Medicinal Chemistry Graduate Student Handbook
INTERDEPARTMENTAL GRADUATE 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. Current versions of all required forms (underlined in this document) are available on the Med Chem MBox site or from the Med Chem office.

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FIRST-YEAR GRADUATE STUDENTS

New graduate students are assigned an academic advisor for their first-year in the Medicinal Chemistry IDP. This advisor will help the student with course selection and other aspects of the first-year. Those whose background indicates that they are not yet prepared for Chem 540 enroll in Chem 419. Similarly, Biochem 515 will be elected for those who need more biochemistry preparation.

Pre-matriculation Summer Research

It is usual for a number of our incoming students to want to come to Ann Arbor early and do some pre-matriculation summer research with one of the department faculty. The Medicinal Chemistry Department will partner with the faculty to provide financial support for the students during the summer. The students must work for a minimum of 6 weeks. Depending on funds available and the number of requests, it is expected that the department will provide 50% (up to $2500) of the summer salary*, for a maximum of 10 weeks.

Note that this summer research does not count as an official rotation, students must do research rotations in the Fall and Winter terms. However, the student may not rotate with the same faculty member with whom they did their pre-matriculation summer research.

To apply for funding, the faculty member should send an email to Sarah Lloyd indicating the student involved, a brief title or description of what they will do for their research, the time frame for the summer research, and a description of how the faculty member will provide their half of the support. No funds are available for supplies, travel etc. Requests should be submitted by May 15th. Funding will be allotted on a rolling basis, so earlier requests are more likely to be approved.

(* The salary will be equivalent to the current graduate student stipend without fringe benefits.)

MEDICINAL CHEMISTRY 660: Responsible Conduct of Research

This course is REQUIRED for the ALL first year graduate students entering the College of Pharmacy (this includes Medicinal Chemistry, Pharmaceutical Sciences and Clinical, Social and Administrative Sciences) and is designed to satisfy the requirement of many government and national funding agencies for a standard course in the responsible conduct of research and scholarship in the biomedical sciences. The course has also been designed to bring a cross-section of the entire research community of the College of Pharmacy together to foster a better understanding of the contribution of each discipline in the overall bench to bedside efforts of drug discovery and patient care.

This course meets once a month in the early evening for the entire school year (8 classes); pizza and drinks will be provided. Attendance and active participation is REQUIRED for every new graduate student in the COP. For each session, a chapter in an ethics book will be assigned to ALL students to read as well as a
short case study to each student to be presented to their classmates with class
discussion following each presentation. Details about the requirements and
procedures for this course can be found in the course syllabus.

MEDICINAL CHEMISTRY 573: Research Rotations

In order to help students in their choice of a mentor and research group, and to
gain understanding of the breadth of research in the Medicinal Chemistry program,
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. Faculty interviewed, sign the Rotation Interview Form, which the
students get from the Medicinal Chemistry office. This choice should be made
after attending the faculty research presentations and by the end of the first week
of the Fall term.

Typically, students will elect to do their dissertation research in one of the two labs
in which they have done rotations. The program does not require a rotation in the
lab prior to joining it; however, individual faculty may. In special cases, students
may request, to the Medicinal Chemistry IDP Director, to complete a third rotation
during Spring term of their first-year before selecting a mentor. In all cases, first-
year students must match with a mentor by the end of Spring term.

So that all faculty and students have equal opportunities for research rotations,
there are a few rules. Eight (8) weeks or more of pre-matriculation research (see
above) constitutes a “significant research experience” (SRE). An SRE performed
under faculty within the Medicinal Chemistry IDP precludes first-year students from
choosing the same lab for a formal (MC573) research rotation. The objective here
is to allow all students equal access to faculty labs for rotations. For the Winter
term rotations, you should approach faculty members who you are considering
rotating with no earlier than November 15th to express your interest in their labs.
Faculty have to wait until the first Friday in December before they can officially sign
off on a winter rotation request, in order to allow all students to interview faculty for
Winter term rotations.

Students are encouraged to spend as much time as possible in their rotation labs,
even when not actively working on their projects. This will help the students
become acclimated to the program and to the research environment. Senior
students and Postdocs are valuable resources for first year students, not just for
their rotation projects, but also for classes etc. Details about the research rotation
requirements and process can be found on the course syllabus.

Beginning approximately March 15th, students should discuss the possibility of
joining a lab with prospective mentors. After April 1st, students may officially join
labs by having their mentor sign their rotation/lab selection form. Students are
required to complete their Winter term rotations.
ALL GRADUATE STUDENTS

Curriculum

The Medicinal Chemistry PhD academic program is divided into four tracks to allow students to customize their curriculum with courses specific to their area of research interest and yet maintain the commonality in the basic fundamentals of Medicinal Chemistry. Note: you must achieve no less than a "B" in each of the core medicinal chemistry courses (MedChem) in order to pass.

Track Course Requirements
(30 credits total required, credits in parentheses, track-specific courses in bold)

First Year

All Tracks: (20 credits)

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<thead>
<tr>
<th>Fall Term</th>
<th>Winter Term</th>
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<tbody>
<tr>
<td>MedChem 532 (3)</td>
<td>MedChem 532(2) and MedChem 535(2)</td>
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<tr>
<td>Chem 540 (3)</td>
<td>or MedChem 534 (3)*</td>
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<tr>
<td>MedChem 573 (3)</td>
<td>MedChem 573 (3)</td>
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<td>MedChem 660 (0.5)</td>
<td>MedChem 660 (0.5)</td>
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*MedChem 533 & 535 and 534 are offered in the winter term, alternate years.

Biochemical Track (Bioc): (3 required credits)

<table>
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<tr>
<th>Fall Term</th>
<th>Winter Term</th>
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<tr>
<td>ChemBio 502 (3)</td>
<td>ChemBio 502 (3)</td>
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Biophysical Track (Biop): (6 required credits)

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<thead>
<tr>
<th>Fall Term</th>
<th>Winter Term</th>
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<tbody>
<tr>
<td>Biophysics 520 (3)</td>
<td>Biophysics 521 (3)</td>
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Bioinformatics Track (Bioinf): (6 required credits)

<table>
<thead>
<tr>
<th>Fall Term</th>
<th>Winter Term</th>
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<tbody>
<tr>
<td>Bioinf 527 (4)</td>
<td>Bioinf Elective (2)</td>
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<tr>
<td>Elective (1-3)</td>
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Organic Track (Org): (8 required credits)

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<th>Fall Term</th>
<th>Winter Term</th>
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<tbody>
<tr>
<td>Chem 543 (2)</td>
<td>Chem 541 (3)</td>
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<tr>
<td>Chem 542 (3)</td>
<td></td>
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</table>
Second-year (all tracks)

<table>
<thead>
<tr>
<th>Fall Term</th>
<th>Winter Term</th>
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<tr>
<td>MedChem 740 (0.5)</td>
<td>MedChem 741 (0.5)</td>
</tr>
<tr>
<td>MedChem 990 (0-9)†</td>
<td>MedChem 990 (0-9)†</td>
</tr>
<tr>
<td>Elective (1-3)</td>
<td>Elective (1-3)</td>
</tr>
<tr>
<td></td>
<td>MedChem 533(2) &amp; 535(2) or MedChem 534 (3)*</td>
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†In the second year, MedChem 990 (pre-candidacy research) is taken to fulfill the 8 credits per term minimum.

**Elective courses:** Five (5) credits of elective courses in the student’s area of interest are required for the Biochemistry Track and two (2) are required for the Biophysical and Bioinformatics Tracks. Your advisor will help you choose among possible electives, which must be approved by the Medicinal Chemistry IDP Director. 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 (regardless of the number of credits) per term with no additional tuition fees (per Rackham guidelines).

*Please note: In the first semester of their Third Year, students will enroll in MedChem 990 for 8 credit hours during the pre-registration period in March. After the prelim committee recommendations for Advancement to Candidacy are approved and processed (September 1), Rackham will change the enrollment to MedChem 995.

Med. Chem. 995 (Fall and Winter, 8 credits)
Elective (option of 1 course per term)
MEDICINAL CHEMISTRY 740/741: Original Research Proposal

In addition to the courses listed in the Curriculum section, each student must prepare an original research proposal (ORP) in an area outside his/her dissertation research. This is done as a separate course, Medicinal Chemistry 740/741 (Med Chem 740/741), which must be completed by the end of February of the Winter term of the second-year.

Two hallmarks of the PhD degree are the ability to engage in thorough independent scholarship, and to plan and conduct original research based on that scholarship. The ORP is designed to provide the student with the experience of researching a medicinal chemistry topic from the literature and then proposing novel studies to extend that work. The research topic will ideally be complementary to the student’s thesis research, i.e., not directly related, but relevant enough that increased knowledge in the area will add value to their thesis research. One overarching theme of medicinal chemistry involves the relationship of chemical structure with biological activity and function. Therefore, it is important that the proposal include some discussion of chemical structure. Medicinal chemistry research is a collaborative effort. It is important to be able to effectively work with others, to both give and receive constructive criticism and these are incorporated into MC 740/741.

Details about the MC 740/741 requirements and process can be found on the course syllabus.
Teaching Requirement

Although our program emphasizes research training of our students, we recognize that a substantial number of our graduates will take positions in academic institutions where they will have significant teaching responsibilities. Therefore, all students are required to gain teaching experience by serving as a graduate student instructor (GSI) for at least one term during the course of their graduate training. (Typically, students will serve as a GSI (or GSSA) one term each in the 2nd and 3rd years in the program.) Specific GSI assignments are made taking into consideration a number of factors, such as: the experience level of the graduate student (e.g., 2nd year students will likely GSI a more basic or lab course), students serving as GSIs for a second time will be preferentially assigned to the same course to minimize prep time, and senior students are more likely to be assigned to less time-consuming GSI positions.

For more formal training on teaching, interested students are encouraged to participate in the UM “Preparing Future Faculty” program. In collaboration with Rackham Graduate School, the UM Center for Research on Learning and Teaching (CRLT) offers seminars and symposia to help graduate students prepare for their first faculty jobs. Topics include preparing for the job market, learning about current issues in higher education, tenure and faculty work life, and effective teaching for a diverse student body. The CRLT also hosts an annual conference on “Preparing Future Faculty”. Topics covered have included: Getting Started with your CV; Negotiating an Academic Job Offer; Developing your Teaching Philosophy; Practicing Interviews; Starting and Running a Research Lab; Dual Career Issues; and Faculty Work-Life Balance. One aspect of this program that a number of our students have taken advantage of is the UM Graduate Teaching Certificate, which provides graduate students with orientation, exposure, mentorship and experience in graduate level teaching in a month-long short course of study and “hands-on” experience.

Department Seminar Program

The Medicinal Chemistry Department seminars involve a mix of prominent researchers from both academic institutions and industry presenting research at the forefront of Medicinal Chemistry (broadly defined). They also include presentations from our own students (dissertation defenses & research seminars). The seminars are held approximately weekly during the academic year on Thursdays at 4:00pm in 2548 CCL unless otherwise stated. We do recognize that students, especially senior ones, may be tied up with research, so we don’t expect everyone to attend every seminar. However, missing them should be the exception not the common practice. Exceptions are granted for GSI or course conflicts.
Candidacy Requirements

Once course work and other requirements (see below) are met, graduate students can be admitted into candidacy by the Rackham Graduate School, upon recommendation of the Medicinal Chemistry faculty. 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.

Faculty in the Medicinal Chemistry IDP determine the academic integrity of the degree in terms of specific requirements, achieving milestones, and completing the degree. The Rackham Graduate School requirements for admission into candidacy include:

A. You must have a bachelor’s degree or equivalent awarded by an accredited institution.

B. You must maintain a cumulative minimum GPA of “B” (3.0 on a 4.0 point scale) or higher. The Medicinal Chemistry Program has established that a grade of “B” is the minimum passing for any of the “core” Medicinal Chemistry courses (see curriculum).

C. Rackham requires Ph.D. students to complete 18 hours of graded coursework (including the grade of S-Satisfactory) in-residence during the pre-candidacy stage of their doctoral studies. That means 18 credits of "real" classes here on campus. You may accumulate more than 9 credits of "in-residency" courses in a single term. Med Chem 990 and any courses that are taken as “visit/audit” do NOT count toward the "in-residency" credits.

D. At least 4 credits must be from a course in a “cognate” field.

E. All Ph.D. students are required to complete training in the Responsible Conduct of Research and scholarship before advancing to candidacy.

F. Successful completion of the Candidacy Examination (see below).

If you follow one of our prescribed curricula, all of the above will be satisfied automatically.

In order to maintain "full-time" status, graduate students (pre- and post-candidacy) must enroll for a minimum of 8 credits in each of the Fall and Winter terms. You do NOT have to enroll for either the Spring or Summer terms.
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 and their research skills by assessing their progress to date. 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 (including pertinent research skills) for embarking upon their dissertation research. The candidacy committee is expected to review the student’s Rotation Reports (MC 573) and MC 741 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:

- The candidacy exam will take place between May 1st and July 31st.
- The candidacy committee will have been previously selected for the student’s Med Chem 741. Any necessary changes and an alternate must be approved by the Medicinal Chemistry IDP Director. 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 Medicinal Chemistry IDP Director, or designee, will assign one committee member experienced in Medicinal Chemistry Preliminary Exams to chair the proceedings. Upon approval of the committee composition, the student consults with the committee to arrange a meeting for the candidacy defense.
- A written proposal for the student’s own thesis research is required and should be submitted by the student to the entire committee, and to the Medicinal Chemistry office, two weeks prior to the meeting date. The proposal should describe a research project in the broad area of Medicinal Chemistry. The student’s faculty mentor is responsible for guiding the preparation of this proposal.
- The written proposal must take the form of an NIH R21 proposal using the following format (approximate page guidelines):
  - Title Page (1 page, see Appendix 4 for example)
  - Abstract (1/2 page)
  - Specific Aims (1 page)
  - Research Strategy (6 pages limit)
    - Significance and Innovation (≤ 1 page)
    - Background and Progress Report (2-3 pages)
    - Approach (2-3 pages)
  - Bibliography (no limit)
- In addition to the proposal, copies of the student’s Med Chem 573 and Med Chem 741 evaluations will be distributed to the committee along with the
proposal. The student’s entire file (currently it will be placed in an MBox folder to which the committee will have access) will be available for the committee to review. It is the responsibility of the student and/or the mentor to ensure that the evaluations have been distributed with the proposal to the committee and that the student’s file is available at the meeting if needed.

- The candidacy meeting will take the form of an oral presentation and defense of the research proposal. The student may prepare a limited number (≤ 25) of slides (usually a Powerpoint presentation) 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 about 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 evaluation and recommendation is then submitted to the Med Chem office on the Prelim/Candidacy Report Form and is kept in the student’s file.

- The Candidacy Committee Chair (not the student’s faculty mentor) shall be responsible for moderating the pre-candidacy meeting and preparing and submitting the Prelim/Candidacy Report Form and presenting it to the faculty at a faculty meeting where it will be reviewed and voted upon by the Medicinal Chemistry faculty.

- 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, this attempt must be made during the Fall term of the third year.
POST-CANDIDACY

Embedded Master's Degree

An "embedded master's" is a master's degree awarded "on-the-way" to a Ph.D. in the exact same program. An embedded master's is NOT required for completion of the Ph.D. degree. The decision to apply for an embedded master's rests with the student and is neither encouraged nor discouraged by the program. Upon advancement to candidacy, students may request to apply for an embedded master's. The student must notify the Medicinal Chemistry office that they wish to apply for an embedded master's degree. The office will process the request and then the student will receive notification from the department that they can log onto Wolverine Access Student Business and "Apply for Graduation". (See: http://www.rackham.umich.edu/downloads/oard-embedded-masters-tip-sheet.pdf)

Post-Candidacy Requirements

ENROLL for 8 credits of Med Chem 995 each term (for the first post-candidacy term, enroll in Med Chem 990, which will changed to 995 by Rackham after official advancement in September). Per Rackham guidelines, students may also elect to take one additional course (1 course regardless of the number of credits) each term with no additional tuition fees. Tuition for additional courses will be assessed.

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 IDP Director. The role of the dissertation committee is to help guide the student, keep the student on track towards completion, and provide assistance to the student in achieving their research goals. It is possible to change the composition of the dissertation committee after it has been formed, but this should be done only after very careful consideration and must be approved by the Medicinal Chemistry IDP Director. (One example of justification for a change in committee composition would be if the student’s research focus has changed such that one or more committee members with different expertise are needed.)

The Dissertation Committee Meetings should be held during the Fall term of the fourth and subsequent years. The student will submit a written progress report to the committee for review at least 2 weeks prior to the annual committee meeting (or Third Year Seminar). The Dissertation Committee Meeting (DCM) Report Form is filled out by the student and advisor prior to the meeting. After the meeting, the committee summary is added to the form by the student's faculty mentor. The faculty mentor meets with the student and reviews the committee feedback, the form is signed by both student and mentor and submitted to the Med Chem office and is kept in the student’s file.
**Third Year Seminar**
In each student’s third year of studies, they will present a public seminar to the IDP on their research project, encompassing background, goals, progress to date, and plans for the future. The student’s mentor will guide him/her in the preparation of this presentation. The seminars will be held in the Winter term of the student’s third year. The students’ dissertation committee will meet to give the student feedback as soon as possible after the seminar, so all committee members should be present. The committee evaluation section of the Dissertation Committee Meeting form should be submitted filled out by the mentor and reviewed with the student. Both the student and mentor sign the form and submit it to the Med Chem office.

**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. A Data Meeting Report Form (distinct from the DCM Form) is filled out by the mentor and a copy is submitted to the Med Chem office and is kept in the student’s file.

**Note:** In all cases above, both the student and the mentor should keep copies of the reports, the PowerPoint presentations and the evaluation/feedback forms for their records.

**Dissertation Defense**
The defense includes a public seminar presentation, ideally 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 the Rackham Website (http://www.rackham.umich.edu/dissertation_information/) for further administrative guidelines regarding the dissertation defense process and dissertation format instructions. In addition to submitting your digital dissertation as per Rackham’s instructions, the department of Medicinal Chemistry requires all students to submit a bound, hard copy of the dissertation defense to the department. See also Appendix 5 for logistical information and important departmental deadlines for scheduling your defense.
PharmD / PhD Dual Degree Program

This program is designed to streamline the process of working toward both the PharmD and PhD (Medicinal Chemistry) degrees at the University of Michigan. Some degree of overlap exists between the two programs and concurrent enrollment and the substitution/waiver of select courses can streamline the process of obtaining both degrees. The student may apply to both programs concurrently or to the PhD program during their P1 year. The PCAT will be accepted in lieu of the GRE in the application. If accepted, the student will be dual enrolled and will follow the PharmD/PhD Medicinal Chemistry curriculum below. Upon completion of the PharmD degree (e.g., the end of Y4), the student will continue in the Medicinal Chemistry PhD program and will be eligible for support (just as any other PhD student). It is anticipated that at least one year can be eliminated from the time for the PhD degree by taking the coursework during the PharmD (see Curriculum below).

Other than the curricular changes noted below, the requirements for the PhD are identical to those for any Medicinal Chemistry PhD student and can be found in the Interdepartmental Program in Medicinal Chemistry Graduate Student Handbook.

PhD Portion of Curriculum
Course Requirements (credits in parentheses)

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<th>Fall Term Y5</th>
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<td>MedChem 532 (3)</td>
<td>MedChem 534 (3)</td>
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<td>MedChem 535 (2)</td>
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<tr>
<td>MedChem 660 (0.5)</td>
<td>MedChem 660 (0.5)</td>
</tr>
<tr>
<td>MedChem 740 (1)</td>
<td>MedChem 741 (1)</td>
</tr>
<tr>
<td>Chem 540 (3)</td>
<td>ChemBio 502 (3)*</td>
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* This curriculum is for students who elect the Biochemical track. If a student elects a different track then the specific courses for that track will be substituted.

- Any of the above courses may be taken during years 1-4, with the exception of MedChem 740 and 741. It is important that these courses be taken in the PhD part of the student’s tenure as this will help to transition the PharmD/PhD students into the PhD program and community.
- The PharmD Medicinal Chemistry coursework will substitute for MedChem 533 and any 700-level PharmD courses will count for the elective requirements.
- The PharmD Investigation requirement, research course and P4 seminar will be waived in lieu of MedChem 740/741 and the 3rd year seminar.
- The College will provide support for summer research for up to 3 summers, Y0: prior to matriculation, Y1: between P1 and P2 years, and Y2: between P2 and P3 years. The PharmD/PhD students will perform two research rotations during the Y0 or Y1 summer. The remaining summers, Y1 and Y2 or just Y2 if the student does not elect to do Y0 research, will be spent getting started on their PhD research.

- During year 5 (Y5), the students will complete their PhD coursework and will take their candidacy exam at the end of Y5.

- Note: MedChem 534 and 535 are offered alternating winter terms, therefore at least one of them must be taken during Y1-4 in order to complete the coursework by the end of Y5.
Appendix 1: Brief Course Descriptions (required courses)

**Medicinal Chemistry 532** (3 credits): Bioorganic Principles of Medicinal Chemistry. Prerequisites: Biochemistry 550 / Chem Bio 501 (or concurrent); Recommended: Chemistry 540 (or concurrent). A molecular/chemical approach to medicinal chemistry, emphasizing macromolecular targets of drug action.

**Medicinal Chemistry 533** (2 credits): Survey of Therapeutics and Their Mechanisms of Action. Prerequisites: Medicinal Chemistry 532. 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): Computational Principles of Medicinal Chemistry. 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 535** (2 credits): Principles of Drug Design. Prerequisites: Medicinal Chemistry 532. An overview of the drug design process from lead selection to ADMET optimization.

**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 660** (1 credit): Responsible Conduct of Research and Scholarship (RCRS) in Pharmaceutical Sciences. (See detailed description above).

**Medicinal Chemistry 740/741** (1 credit total, .5 credits per term): Original Research Proposal. The student presents an original research proposal on a topic distinct from, but related to his/her dissertation work (See detailed description above).

**Medicinal Chemistry 990** (1-8 credits): Dissertation Research/Pre-candidacy. Prerequisites: 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.

**Bioinformatics 527** (4 credits): Introduction to Bioinformatics and Computational Biology. Prerequisites: Upper level or graduate level Statistics or concurrent enrollment in Statistics; Calculus I & II, Biochemistry, Molecular Biology, or Cellular Biology; or permission of instructor. This course introduces students to the fundamental theories and practices of Bioinformatics and Computational Biology via a series of integrated lectures and labs. These lectures and labs will focus on
the basic knowledge required in this field, methods of high-throughput data generation, accessing public genome-related information and data, and tools for data mining and analysis. The course is divided into four areas: Basics of Bioinformatics, Computational Phylogeny (includes sequence analysis), Systems Biology and Modeling. There will be weekly homework, two take-home exams, and students will prepare and present group projects.

**Biophysics 520** (3 credits): Energetics, Interactions, and Dynamics of Biomacromolecules. Biological macromolecules such as proteins are at the basis of virtually all processes of life. These molecules are not the inert entities the pretty pictures suggest -- they interact with other molecules, they fold, they catalyze reactions, they change their conformation, they move around. In this course we will try to share the excitement of understanding how these proteins really work -- in terms of energy functions, in terms of changes of conformation, in terms of kinetics and dynamics.

**Biophysics 521** (3 credits): Physical Methods for the Study of Biomacromolecules. This course gives background and applications of several physical techniques used in Biophysical research. General principles of spectroscopy will be explained. Macromolecular structure determination by X-ray diffraction and two-dimensional NMR will be treated in detail. IR, Raman, CD, EXAFS, and single molecule spectroscopy will be introduced.

**Chemical Biology 502** (3 credits): Chemical Biology. Course in chemical biology focusing on the biological context of chemical reactions and on molecular level (chemical) explanations for biochemical phenomena.

**Chemistry 540** (3 credits): Physical Organic Principles. Principles of chemical bonding, mechanisms of organic chemical reactions and stereochemistry. The important types of organic reactions are discussed. Basic principles and physical organic chemistry are emphasized; however, 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): Organic Mechanisms

**Chemistry 543** (2 credits): Spectroscopy

CONSULT INDIVIDUAL DEPARTMENTS WEBSITES FOR DESCRIPTIONS OF ADDITIONAL COURSES
## Appendix 2: Timetable of Deadlines

<table>
<thead>
<tr>
<th>Item</th>
<th>Students</th>
<th>Term/Month</th>
<th>Form</th>
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<tbody>
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<td>1st Year Evaluation</td>
<td>1st Yrs</td>
<td>end of Winter term</td>
<td>Yes, CoP IDP Website</td>
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<td>IDP/Mentoring Agreement</td>
<td>1st Yrs</td>
<td>Before start of 2nd year</td>
<td>Yes, CoP IDP Website</td>
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<td>2nd Yrs</td>
<td>Fall/Winter, by end of February</td>
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<td>Prelim/Candidacy Exam</td>
<td>2nd Yrs</td>
<td>May-July</td>
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<td>Establish Dissertation Committee</td>
<td>3rd Yrs</td>
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<td>≥ 4th Yrs</td>
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<td>Data Meeting</td>
<td>3-6 months prior to defense</td>
<td>as needed</td>
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<td>Defense</td>
<td>graduating students</td>
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Appendix 3: Academic Progress Form

Name __________________ Date of last Relevant Degree/Major __________________

Previous Degree/Institution _______________________________________________________

Tracks:
BIOCHEMICAL=Bc  BIOPHYSICAL=Bp
BIOINFORMATIC=Bi  ORGANIC=O

573 Advisors: 1st ____________, 2nd ____________, 3rd (optional)* ____________

Milestones

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Coursework

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GPA

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Appendix 4: Example Title Page for Candidacy Proposal

Candidacy Proposal

Title of proposal
Your Name
Medicinal Chemistry Program
University of Michigan, Ann Arbor
Date of meeting
Place of meeting

Committee:
Prof. XXXX (Chair)
Prof. YYYY
Prof. ZZZZ
Prof. AAAAA (Ex officio, mentor)

Note: Use similar format for MC 573 reports and MC 740 proposal. Page number document.
Appendix 5: Guidelines for Oral Dissertation Defenses

1. Links to Guidelines on Rackham Website:

   http://www.rackham.umich.edu/current-students/dissertation/the-dissertation


   http://www.rackham.umich.edu/current-students/dissertation/defense

2. Flyer and Website Information

   Due at least 30 days before defense, to be e-mailed to Sarah Lloyd, sarloyd@med.umich.edu

   Information needed:
   - Date
   - Time
   - Location
   - Title

3. Reserving Room for Oral Defense Seminar

   To reserve a room for the oral defense seminar, send an e-mail with the requested room, date, start time and end time to:
   - College of Pharmacy or CC Little, email: cop.facilities@umich.edu
   - Rackham (if no rooms are available in the COP): http://www.rackham.umich.edu/rackham-building/room-scheduling/scheduling-guidelines#who-may-schedule, e-mail: RackhamScheduling@umich.edu.
   - Chemistry (If your advisor is in Chemistry Dept.) e-mail: chemreservations@umich.edu
   - Life Sciences Institute (If your advisor is in LSI) e-mail: LSIreservations@umich.edu

   Also reserve a room (allow at least 1 hour) for the private meeting with the committee immediately after the seminar. This can be in the seminar room itself.

   Note that the department will provide refreshments ONLY if the defense seminar is in the College of Pharmacy.

4. Program Book (Yellowbook)

   Due two weeks prior to your defense, please e-mail information to Sarah Lloyd, sarloyd@med.umich.edu

   Information needed:
   - Your name as you would like it listed
   - Photo image (mugshot)
   - Title
   - Abstract
   - Publications
   - Presentations
   - Committee Member Names
   - Future plans
   - Anything else you want included in the yellowbook.
5. Final Steps after oral defense:

- Provide your forwarding address and e-mail contact to the department.
- Provide a printed, bound hard copy of your dissertation to the MedChem Department.
- Complete the exit survey and exit interview with the Dean.
- Optional: schedule an exit interview with the MedChem Dept. Chair.

Revised 12/18/2018

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