovery and Development. Prerequisites: Medicinal Chemistry 532. A survey of methods used in contemporary pharmaceutical research including computational and combinatorial approaches, and high-throughput analysis of drug efficacy and metabolism.

Medicinal Chemistry 573 (3 credits): Investigations in Medicinal Chemistry. Prerequisites: none. A lab rotation course that allows the student to experience research prior to selecting a dissertation mentor.

Medicinal Chemistry 740 (1 credit): Literature Research Seminar. The student presents a literature seminar on a topic unrelated to his/her dissertation work. (See detailed description above)

Medicinal Chemistry 940.(1 credit): Dissertation Seminar. The student presents a seminar describing his/her dissertation research. This seminar serves as the public component of the dissertation defense.

Medicinal Chemistry 990 (1-8 credits): Dissertation Research/Precandidacy. Prerequisites: Advanced doctoral student status. Election for dissertation work by doctoral student not yet admitted to candidacy.

Medicinal Chemistry 995 (8 credits): Dissertation Research/Candidacy. Prerequisites: Advancement to candidacy. Election for dissertation work by doctoral student admitted to candidacy.

Biological Chemistry 550 (3 credits): Prerequisites: Biol. Chem. 415 or Biochemistry 451/452, or equivalent; or permission of instructor. This new course will cover protein structure, catalysis and kinetics.

Chemistry 525 and 526 (3 credits, each): Chemical Biology. Two semester sequence in chemical biology focusing on the biological context of chemical reactions and on molecular level (chemical) explanations for biochemical phenomena.

Chemistry 540 (3 credits): Organic Principles. Principles of chemical bonding, mechanisms of organic chemical reactions and stereochemistry. The important types of organic reactions are discussed. Basic principles are emphasized and relatively little attention is paid to the scope and synthetic applications of the reactions.

Chemistry 541 (3 credits): Synthetic Organic Chemistry. The scope and limitation of the more important synthetic reactions are discussed within the framework of multi-step organic synthesis.

Chemistry 542 (3 credits): Application of Physical Methods to Organic Chemistry. Applications of infrared, ultraviolet, nuclear magnetic resonance spectroscopy, optical rotatory dispersion, mass spectrometry and other physical methods to the study and identification of the structure and reactions of organic compounds.

Pharmacology 611 (2 credits): Overview of Pharmacology including drugs and receptors, structure-activity relationships, drug absorption, drug metabolism, toxicology, drug resistance, and pharmacokinetics.

Biophysics 520 (3 credits): Energetics, Interactions, and Dynamics of Biomacromolecules.

Biophysics 521 (3 credits): Physical Methods for the Study of Biomacromolecules.

CONSULT **RACKHAM BULLETIN** FOR DESCRIPTIONS OF ADDITIONAL COURSES