

# **JCCO Handbook**

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## 1: General Information

Welcome to the Joint Program in Chemical Oceanography! In this handbook you will find information that we hope will ease your progress during your graduate years in Cambridge and Woods Hole. Although our program is flexible, we expect most students to follow a pattern somewhat like this (see Appendix IV for a table of dates):

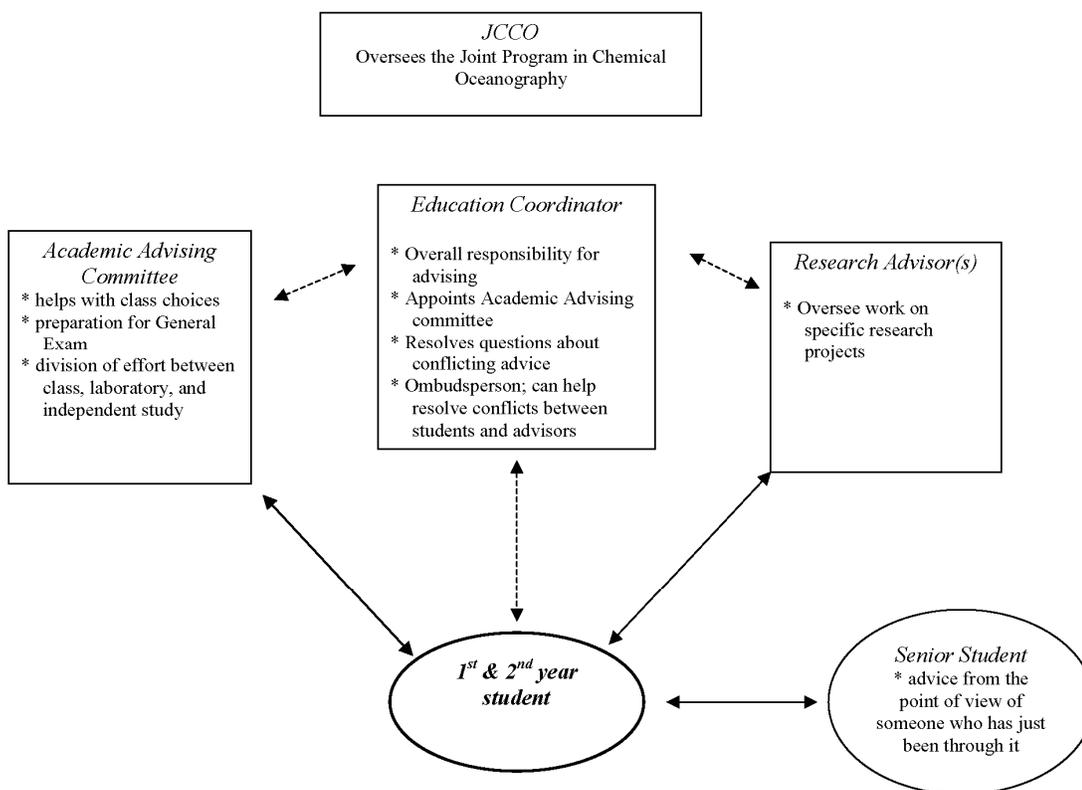
### 1-1: Summer after Admission

New students, including those with MIT research advisors, have the option of spending the first summer in residence at Woods Hole working on a summer project with a member of the WHOI scientific staff. Students with MIT research advisors should discuss this option with their advisor since the opportunity may also exist to spend the summer conducting research at MIT. If at WHOI, we expect you to use this summer to acquaint yourself with WHOI, the staff, your fellow students, and the education program. You are encouraged to meet the staff and to familiarize yourself with their research interests. We urge you to take time to get to know the Institution and its many resources. You are also encouraged to attend a variety of seminars and talks given regularly in the Woods Hole scientific community. Each summer, special seminar series are given by senior students and staff that will introduce you to the many different avenues of oceanographic research. Talks are also given daily at the Marine Biological Laboratory, the U.S. Geological Survey, and the NOAA National Marine Fisheries Laboratory.

The Education Coordinator appoints an Academic Advising Committee for each first year class. This committee, consisting of two people from the MC&G department at WHOI and one from MIT, will advise you about courses and other education-related matters. The committee follows the first-year class through their general exam, which occurs in June of the second year. Since one committee works with each class during the pre-generals period, we hope that the committee and its students will get to know each other well and that the students will receive consistent advice throughout this period. Other staff and students, both at MIT and at WHOI, are also valuable sources of information about the graduate program. Each incoming first-year student will be appointed a more senior JP student as a mentor, who will serve as a valuable resource to discuss course choices, the General Exam process, and life as a graduate student. In addition, since you will be working on a research project, your research advisor is a good resource for information about the Joint Program. Thus, information about how to succeed in the Joint Program comes to you from several directions, and you should feel free to consult any/all of these mentors as desired or needed. The Education Coordinator can help to sort out conflicting advice should it arise. The advising structure for pre-generals students is summarized on the flowchart below.

### 1-2: First Year

Emphasis in the first year is generally placed on coursework (see section 2). *All Chemical Oceanography (CO) students are required to take the Introduction to Marine Chemistry course (12.742). You are also required to take the Seminar in Oceanography (12.759) twice before graduation, preferably during your first two years.* Each student is expected to be involved in an



independent research project (see Appendix 1: "Graduate Student Research and Teaching Responsibilities"). In some cases, research projects initiated in the summer following admission will continue throughout the academic year. In others, factors such as financial support, research interests, and place of residence (Cambridge or Woods Hole) may lead to a change in your research. The time available for you to conduct research will fluctuate over the semester and throughout the first year. While the Joint Program is designed to be flexible, if you are funded by a grant or contract, you may have obligations set by the funding source. Therefore, it is important that you meet with your research advisor early in the academic year to work out a research plan and timeline. The first two years of your graduate education are an excellent time to expose yourself to different sub-disciplines of chemical oceanography. We encourage you to take advantage of the program's flexibility and consider independent projects in more than one laboratory.

Depending on academic and research demands in the first year, you have a choice of residence, Cambridge or Woods Hole. A bus is provided from MIT to attend classes at WHOI on Tuesdays and Thursdays. Transportation to MIT from WHOI is either by public bus service or private vehicle. You will be reimbursed by the Academic Programs Office at the current bus ticket rates for the use of your private vehicle and/or public transportation. If you carpool, drivers will be reimbursed \$10/JP passenger each way. Reimbursement forms can be found on the Joint Program website: <http://mit.who.edu/personal-vehicle>.

### **1-3: Summer (end of year 1)**

Summer is spent doing research for your General Exam research paper or getting acquainted with the research of a different laboratory. Independent projects and cruise participation may be undertaken as opportunities arise. Cruise participation at an early stage in your studies can be useful in choosing a research topic as well as in getting some "hands-on" oceanographic experience. The best way to get on a cruise is by word-of-mouth. Ask fellow students, staff members, the WHOI Education Coordinators, and/or the Academic Programs Office about opportunities.

Towards the end of the summer the Education Coordinator will schedule a series of summer advisory meetings during which students meet individually with the CO faculty to discuss and select topics to be covered by your General Exam questions.

### **1-4: Second Year**

In the second year, you should begin a research project in the laboratory of your research advisor. You will also continue to take courses. In March of the second year, students will submit their Generals Research Paper. In June of the second year, students take the written and oral portions of the general exam (see section 3).

### **1-5: Third Year**

The third year is devoted to thesis research. After the written and oral portions of your general exam are completed, you will need to formally identify a thesis advisor or co-advisors. In October of the third year you will present your thesis proposal to the faculty. Within a month of completing the thesis proposal presentation, you should assemble a thesis advisory committee of at least three scientists after consultation with your thesis advisor(s). The committee must include at least one member from both MIT and WHOI. Scientists from other institutions should also be considered. Once you have formed your committee, you must write the JCCO chair for approval. If your committee includes members from outside WHOI and MIT, JCCO will ask you to describe your expected interaction with these members, and will require that your advisor, the prospective committee member, or the Academic Programs Office set aside funds for travel to MIT or WHOI for the thesis defense. You will need approval of the Director of the Joint Program at MIT and the WHOI Associate Dean if travel expenses will be covered by the Academic Programs Office. We encourage you to identify potential members of your thesis committee as early as possible so that you can invite them to participate in your thesis proposal presentation. Information about APO's reimbursement policy for committee member travel can be found on the Joint Program website: <http://mit.who.edu/thesis?tid=1423&cid=117649>.

You should convene your Thesis Committee for meetings on a regular basis throughout your research (every 6-12 months, or more frequently if needed). Your Thesis Committee provides a productive forum to advance evolving ideas and evaluate your research plan.

## **1-6: Fourth Year**

You should have made substantial progress on your thesis research by the end of your fourth year. This progress should be made evident through publications and oral or poster presentations at MIT, WHOI, and/or (inter)national meetings. It is important to maintain close contact with all members of your thesis committee through annual or biannual meetings. Written drafts of some chapters of your thesis should be in progress. Published papers are a particularly effective means to get a jump start on putting together your written thesis. You are encouraged to submit papers as soon as is appropriate, which in many cases may be earlier than your 4<sup>th</sup> year.

## **1-7: Fifth Year**

By the end of your fifth year your graduate career will conclude with the final draft of your thesis, which must be approved by all members of your Thesis Committee. Your thesis defense must occur before the end (August 31<sup>st</sup>) of your fifth year.

## **1-8: Extensions beyond the fifth year**

If you plan to defend your thesis after August 31<sup>st</sup> of the fifth year, you will need to have an extension of your student status approved by JCCO, with submittal of the request by May 31 of the fifth year. The request for an extension should be communicated by letter to the JCCO Chair. Prior to requesting an extension, you should discuss what is needed to complete a viable thesis with you advisor(s) and committee members. The request should include the length of time needed to complete your thesis, the reasons for the delay in completion and how these have been addressed, and a detailed work plan and timeline of major tasks to be completed during the extension. In addition, the request should be accompanied by a separate supporting memo from your thesis advisor(s). This supporting memo should, for information purposes relevant only to the WHOI Dean and the MIT JP Director, include the level of funding available for your support during the extension period; extensions are possible even without advisor funding. An extension will be granted if: 1) there have been good reasons for not finishing in five years, 2) there is evidence of good progress, and 3) you and your advisor agree that an extension is needed. Initial extensions are typically approved through the end of November. Extensions into the second half of the sixth year need to be very well justified and will not be granted until after November of the sixth year. Extensions beyond the sixth year are granted only under rare circumstances. Any extension beyond the original extension request should be submitted at least 6 weeks before the end of any previous extension. Upon review of the request, JCCO will consult with the WHOI Dean (for JP students advised at WHOI) or the MIT JP Director (for students advised at MIT) and after that consultation recommend to 1) approve the extension as requested, 2) modify the length of the extension, or 3) deny the extension.

The schedule described above is an example only. Some students move more quickly or more slowly at different stages. We try to remain as flexible as possible to provide you with the best educational experience. Faculty members participating in the program meet annually to discuss student progress, and your academic advisory or thesis committee should meet with you regularly. If you have any questions, be sure to ask.

## **2: Seminars/Courses**

### **I. Required**

12.742 Marine Chemistry (Van Mooy/Kujawinski, WHOI; Fall)

12.759 Seminar in Marine Chemistry (WHOI faculty; Spring) – take twice

### **I. Recommended Courses**

1.76 Aquatic Chemistry (Plata, MIT; Fall)

1.83 Environmental Organic Chemistry (Gschwend, MIT; Fall)

12.741 Marine Bioinorganic Chemistry (Saito, WHOI; Spring) – former 12.755

12.743 Geochemistry of Marine Sediments (McCorkle, WHOI; Spring)

12.744 Marine Isotope Geochemistry (Peucker-Ehrenbrink WHOI; Spring)

12.746 Marine Organic Geochemistry (Repeta/Galy, WHOI; Spring)

12.747 Modeling, Data Analysis, & Numerical Techniques (Nicholson/Glover, WHOI; Fall)

### **III. Electives and Specific Interest Courses**

12.702 Elements of Modern Oceanography (Kirincich/Laney, WHOI; Fall)

1.75 Limnology and Wetland Ecology (Hemond, MIT)

1.84/12.807 Atmospheric Chemistry (Kroll, MIT)

7.47 Biological Oceanography (Pineda/Johnson, WHOI; Spring)

12.749 Solid Earth Geochemistry (Gaetani/Nielsen/Shimizu, WHOI; Spring)

12.710 Marine Geology and Geophysics I (Ashton/Lizarralde/Soule; Fall)

12.753 Geodynamics Program (Seminar series and field component, JP faculty; Spring)

12.756 Marine Microbiology and Biogeochemistry (Apprill/Sievert, WHOI; Spring)

12.439 Recent Advances in Marine Microbial Biogeochemistry (Apprill/Sievert, WHOI; Spring)

12.740 Paleoceanography (Boyle, MIT; Spring)

12.808 Introduction to Observational Physical Oceanography (Andres/Gebbie, WHOI; Fall)

#### **IV. Some of the Available Courses of Interest to Chemistry Students:**

##### CHEMISTRY and CLIMATE

- 5.062 Principles of Bioinorganic Chemistry
- 12.300 Global Change Science (1.071J)
- 12.301 Climate Science
- 12.306/12.806 Atmospheric Physics and Chemistry
- 12.754 Seminar: Oceanography at WHOI
- 12.757 Climate Change Science
- 12.842 Climate Physics and Chemistry
- 12.846 Global Environmental Science and Negotiations

##### BIOLOGY

- B-118 Biological Oceanography – McCarthy, Harvard
- 12.158/458 Molecular Biogeochemistry – Summons, MIT
- 12.471 Essentials of Geobiology – Bosak, MIT
- MBL courses in Marine and Microbial Ecology
- 1.89 Environmental Microbiology – Cordero/Polz, MIT

##### PHYSICAL OCEANOGRAPHY

- 12.800 Fluid Dynamics of the Atmosphere and Ocean – Cenedese/Pratt, WHOI
- 12.801 Large-scale Ocean Dynamics – Ferrari, MIT
- WH1.699 Coastal and Estuarine Field Methods

##### GEOLOGY

- 1.67 Sediment Transport and Coastal Processes – Madsen, MIT
- 12.480 Thermodynamics for Geoscientists – Grove, MIT
- 12.751 Student Seminar in Marine Geology/Geophysics – WHOI staff

##### MODELING/STATISTICS

- 1.77 Water Quality Control - Adams, MIT
- 10.34 Numerical Methods Applied to Chemical Engineering – Green/Swan, MIT
- 7.410 Applied Statistics - Solow, WHOI, Spring

It is impossible to keep this list current as course schedules and instructors change frequently. Please check the MIT/WHOI website and the MIT course catalog, which are modified every year. JP students are typically the best source of information on course quality and usefulness.

Because this is an oceanographic program, it is recognized that cruise opportunities may interfere with course schedules. If you are planning on participating in a cruise that will result in

missed classes, it is important that you discuss the situation with faculty member(s) teaching the class before it begins to develop a plan for you to cover the missed material.

There are opportunities for advanced graduate students to obtain teaching experience by serving as Teaching Assistants (TA). There are also Teaching Assistant opportunities to assist in laboratory sections of courses. If you have an interest being a TA, you should discuss it with the course instructors and/or the education coordinator who can point you to people at WHOI and MIT teaching relevant courses at undergraduate or graduate levels. There are resources available at MIT to prepare TAs for their teaching responsibilities (e.g., courses 1.95J/5.95 – Teaching College-Level Science and Engineering; 1.984 – Teaching Experience in Civil and Environmental Engineering). The Teaching & Learning Lab at MIT also offers the Kaufman Teaching Certificate Program (<http://tll.mit.edu/design/kaufman-teaching-certificate-program-ktcp>), along with other services and workshops designed to support TAs.

### **3: General Examination**

The purpose of the General Exam is to determine whether you are ready to begin your Ph.D. thesis research. The preparation for this exam gives you the opportunity to integrate studies completed during your first two years. You can learn the material that you will need to know to pass the exam through coursework, tutorial, or self-teaching. Courses are available at WHOI and MIT, as well as through cross-registration at Harvard University, Wellesley College and the Massachusetts College of Art and Design. If you are planning on taking a class from an instructor who is not a member of the JP Faculty and want to use it as one of your General Exam topics, it is very important that you speak with the instructor prior to taking the class and specifically ask if they would be willing to write a question for the written part of the General Exam. If they agree, the Education Coordinator will contact the instructor to provide guidance on the type of question that is appropriate for the General Exam. A list of courses frequently taken by Chemical Oceanography students in the past appears in section 2. Tutorials can be arranged with individual members of the Staff for help in specific areas.

The General Exam has four parts summarized below (see Appendix IV for summary of dates):

- (1) By the end of April of the second year, you are to electronically submit a research paper to the Education Coordinator, which is available for all JCCO faculty to read (an abstract of the proposed paper topic should be electronically submitted to the Education Coordinator by May 31<sup>st</sup> of the first year).
- (2) There is a four-hour, closed book written exam consisting of 5 questions covering topics in marine (bio)geochemistry and general oceanography relevant to your research focus. You will identify these focus areas in consultation with your advisor(s) and the JCCO faculty during summer advisory meetings scheduled at the end of summer after the first year.
- (3) There is a one-hour oral exam TWO weeks after the completion of the closed book exam. The exam begins with an AGU-style (12 min.) presentation of your research paper, followed by questions on that paper and on your general oceanographic knowledge. You may be asked to

elaborate on some of your answers from the written portion of the exam.

- (4) The general exam also includes development of a thesis topic and the oral and written presentation of a thesis proposal. The written thesis proposal must be submitted to the Education Coordinator by September 30th, approximately three months after the oral part of the general exam. After consultation with you, the Education Coordinator will schedule the oral presentation of your thesis proposal approximately 2 weeks after submission of the written proposal. If you have a conflict, such as extended field work, or extenuating circumstances which will prevent you from completing either the written thesis proposal by September 30th, or the oral presentation by the end of October, you must request an extension from JCCO by July 31st. The request should include the reasons for the delay and the length of additional time needed to complete your thesis proposal defense.

Each part of the exam is designed to test skills that are essential for the successful completion of a Ph.D. in chemical oceanography. The closed book and oral portions of the exam tests your command of fundamental principles in chemical oceanography relevant to your field of study. The research paper allows the staff to evaluate your abilities to carry out research, critically read recently published articles, integrate them with your data and general knowledge of chemical oceanography, and synthesize your ideas and conclusions. The thesis proposal assesses your ability to identify an important problem in chemical oceanography and related fields and develop an appropriate research plan that will advance the field.

Details related to each part of the General Exam are as follows:

*Research Paper* - The research paper is to be written on work that has been carried out during some part of your first 1.5 years in the Joint Program. The paper may be written on a topic of your choosing, and can be part of or distinct from anticipated thesis research. To ensure that it is distinct from the thesis proposal, it must be written in the form of a published paper, including an overview of the research presented, results of the research effort, and discussion of the contribution that the results make to the research area. The paper should be no more than 12 pages long (12-point font, single-spaced with 1" margins, including figures, but excluding references). You are required to submit an abstract of the proposed paper topic by the end of May of your first year. JCCO, in consultation with your research advisor, will review the abstract, may provide feedback, and may request changes to the proposed research. It is recognized that much pre-thesis research is exploratory in nature and takes place over a short time period. For these reasons, it is not expected that the research papers will be manuscripts ready for submission to a journal; rather, they are to be research papers of high quality that show an ability to conduct research and present the results coherently. It is expected that the research paper will present the results of a collaborative effort by you and the scientist in whose lab the research took place. You should regularly discuss your results and interpretations with your advisor and other collaborators prior the writing your generals paper. However, it is important that the paper represent your work. The initial draft of the paper may be given to your advisor and other faculty collaborators for review. Advisor and collaborator input should be limited to comments relevant to the interpretation, organization, and scope of the paper. They should not rewrite sections or heavily edit text. Advisors and collaborators may review two drafts of the paper. Upon submission of the paper by the end of April of the second year, the

Education Coordinator will ask two CO faculty members with relevant expertise to provide written reviews of the paper. You will then either be given a Pass on the paper or will be asked to revise it in specified areas and resubmit. You will give a short presentation of this paper at the beginning of the oral exam. Your performance will be evaluated by the faculty present following the completion of the written and oral parts of the exam, when they evaluate your performance on the entire exam. Feedback from the written reviews of the paper will be provided to you by the MC&G Education Coordinator following the oral exam.

*Closed Book Written Exam* - The closed book written examination is a 4 hour exam consisting of 5 questions designed to assess your knowledge of topics in marine geochemistry and general oceanography relevant to your research. For each student, the General Exam Committee solicits appropriate questions from the faculty and compiles a draft of the exam. The committee checks the exam, and then meets to draft the final exam for each student. The exam is administered to all students of the class simultaneously; students residing in Cambridge may take the exam at MIT, while students residing in Woods Hole may take the exam at WHOI.

Following the written exam, you will receive scanned copies of your exam answers (for preparation for the orals) within 48 hours. Appropriate faculty members are given copies of the exams for grading. The General Exam Committee is responsible for ensuring that individual written exams are evaluated within 1 week of completion of the written exam. Prior to that point, you should not inquire as to your performance on the written exam. Upon consultation with the Written Exam Committee, and no less than 5 days before the oral exam, the Written Exam Chair prepares a brief summary, which will be passed to you, concerning your performance on the written portion. Feedback provided to you at this point will be of a general nature only, and not so specific as to provide expected answers to the oral exam. This is because the oral exam is meant to be a continuation of the written exam process, in which you have the opportunity to recover from mistakes that you have since recognized, or to show that you know more than your answer indicated. It is important that the Exam Committee provides feedback and information to all students that are consistent and uniform. No other discussion of your performance on the exam is allowed.

For example, you will be told when you have made a major error on a particular question, but will not be told what the error is beyond a one-phrase or one-sentence statement (e.g., "you made a mistake in your derivation of the advection-diffusion equation"). If a question was answered without error but was incomplete or otherwise weak, you will be advised to study the subject and be prepared for detailed questioning on the oral (e.g. "your answer to the dissolved organic carbon question was OK as far as it went but left out an important recent result"), but you will not be told the specifics to be covered. If there is a range of opinion on how well you have done on a particular question, you will be told of that difference of opinion and will be given a general sense of where the difference of opinion occurred (e.g., "some people liked your answer to the carbonate chemistry question, but one of the evaluators felt that you had not explained the significance to the fossil fuel problem"). Evaluators may use words of praise as long as it is clear as to whether they reflect their own opinion (e.g., "I thought that your answer to the gas exchange question was excellent") or are representative of all of the evaluators (e.g., "everybody thought that you had the best answer to the AOU/new production question").

*Oral Exam* - The oral exam, which typically lasts for one hour, is held at WHOI or MIT and is open to all interested faculty. In the oral exam, after your presentation of your research paper, you will be asked questions related to your research paper. You may also be asked follow-up questions on the written exams and participate in follow up discussions on related topics.

Possible outcomes of the first three portions of the general exam are: 1) an unconditional pass, 2) a pass with certain conditions requiring further study, 3) a fail with the recommendation that all or part of the exam be repeated, or 4) a fail. You will be informed orally of the outcome immediately after the oral exam. A written follow-up will provide more explicit information on conditions and recommendations that may be attached.

*Thesis Proposal* - The written thesis proposal, due on September 30<sup>th</sup>, should be a description of your research project that includes an abstract, an introduction to the problem/question, a summary of hypotheses and objectives, and a detailed plan of research. The thesis proposal may include an optional budget. An electronic (preferably pdf) copy of your proposal should be sent to the Graduate Admissions and Student Affairs Officer in the WHOI Academic Programs Office, the Education Coordinator, and the JP Administrator at MIT. The total length of the proposal, excluding figures, bibliography, and optional budget, should not exceed 15 pages (12-point font, double-spaced with 1" margins). The proposal is reviewed by members of the JP Faculty.

The thesis proposal defense will be scheduled in consultation with the Education Coordinator approximately 2 weeks after submission of the written thesis proposal. During the oral presentation of the proposal, you should provide a brief introduction, outline your major hypotheses, and discuss your proposed research including any preliminary results you may have. You are allowed 30 minutes for your talk. Your presentation will be followed by 30 minutes of questions on your proposed research from the faculty present. The thesis proposal presentation should be chaired by a member of the staff of MIT or WHOI who is not your research advisor. Responsibilities of the Thesis Proposal Chair may be found in Appendix III. This person is chosen by the WHOI MC&G Education Coordinator in consultation with you and confirmed at least two weeks prior to the defense. You should think about potential thesis committee members and invite those faculty members to participate in the thesis proposal defense.

All students are expected to complete the written and oral portions of the general exam by the end of their second Academic year. If you believe that you are insufficiently prepared, you may petition JCCO for an extension at least six weeks before the start of the exam. Your petition should include the reasons for your request and an estimate of the time you feel you will need to prepare for the exam.

If you entered the Chemical Oceanography Program with a Master's degree in Chemical Oceanography or a related field, you may choose to take the written and oral portions of the general exam in the spring of the first year. If this option is chosen, submission of the general exam research paper and its oral presentation may be deferred to the spring of the second year to allow sufficient time to conduct requisite research. Similarly, the thesis proposal defense may be deferred to October of the third year.

*Written and Oral Exam Committee* - The written and oral exam committee consists of the first year

students' Academic Advisors and the Education Coordinator. In the event of work at sea or other reasons why the Education Coordinator cannot complete these matters by that date, the responsibility is assumed by the JCCO Chair. The Education Coordinator is responsible for announcing the exam dates and for scheduling the rooms. Typically, one of the first year students' Academic Advisors will chair the written exam and the other will chair the oral exam. The Written Exam Chair is responsible for gathering together questions for creating the final draft of the exam. The Oral Exam Chair is responsible for moderating the oral exam and communicating the results to the student.

*Timing and announcement of written and oral exams* - The (~4 hours) closed book written General Examine is usually taken on the second Tuesday after MIT commencement. If special circumstances warrant it, the Education Coordinator may, in consultation with the General Exam Committee and students taking the exam, schedule the exam for a different date. The General Exam Committee will meet with students taking the exam in February to discuss any potential scheduling issues. It is expected that all second year students will take the exam at that time. If you believe that extenuating circumstances prevent you from participating in the scheduled exam, contact the Education Coordinator at least three months ahead of time.

The (~1 hour) oral exam will normally be taken on the Thursday or Friday 2 weeks after completion of the written exam. Depending on the number of students taking the exam in a given year, the oral exam may be scheduled over two days. You should not make travel plans that interfere with your availability on either of these days. Deviation from these dates will normally not occur; unavoidable changes will be announced by May 1 if they are to occur. Student requests to deviate from these procedures will be granted only upon written permission from JCCO.

## 4: Thesis

After passing the General Exam you will begin to work on a research topic under the supervision of your Thesis Committee. Preparation of the doctoral dissertation is carried out in close association with one or two faculty members you have chosen as thesis advisor(s). Within one month of completing your Thesis Proposal defense, you must form your Thesis Committee by selecting at least two additional faculty members (including at least one faculty member from both MIT and WHOI) to help guide your research and dissertation work. If appropriate, your Thesis Committee may include one additional member from outside the Joint Program. The names of Thesis Committee members should be submitted to JCCO for approval. Once approved, the names of the members of your Thesis Committee should be sent to the WHOI Academic Programs Office (Lea Fraser, x 2225, [lfraser@whoi.edu](mailto:lfraser@whoi.edu)) and the MIT Joint Program Office (Kris Kipp, 3-7544, [kipp@mit.edu](mailto:kipp@mit.edu)).

### Thesis Format

In general a thesis consists of four parts:

- (1) A historical review and setting of the problem;

- (2) Chapters developing the original contribution toward the solution of the problem;
- (3) A final summary of the work and its significance;
- (4) A bibliography.

You are encouraged to incorporate, as part of (2) above, published papers or manuscripts that have been prepared for publication, if they contain some part or all of your original contribution. If the published paper has been copyrighted, a variance of the copyright must be presented to MIT with the thesis.

MIT and WHOI have very specific requirements for preparation and electronic submission of the thesis. Detailed information can be found on the Joint Program website: <http://mit.whoiedu/thesis>. The WHOI Academic Programs Office has a pamphlet, “WHOI Thesis Specifications”, available in the Academic Programs Office. They have tried to incorporate MIT requirements in their document, but you should also check the MIT specifications at the MIT website: <http://libraries.mit.edu/archives/thesis-specs/>. If you have questions about these requirements, contact the WHOI Academic Programs Office or the MIT Joint Program Office.

## 5: Thesis Defense

There are four important deadlines that must be honored as you prepare for your defense and complete your thesis.

- (1) *Degree Application Deadline* - You must apply online to be on a specific degree list (June, September, or February) at MIT. This is done through WebSIS under “Online Degree Application” (<http://student.mit.edu/cgi-docs/student.html>). The application must be completed in the first week of the term in which thesis submission is planned. Accordingly, the June degree list requires submittal of your application the first week of February, the September degree list requires submittal of your application the first week of June, and the February degree list requires submittal of your application the first week of September. It is important to check the Joint Program Academic Calendar (<http://mit.whoiedu/whoiacademic-calendar>) for specific deadlines.
- (2) *Submission of Defendable Draft Deadline* – A defendable draft of the written thesis must be submitted to your committee (including the defense Chair), the WHOI Academic Programs Office, and MIT Joint Program Office at least **two weeks** prior to your scheduled defense.
- (3) *MIT Thesis Submission Deadline* – This is the date that you must submit the **final revised version** of your thesis following the defense to be on the September, February, or June degree lists. This is **not** necessarily the same deadline as the date recommended by your thesis committee for completion of revisions following the thesis defense, which may be earlier. MIT thesis submission deadlines typically fall in the first two weeks of the month preceding a given degree list (early-August for the September degree list, early-January for the February degree list, and early-May for the June degree list). Thesis submission deadline dates are given in the

Joint Program Academic Calendar (<http://mit.who.edu/who-academic-calendar>) and the MIT Academic Calendar (<https://registrar.mit.edu/calendar>). There is some flexibility in these deadlines that varies between departments at MIT. For students who are a part of EAPS at MIT, in exceptional circumstances, with full Thesis Committee approval, the candidate can seek permission for a Thesis Defense date as late as the MIT thesis submission deadline. No thesis defense after this date can be considered. For students who are a part of CEE at MIT, the final revised version of the thesis must be submitted 1 week after the MIT deadline published in the academic calendar to be on the February degree list, by the first Friday in May to be on the June degree list, and by the first Friday in August to be on the September degree list. Students should contact their MIT department administrators to confirm these deadlines.

- (4) *JCCO/Thesis Committee Deadline* – this is the deadline that your thesis committee will recommend to JCCO for you to complete revisions to your written thesis after your oral defense and submit the final version. Although it may coincide with the MIT Thesis Submission deadline, it may be earlier depending on when your defense is scheduled. The default period of time to make revisions following your thesis defense is two weeks, but more time may be recommended depending on the extent of revisions required by your thesis committee.

You are advised to keep these deadlines in mind when scheduling a date for your defense. In particular, it is important to account for the 2 or 3 weeks that may be needed to make revisions following the oral defense. Missing a thesis submission deadline could mean that you would be obliged to register and pay tuition for the next term. Approximately 30 days after the MIT deadline date, faculty committees meet at MIT to approve candidates for advanced degrees. At that time, if your corrected thesis is not at MIT you will not be recommended for a degree. If this happens you will have to be placed on the degree list for the following semester and will be charged minimum tuition for that semester.

It is critical that the WHOI Academic Programs Office and the MIT Joint Program Office know the time and place of the defense at least **two weeks** in advance of your thesis defense.

The thesis defense should be chaired by a member of the JP Faculty at MIT or WHOI who is not a member of your Thesis Committee. Responsibilities of the Thesis Defense Chair may be found in Appendix III. This person is chosen by the Education Coordinator in consultation with you and your thesis advisor(s).

The oral defense of the doctoral dissertation, which is scheduled by you and the Chair of the defense, should be held **at least two (2) weeks** after the electronic submission (preferably pdf) of the completed thesis to allow adequate time for staff members to review the thesis. The thesis must be submitted to both the WHOI Academic Programs Offices and the MIT Joint Program Office no later than two (2) weeks following the defense, unless major revisions are required. If major revisions are required, your Thesis Committee, through the Chair of the defense, will make a recommendation to the JCCO Chair for the deadline by which the final revised thesis must be submitted. The JCCO Chair has the responsibility to seek advice as rapidly as practicable from the JCCO and then set a deadline, communicate that deadline to you, the thesis committee and the Joint Program Director at MIT and Dean at WHOI. Failure to meet the deadline can result in

denial of further stipend and tuition support by either the Director of the Joint Program at MIT in consultation with the Department Head at MIT or by the Dean at WHOI in consultation with the Department Chair at WHOI. All other MIT policies and Joint Program policies with respect to continued registration also apply.

Each thesis defense will consist of three parts:

- (1) A public seminar (approximately 30 to 50 minutes) to present the principal findings of the thesis.
- (2) A brief (15-20 minutes at most) public question and answer period following the seminar, to be presided over by the Chair of the Thesis Defense.
- (3) A private defense of the thesis before all interested members of the JP faculty who have read the thesis and invited guests, to be presided over by the Chair of the Thesis Defense.

It is intended that the public presentation offers you an occasion for displaying your accomplishments as represented by the dissertation, and that it will be well attended by JP faculty, other students, employees, and any guests that you wish to invite.

Corrections or changes designated at your thesis defense must be made in the original and in all official copies submitted to the Academic Programs Office and your MIT department.

## **5: Who's Who**

The Joint Program is the responsibility of two different institutions with different primary purposes, administrative structures, and operating formats.

Massachusetts Institute of Technology (MIT) is an independent, coeducation, privately endowed university, and it is recognized worldwide for contributions to education and research in engineering and the sciences, and at the intersection of science, technology, policy and management. MIT brings to the MIT/WHOI Joint Program partnership the full range of educational opportunities and resources of a preeminent research university. Many programs of study and research focus on environmental processes on local, regional and global scales. The environment is now a major MIT-wide priority, and extensive intellectual and financial resources are devoted to it. The world's oceans are a key element of our environment and an important focus of research and teaching in several MIT departments. These studies encompass both the oceans and their interactions with other natural systems and with society.

Woods Hole Oceanographic Institution (WHOI) is a private, independent, not-for-profit corporation dedicated to research and higher education at the frontiers of ocean science. WHOI brings to the MIT/WHOI Joint Program partnership a broad group of scholars and technical staff, with strong interest and involvement in all major aspects of research and higher education focused on understanding the oceans, and the interactions of the oceans with the planetary habitat. In

addition, WHOI scientists and engineers have pioneered unparalleled access to the sea through expertise in sea-going operations and the development and deployment of technologies for collecting and interpreting data for oceanic processes and interactions between the oceans, the land and the atmosphere.

The Joint Program brings these two organizations together in a common cause, to provide the education and research program in the ocean sciences and engineering of the highest quality. By necessity there are a number of people and groups with responsibility for the successful operation of the program and we have listed them below. You will notice that there is considerable overlap in personnel and responsibility between several of the groups mentioned. We hope that this provides the checks and balances necessary to produce a Joint Program that is reasonably consistent from year to year and from discipline to discipline.

Dean, WHOI - The Vice President for Academic Programs and Dean at WHOI, Meg Tivey, has responsibility for all educational programs offered by WHOI. The Dean is a member of the WHOI Senior Administration, the policy making body of the Woods Hole Oceanographic Institution, and has full responsibility for the administration, financial welfare, and ultimate success of WHOI's role in the Joint Program.

Director of the Joint Program, MIT - Designated by the Provost and Chancellor at MIT, Ed Boyle is the Director of the Joint Program at MIT. He has overall administrative responsibility for the Program at MIT and serves as an advocate for the Program before the MIT administration. He is, in many ways, the counterpart of the Dean at WHOI.

Associate Dean, WHOI – Delia Oppo, as Associate Dean, is primarily responsible for Joint Program activities at WHOI.

WHOI Academic Programs Office - The Academic Programs Office (Clark 223) is the center for administrative support for education activities at WHOI. It serves as the office for admissions, student affairs, student accounts, registrar, and whatever else you may need. The people that will help you, in addition to the Deans mentioned above, are:

Leanora Fraser (x2225), Graduate Admissions and Student Affairs Officer (with primary responsibilities for the Joint Program)

Christine Charette (x2848), Executive Assistant to the Dean (financial responsibilities for Joint Program students)

Julia Westwater (x3379), Registrar

Martha Bridgers (x2971), WHOI Housing Coordinator

MIT Joint Program Office - The MIT Joint Program Office, under the direction of Kris Kipp (617-253-7544), provides program-wide administrative focus for the five MIT departments involved in the Joint Program and coordinates with the WHOI Academic Programs Office. Kris Kipp is the Administrator of the Joint Program at MIT and is always available to students for consultation on problems or questions regarding the Joint Program. Other administrative support (e.g. graduate appointments, office assignments) is handled by the Department Administrators

(Megan Jordan in EAPS, phone: 617-253-3380; Kiley Clapper in CEE, phone: 617-253-7119).

Department Chairs/Heads, WHOI and MIT - Department Chairs/Heads have overall responsibility for the education activities of their departments. Their authority is vested in the individuals that they, in consultation with the Dean at WHOI and the Joint Program Director at MIT, appoint to the Joint Committee on Chemical Oceanography and as the WHOI MC&G Education Coordinator. Bernhard Peucker-Ehrenbrink is the Chair of the Department of Marine Chemistry and Geochemistry at WHOI; Rob van der Hilst is Head of the Department of Earth, Atmospheric, and Planetary Sciences at MIT; and Markus Buehler is Head of the Department of Civil and Environmental Engineering at MIT.

Joint Program Advisory Committee – This committee consists of the Department Chairs at WHOI and Department Heads of Joint Program active departments at MIT. The committee advises the Director of the Joint Program at MIT and the Vice President for Academic Programs/Dean at WHOI and provides overall advice for the Joint Program.

Joint Committee on Chemical Oceanography - JCCO oversees the Joint Program in Chemical Oceanography and is responsible for your progress from admission to signing off on your thesis. JCCO keeps an eye on exam procedures, admissions, course offerings and quality, and produces this handbook. Current members are Phil Gschwend (MIT), Colleen Hansel (WHOI, Chair), Shuhei Ono (MIT), Mak Saito (WHOI) and Roger Summons (MIT), in addition to the WHOI MC&G Education Coordinator Jeff Seewald.

Joint Program Committee - The JPC is co-chaired by the WHOI Dean and the Joint Program Director at MIT and includes the Chairs of the Joint Committees in each discipline (JCCO, JCBO, JCPO, JCMG&G, JCAOSE) plus the Associate Dean (WHOI). They are responsible for education policy, admissions, and allocation of program resources across the Joint Program.

WHOI Educational Council - The Educational Council (about 15 people) meets regularly to advise the Dean at WHOI on educational policy. Members represent each department and the student body. The Council serves as the Executive Committee to the Educational Assembly.

WHOI Educational Assembly - The Assembly reports to the WHOI Director and Trustees and consists of the WHOI Scientific Staff, selected Technical Staff, and Student Representatives from each discipline. Serving as a faculty body, it meets several times a year to debate and recommend educational policy at WHOI. The Assembly is chaired by the WHOI Vice President for Academic Programs and Dean.

WHOI Marine Chemistry and Geochemistry Education Coordinator (J. Seward Johnson Chair) - Jeff Seewald, the present Coordinator, represents the Department of Marine Chemistry & Geochemistry at WHOI Educational Council meetings and also assigns Academic Advisory Committees and Exam Committee members in consultation with the Chair of JCCO. The Education Coordinator will also set the general schedule of your exams and Thesis Defense in consultation with you and your Advisory or Thesis Committee. The Education Coordinator can also act as an intermediary for students if necessary.

Academic Advisory Committee - Each incoming class is assigned an academic advisory committee consisting of two faculty members from the MC&G department at WHOI and one from MIT. During the two years leading up to your general exam, this committee will help you decide what courses to take and will try to guide your exploration of potential research topics. Your committee can also help you find advisors for lab projects during your first years in the Joint Program. You are encouraged to seek out your advisors and talk to them. Remember that you are free to talk to all of the staff about questions or problems you might have. If you feel it necessary to change the members of your advisory committee, it is possible to do so with the approval of the MC&G Education Coordinator and Chair of JCCO.

Exam Committees – The members of the first year students' Academic Advisory Committee are responsible for administering the general exam.

Thesis Committee - The Thesis Committee is selected by you and your Thesis Advisor(s) and must be approved by JCCO. This committee is responsible for advising you on your thesis research and monitoring your thesis progress. You should meet with your Thesis Committee twice a year to keep them up to date on your progress.

## Appendix I

### Graduate Student Research and Teaching Responsibilities

The goal of the Joint Program in Chemical Oceanography is to educate scientists; therefore research experience in laboratories is an integral part of the education of pre-generals students. Depending on the source of support for the student, this experience is attained slightly differently:

- (1) For students supported as Research Assistants: The principal duty of a Research Assistant is to contribute, under supervision, to a program of departmental or interdepartmental research. The appointment is made with the understanding that the required services will be such as to contribute to the professional training of the graduate student. Through project work, the assistant gains increased facility in organizing work, in applying new experimental techniques or analytical tools to real problems, in technical writing, and in oral presentation, which will be of inestimable value for any career path. Research Assistants are expected to devote at least 50 hours per week on average to academic activities (including the time devoted to classes and their research assistantships). This requirement is normally met by registering for approximately 36 units of regular subjects, which may include "Special Problems" research projects, and by devoting 20 hours to RA duties. The latter may include additional units of regular subjects. The appropriate subjects are determined by consultation between the student and the student's research and academic advisors, and must have their approval.
- (2) For students supported as Teaching Assistants: The principal duty of a Teaching Assistant is to contribute, under supervision, to a program of classroom education. The appointment is made with the understanding that the required services will be such as to contribute to the professional training of the graduate student. Interacting with students in the classroom, grading their problem sets and exams, and discussing subject matter during office hours, the assistant gains increased facility in organizing work, in oral presentation and communication, and motivational skills which will be of inestimable value for any career path. A Teaching Assistant is expected to devote at least 50 hours per week on average to academic activities (including time devoted to their classes and teaching assistantships). This time includes 20 hours per week of Teaching Assistant duties. Normally a TA should be registered for about 36 units of subjects, which may include "Special Problems" research projects.

For both RAs and TAs, the temporal distribution of work may be highly non-uniform; the requirement is that the appropriate average level of effort during the term be achieved. Also, both TAs and RAs are allowed normal MIT/WHOI holidays and can take a 2 week paid vacation at a time arranged with the approval of their research advisor.

- (3) Fellowship and traineeship holders are similarly expected to devote at least 50 hours per week on average to academic obligations including a research project approved by their academic advisors. The subject unit requirements are the same as for those holding TAs or RAs.
- (4) If you accept a graduate assistantship (whether supported by research, teaching, or fellowship funds), you should understand that you are expected to exhibit a professional attitude toward your work, and to take seriously your responsibility for the conduct of the Program's research and/or teaching functions. Each semester your performance is evaluated by the faculty. Poor performance may result in a warning or in termination of your assistantship. In addition to satisfactory performance of your assigned duties, your academic performance and progress are

considered in the award/continuation of your graduate assistantship, traineeship or WHOI or MIT granted fellowship. National and international fellowships have their individual requirements for continuation.

## Appendix II

### Master of Science Degree

Although there is no formal program resulting in an M.S. Degree in Chemical Oceanography, the decision that a student should terminate their studies in the Joint Program with an M.S. degree can be made for a variety of reasons (e.g. a student's personal reasons for not proceeding to a Ph.D., unsatisfactory performance in formal classes, or in the General Examination, etc.). The point at which this decision is made will depend on each specific case; however, students should typically plan to complete the requirements for a Master's degree within a year of the decision.

The requirements for a Master's Degree are as follows:

- (1) Completion of at least 66 units worth of formal subjects (exclusive of thesis units; 44 units at a graduate level, and 34 units in a given field). It is expected that, in most cases, much of this course work will have been completed prior to the decision that a student will terminate with a Master's Degree.
- (2) Completion, and oral presentation of, an acceptable Master's thesis, based on original research by the student. The Master's thesis must make an original contribution to a particular field of study.

Conduct of Master's Degree Research:

As soon as the student has determined a research topic through discussion with their Academic Advisor(s), a Thesis Committee consisting of at least one member from each of the partner institutions will be formed (exceptions must be approved by JCCO). The student will take responsibility for keeping all members apprised of their progress. At the beginning of her/his research, the student will also submit a short abstract of the proposed thesis and the members of the Thesis Committee to JCCO for approval.

The M.S. thesis will consist of:

- (1) Abstract
- (2) Historical review and background of the problem
- (3) Presentation of the original research and its contribution toward solution of the problem
- (4) Summary
- (5) Bibliography

Conduct of the M.S. Thesis Presentation:

A public presentation of the research represents an opportunity for the student to communicate the result of their research, and brings closure to the scientific process. The thesis must be submitted to the Thesis Committee at least two weeks prior to the public presentation. In consultation with the student, the Thesis Advisor will schedule the presentation, and inform the Academic Program Office at WHOI and Joint Program Office at MIT of the date, time and

location. Those offices will then advertise the presentation.

The presentation will be chaired by the Thesis Advisor and will consist of two parts: (1) a public presentation (typically about 45 minutes long) of the results of the research, followed by a brief public question and answer period; and (2) an informal, private discussion of the research results between the student and the Thesis Committee. Other MIT faculty and WHOI Education Assembly members who have read the thesis and informed the defense chair of their interest in participating may also participate in the private discussion, but do not participate in the Thesis Committee's deliberations on the acceptability of the thesis.

Following the private discussion, the student will retire from the room and the Thesis Committee will determine the acceptability of the thesis and recommend any changes. Once any recommended changes/revisions have been completed, the student's Thesis Advisor will sign the thesis signifying its acceptance.

## Appendix III

### Responsibilities of Chairs of Thesis Proposal Defense and Thesis Defense

The Chair of the Thesis Proposal Defense presides over the question and answer period following the thesis proposal defense seminar. Following the defense of the thesis proposal, the Chair of the defense should send a memo to the Chair of JCCO reviewing what happened at the thesis proposal defense, including who was present, any concerns raised, and a summary of comments made and suggestions that were given. The draft of this memo should be circulated to the faculty present at the defense to achieve consensus on the content of the memo. The Chair of JCCO will send copies of the final memo to the student, the advisor(s), the MIT JP Office and the Academic Programs Office at WHOI.

The Chair of the Thesis Defense presides over the brief public question and answer period following the thesis defense seminar, and then presides over the private defense of the thesis before all interested members of the faculty and staff plus invited guests. Following the thesis defense, the Chair of the defense should send a memo to the Chair of JCCO with the following information:

- The date and time of defense and whether the Ph.D. was successfully defended.
- Who was present (committee members and others who stayed for questioning).
- An explanation if any committee members were NOT present (and if so, how did/will that committee member provide input).
- Any comments made about the thesis and defense presentation (e.g., glowing remarks, concerns, etc.)
- The anticipated time that it should take the student to complete revisions. The default amount of time is 2 weeks after the defense date. If more time is needed, the committee needs to decide on a time limit (e.g., 4 weeks from date of defense) and provide a brief justification of why more than 2 weeks is needed. The date for submission of the final version of the thesis should be stated in the memo.
- Either as a postscript to the memo or within memo, general recommendations or specific comments that the student needs to consider in revising the thesis should be listed (usually done by chapter).
- The names of committee member(s) responsible for approving the revisions prior to submission of the final thesis.

## **Appendix IV**

### **Switching Advisors**

A student or the student's advisor may recommend a change of advisor for a variety of reasons, such as the departure of the advisor to another institution, a shift in research interests, or an ineffective student/advisor relationship. Generally, switching advisors should involve discussion with the Education Coordinator, who can facilitate discussions with the initial advisor, help the student to identify a new advisor, and provide guidance toward developing a transition plan.

As soon as it is clear that an advisor switch is desired, the WHOI Dean and/or MIT JP Director (and Associate Directors when necessary) must be consulted, either directly by the student or through the Education Coordinator, in order to help with the transition plan. The transition plan will consider how best to wrap up the research the student has done with the initial advisor, as well as the timing of the move to the new advisor's lab. In cases where advising shifts between WHOI and MIT, it is necessary to notify both the WHOI Dean and the MIT Director of the MIT/WHOI Joint Program. Once a new advisor who is committed to taking on and finding funding for the student has been identified, and once a transition plan is worked out, the JCCO will give official approval to the change.

JCCO will work with the student and new advisor to determine whether adjustments to the timeline are warranted. For students who have already advanced to candidacy, JCCO will consult with the student and advisor and will determine whether the change will result in a substantial shift in research focus. If so, the student would need to prepare and defend a new thesis proposal.

## Appendix V

### Deadlines (NOT target dates) for steps to Ph.D. within the Joint Program in Chemical Oceanography

[Note that years run either Sept 1 – Aug 31, or Feb 1 – Jan 31]

Step	Deadline if Enter in Summer or Fall	Deadline if Enter in January	Extension Request Date
Summary of proposed pre- generals research paper	May 31, year 1	Oct. 31, year 1	
Identify general exam topics	Sept., year 2	Feb., year 2	
Generals research paper	April 30, year 2	Oct. 31, year 2	
General exam - written	mid-June of year 2	Jan. of year 2	3 months prior
General exam - oral	2 weeks after written exam, late-June/early- July, year 2	2 weeks after written exam, late-Jan./early- Feb., year 2	
Written thesis proposal	Sept 31, year 3	April 30, year 3	2 months prior
Thesis proposal presentation	Oct. 31, year 3	May 31, year 3	2 months prior
Thesis committee approval	Nov. 1, year 3	June 1, year 3	
Request to extend >5 years	May 31, year 5	Oct 31, year 5	3 months prior
Thesis draft submittal	mid-Aug, year 5	mid-Jan, year 5	6 weeks prior to existing extension end date
Thesis defense	late-August, year 5	late-Jan, year 5	
Final thesis submittal	early-Sept, year 6	early- Feb 12, year 6	Thesis committee can request additional time to complete thesis