

Information for Graduate Students

Dartmouth College Mathematics Department

Graduate Program Committee

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1 Introduction and Caveats

This document is intended to be a leisurely yet detailed look at — and an explanation of — your involvement with the graduate program over the next five years. If you are in a desperate hurry to see all the requirements, read the first two sections of the appendix, Chapter 11, but for more context, read this document first. A handy reference is the timeline summary at the end of Chapter 2 which will make more sense when you have read that chapter.

Early in 2010, the Department undertook a major revision of the structure of the graduate program, which dramatically affects the first two years of graduate study. With a change of this magnitude we recognized that we could not anticipate all contingencies, and understood that the guidelines set down in this document would require tweaking as we worked through implementation of the new features.

Thus this document represents our best approximation as to policies, deadlines, and procedures to be followed by you in this program. Any questions that are not suitably answered should always be referred to the GPC (Graduate Program Committee) for clarification.

2 Timelines by class

2.1 Year 1

Your introduction to graduate school begins with basics: getting an ID card, an office assignment and keys, and perhaps a cup of coffee or tea in the graduate lounge where you can (re)acquaint yourself with some of the older graduate students. Your first real stop should be 102(C/D) Kemeny where you will meet Tracy Moloney (the Department Administrator) and Amy Potter (the Graduate Program Administrator); you cannot survive in the program without their efforts on your behalf. Amy will have keys and either of them will push you out the door (presumably in the right direction) in search of the ID office. Note that you will need your ID card to get into Kemeny late at night or on weekends, borrow books from the library, as well as to gain access to places like the gym and fitness center.

You now officially exist at Dartmouth; what's next? The main goal of the first year is to pass six core courses, two in each of 3 core areas: algebra, analysis, applied math 1&2, and topology, and then to pass (near the start of summer term) a written certification exam covering the material in these six courses. To start planning your career as a graduate student, you need to meet both with your individual advisor as well as the departmental advisor to graduate students [Orellana in 20-21]. The idea is for you to have a long discussion about your background (including advanced courses you may have taken or background material you lack), and set up a plan of study (which will be modified as necessary) which looks forward through the first two years. Courses, including qual courses, topics courses, and reading courses, as well as research seminars will be considered, and a timetable discussed which will plan the dovetailing of qual deadlines and available courses. In particular (see the

section on quals for details), the coordination of course work supporting the oral qualifying exams requires some advanced planning. The student will summarize this plan in writing, which will be signed by the student and the graduate and individual advisor and filed with the Graduate Program Administrative Assistant, Amy Potter. It should be revisited each term, and updated as necessary.

An important outcome of this planning process should be the decision of whether you will attempt the certification exam just before the start of fall term. If you have a reasonable chance of passing the exam in at least one of the three areas of algebra, analysis, or topology, taking this exam may help inform your choice of courses for the first year.

After the start of term, you should meet with your individual advisor minimally once or twice per quarter, and of course as often as you feel the need. You can talk with your advisor about any problems or questions you may be having, in class or out of it. Your advisor not only can give you advice and encouragement, but help find resources to help you with any difficulty. You should talk to the graduate advisor at least once per term, to update your plans and discuss any mid-course corrections which are needed. When there are major changes you should update your plan of study which is on file, since the GPC uses this plan to assess your progress in the program.

In addition to the core courses whose contents form the basis of questions on the written certification exam at the end of the first year, topics courses are also offered each term. They provide a natural opportunity to explore many new subjects as well as gain insight into what it might be like to have a given professor as a thesis advisor.

A number of changes have been made to our curriculum to reflect the growth of applied mathematics in the department. As of Fall 2017, there will be 10 core first-year courses: two each in algebra (101, 111), analysis (103, 113), and topology (104, 114), and four in applied mathematics (106, 116, 126, 136). In terms of the written certification exam given at the end of the first year, students will choose three of five 2-course core areas, algebra, analysis, applied mathematics 1&2, and topology, in which to take their written exam. The choice of which three areas are to be examined in no way constrains the eventual research path a graduate student may take, but of course in preparation, you must take (at least) the six core courses covering three subject areas. It is hoped that students will choose to take more than the required six courses.

The offerings of first-year courses typically will be:

- Fall: Algebra 1, Analysis 1, Applied 1;
- Winter: Algebra 2, Applied 2&3, Topology 1;
- Spring: Analysis 2, Applied 4, Topology 2.

Your schedule should have at least two core courses in each term, though the third can either be another classroom course, or can be a supervised reading course (127) or supervised independent project course (148) in which the student pursues a topic to advance their progress toward certification. Any core course exempted by the graduate advisor will be replaced by another classroom course. **As a fourth course**, every student in each of their

first two years needs to register for one offering of Math 107 (Supervised Tutoring) in the second term that they TA that year.

An important discussion which sometimes takes place is whether the entering student might or will require **zeroth year status**. Consideration of this status is made by the Graduate Program Committee (GPC) in consultation with the graduate advisor and the student's instructors **by the end of the first term**, based on perceived need for the student to take some additional background courses coincident with or even prior to taking the standard graduate level courses. If there is a need for additional courses, there will almost certainly be an impact on the standard timetable for passing qualifying exams, and a new schedule of deadlines is worked out. Zeroth year status is only intended for students with deficiencies in their background, not for students who may simply have difficulty in their courses, though certainly extreme difficulty early in the term may be a signal for the course instructor to engage the graduate advisor in a discussion of zeroth year status.

What else is on the horizon? In the near view are your courses and written certification exam, and in the mid view are your oral qualifying exams. There is an entire section of this document devoted to qualifying exams, so we shall be brief here. The typical course schedule listed above puts you in good stead to take the written exam, and presents some early opportunities to explore topics for your oral qualifying exams. These exams can be on topics which overlap with the core, but are more advanced, and generally are in an area(s) in which you want to do research.

Other topics in upcoming sections include:

- TA responsibilities (two courses each year)
- Seminars and Colloquia
- Topics courses and area of specialization
- Grades: Are they important?
- Time management and perspective

Let's talk a little about time management and perspective. While you no doubt developed some time management skills as an undergraduate, graduate school presents new demands including new perspectives. As an undergraduate, you took a series of courses and via final exams were responsible only for their individual contents. As a first-year graduate student, you take a series of courses in each of three core areas, and are responsible not only for assimilating their combined discrete facts, examples and proofs, but also the integration of ideas that span these courses.

Learning mathematics is an iterative process. Each new topic must be integrated with old ones, and each pass at an old topic reveals a deeper layer enriching your understanding by making new connections to other ideas you already know something about. Many notions are very confusing the first time through. As an undergraduate you may have found linear independence of vectors confusing, but later came to view linear algebra of finite dimensional vector spaces as completely elementary. Then you meet free modules and all the standard linear algebra theorems seem to go wrong. Of course you couldn't appreciate how pathological free modules could be unless you understood vector spaces in the first place. As another

familiar example, we learn calculus first, then real analysis, then study differentiable manifolds, absorbing first the bare mechanics of calculus, then the reasons, proofs, and larger vista of euclidean metric topology, and finally move on to an even more general setting.

Students will sometimes ask to be exempted from core courses like 111 (Ring and Galois theory). Unless you have done very well in that area when you tried the written certification exam upon entry, it is probably a poor idea. Even if you have covered the material once, a second pass will afford the opportunity to peel back another layer and obtain a better understanding of the connections qual examiners like to probe. The person teaching the course may well be one of the people who have contributed problems for your certification exam, so you can see his or her perspective on the subject and get a sense of the kind of questions that might be posed. Not taking (or not retaking) the course puts you entirely on your own for learning or review, which generally means obtaining only an understanding of the basic facts and mechanics.

In your first year, the responsibilities you have to juggle include:

- Course work (understanding material, homework, exams)
- TA responsibilities (2 terms; 10-15 hours/week)
- Seminars: Colloquia, Graduate Student Seminar, Research Seminars (2 - 4 hours/week)
- Certification exam preparation

As you can see, in terms when you are TAing or beginning to prepare for your written certification exam, the time available for course work is diminished, so careful planning is required. As a first-year student, the only hard deadline you face is being prepared for the written certification exam, given just before the start of summer term. If you're thinking it will be difficult to make that deadline, you need to be talking to lots of people to help you reprioritize.

The Written Certification Exam: This exam represents the culmination of your efforts in the first year; it is given just before the start of summer term. Simply put, the exam covers the content of the six courses comprising the three core areas (pure and/or applied) which you have chosen, but it should be thought of as slightly more than a cumulative exam. For example, a group theory problem could be presented in the guise of Galois theory, or best addressed via the structure theory of finitely generated modules over a PID. None of these connections should come as a surprise, but exam problems can have solutions whose tools span more than one course. The one truth you will realize as you progress is that mathematics is highly interconnected, and often the most interesting and deepest mathematics arises from unexpected connections. The certification exams from previous years are available online: <https://math.dartmouth.edu/graduate-students/current/syllabi/>.

Your goal is to pass this exam at the start of summer; it is our expectation that you will. To do so, you must demonstrate proficiency in each of the three core areas you have chosen. Students who do not demonstrate proficiency in one or more areas, but who have been making satisfactory progress in their course work, will be allowed to retake the exam at the end of summer term.

Satisfactory progress is assessed largely by considering the internal course grades you have received in the first year (see §6 on Course Grades). Students are presumed to making satisfactory progress unless notified otherwise by the GPC. Also, students will only be asked to retake the portions of the preliminary exam that they did not pass the first time. Failing to pass a second time (at the Ph.D. level) will result in termination from the Ph.D. program. A student in this position who has passed the written exams at a Master's level is encouraged to stay through the fall term to see whether they can complete the requirements for a Master's Degree (cf. §6).

Remember: Your instructors are here to help you; see them in office hours to resolve issues with lectures as well as homework problems. The Graduate Advisor, the Graduate Representative and GPC are here to help you with broader issues; talk to them. While your fellow graduate students can be supportive and this support also can be instrumental to your success, they are not the ones who are assessing your progress in the program, so make a point to talk to the faculty associated to the graduate program.

2.2 Year 2

It is now summer. Hopefully you have just passed your written certification exam. If not, in addition to working towards your oral qualifying exams, you need to intensify your efforts to pass the written exam when it is next offered just before the start of fall term. You also must update your written plan of study and have it approved by the graduate and your individual advisor. If you have passed your exam, you can set your sights on the two qualifying exams.

Your deadlines for passing these oral exams are:

- First qual: by the sixth week of winter term
- Second qual: by the sixth week of spring term

Let us say that again. These are the deadlines for passing these exams. Given the rules regarding quals (see the section on qualifying exams in this document), you should be aiming to attempt the qual at least four weeks before the deadline!

Moreover, you should not prepare for these exams serially since for most of you, you will have two terms between passing the written certification exam and the first qual deadline, while only one term between between the first and second qual deadlines. You should have an idea what both qual areas will be, and have talked to your committee members well in advance to set the syllabus for those exams.

Let's take stock of where you are. You have taken six core courses, three additional courses, and are looking at the summer and fall offerings to help support your effort towards quals. A few general comments are in order. Your oral quals are intended to prepare you to do research. To that end, you should be thinking hard about potential advisors and those people should be on your qual committees. Indeed, advisors may have a great deal to say about which quals are appropriate. For example, someone wanting to work in algebraic number theory may well be advised by their potential advisor to pass quals in algebra and number

theory. Yes, even though algebra was one of the core areas, your qual will go more deeply into this area. Someone wanting to do applied mathematics may take two quals both in applied math, each focusing on different aspects. How can you make effective decisions? Talk to your potential committee, get the committee approved, learn what their expectations are and what you should do to prepare.

You have a great deal more flexibility in your choice of courses this year, though you are required to take at least four classroom courses this year, supplemented by reading courses (127 and 137 as a second course), which can be used as a mechanism for structured and supervised preparation for your quals and for investigation of your thesis research area. Reading courses not only expose you to new areas of mathematics for enrichment and as potential areas of research, but also allow you one-on-one time with potential advisors. This is someone with whom you will work closely for three years; it is good to have some rapport with them.

Indeed, even the first year is not too soon to be thinking about potential advisors and research areas. Perhaps your courses are helping you find areas of interest and faculty in those areas with whom you would like to work. Perhaps you should broaden your attendance at research seminars both in areas of interest and in areas of potential interest. Finding an advisor is a two-way street; your advisor is going to want to have some sense that you are interested, motivated, and hopefully would be a good fit with whom to work. You also will need a secondary advisor; he or she need not be in the same research area (though often is), but should be someone who you want to be a part of your annual meetings with your advisor, and who can understand expectations between you and your advisor. The secondary advisor will also be a natural choice to ask for a letter of recommendation when applying for jobs.

It is probably a good idea to talk early to potential advisors even with basic questions such as “Do they plan to take on new students?” or “How many students will they take on at a given time?” You may want to make them aware they are on your short list of potential advisors should your own interests continue to develop. Maybe this interaction alone will spawn suggestions for reading courses.

TAing should be old hat by now, though you may be mentoring a first-year graduate student in the role, and don't forget to register for Math 107 (as a fourth course) in the second term you TA.

Time management skills are crucial this year, but when you can spare a few moments, now might be a good time to do a light reading of Mark Tomforde's guide (<http://www.math.dartmouth.edu/graduate-students/current/guide/>) which offers a great deal of insight into the entire process of choosing an advisor, successfully writing your thesis, and thoughts for how to sustain a research program.

By the end of spring term, you need to have passed both oral quals at the Ph.D. level (actually by the end of the sixth week of spring term), and received at least two thesis-ready passes from among your four examiners. You then need to obtain the advisor approval form and get your advisor and secondary advisor to sign it. Once returned to Amy, you should be in good shape for advancement to candidacy.

2.3 Year 3

It's summer again; you have advanced to candidacy, and for a brief moment all is right with the world. You have passed one of the two major hurdles in your quest for a Ph.D. Now the only hard task remaining (grin) is to write an acceptable thesis.

First up; the teaching seminar. Assuming you have successfully advanced to candidacy, you are eligible (and required) to take the teaching seminar. Formally you register for both 147 and 148, and a third course (156 or 157) as appropriate. In recent offerings, the seminar has been condensed to an intensive course lasting six out of the ten weeks of summer term. While the teaching seminar will keep you quite busy, most thesis advisors (since you've advanced to candidacy, you now have a thesis advisor) will still expect some degree of interaction with you during this period.

The teaching seminar is a highly visible centerpiece to our graduate program which distinguishes our program from the vast majority. It is taken seriously by the department, and hopefully by you as well. As with many things in life, its value will increase as you begin to teach courses on your own and grapple with the dynamics in the classroom while trying to carry out your plans.

Generally, you will have three teaching opportunities as part of the graduate program, one in each of your third, fourth and fifth years, although in unusual circumstances, teaching in the fifth year may be replaced by a flexible fifth-year teaching experience described below. Register for Math 149 during each term in which you are teaching. As with all temporary and junior faculty in the department, you will have a course supervisor for each course you teach, with whom you must discuss and obtain agreement on your choice of textbook, syllabus, and grading scheme. In addition, you must show your course supervisor drafts of all exams (prior to them being given), and consult with him or her about the assignment and distribution of final grades. Hopefully you will also take advantage of your supervisor's experience to engage in broader discussions should unexpected issues arise with the class. Beyond the formal oversight by the course supervisor, you will also have a teaching mentor whose job is to advise and assist you as an instructor regarding both teaching and development as a teacher. For students teaching their first course, the teaching mentor will at a minimum review the first week's worth of lesson plans and visit at least three classes throughout the term. Classroom visits will be preceded by a review and discussion of the objectives and lesson plan for the day and followed by a discussion of how the class went. The teaching mentor may also (if they and the course supervisor wish) replace the course supervisor in reviewing drafts of syllabi, exams and so forth. You should also make a point to ask the Teaching Evaluation Committee to visit your class (optimally in the second week), both for feedback for you, and to write a formal review which can be used for part of a teaching letter when you apply for jobs.

While the teaching seminar and your first teaching assignment seem like they fill a large part of your third year, it is important to remember that the most significant requirement separating you from a Ph.D. is your thesis. You should meet at least weekly with your

advisor. You will no doubt be doing a lot of reading and it is important to discuss it and gain your advisor's insight on what you read. Your primary goal is to get a problem, assimilate the tools necessary to begin to chip away at it, and to start that work as soon as you can. You may also want to have discussions with your advisor about what kinds of jobs you are interested in — especially if you are not that excited about an academic career — and what you can do to strengthen your background and future job applications. Your advisor may suggest different strategies if you are interested in industry, post-doctoral positions, or a tenure-track teaching position. For starters, you might consider DCAL workshops <http://www.dartmouth.edu/~dcal/>, and specialized conferences to attend or at which to speak.

Remember, that during years 3 - 5, you are required to take a total of 8 classroom courses, with the proviso that a student whose accumulated total falls behind 3 classroom courses per year would have to petition the GPC for an exception. Such exceptions would only be granted if there was a plan in place to make up the deficit the following year. And neither teaching your own course nor the teaching seminar counts as one of the classroom courses. This is a time for enhancing your mathematical background. The broader your background, the more opportunity you will have for seeing connections between different areas of mathematics. And let's face it, someday you may have to teach a version of the course you are taking; it is very nice to have a detailed set of notes to serve as a starting point.

In late summer or early fall, you have your first annual meeting with your advisor and secondary advisor. You write up a statement indicating your current plans, and what you have done. The three of you discuss the document and your advisor offers his or her perspective on how you are doing and perhaps his or her expectations. A summary is produced, which is included in your file and forwarded to the GPC for the general department discussion of graduate students' progress and continuation of their funding.

Your first teaching experience will take a lot of your time, but research will take a great deal more. Your (minimal) goal should be to have your results completely in hand by the end of the summer going into your fifth year. This way your letter writers have real content to talk about in describing your potential as a researcher.

You should be attending research seminars and beginning to speak in them. If you haven't obtained a working knowledge of \LaTeX , now is a good time. You can hone your skills by typing up small snippets which will eventually form pieces of your thesis. When time for writing up the thesis finally comes, you can get a template from the current graduate student information page on the department web site:

<https://www.math.dartmouth.edu/graduate-students/current/dcthesis.zip>. This template conforms to current rules from the graduate office concerning format.

2.4 Year 4

It's summer again. Your advisor is pushing you; you don't sleep at night anymore, and yet this is the most important year of your graduate career. This is the year when you make significant strides towards the resolution of your thesis problem(s).

You are meeting regularly with your advisor, telling him or her each week what successes you have had, or approaches you have tried, but which failed. You discuss your progress, bandy about new ideas and approaches, and leave each meeting ready to go at it again.

Once again in late summer or early fall, you need to arrange a meeting with your thesis and secondary advisor. As before, you prepare a document indicating your progress and plans, and where you feel you are in the process. The three of you discuss your progress, express expectations, and once again you write a summary which is included in your file and forwarded to the GPC for the general department discussion of graduate students' progress and continuation of their funding.

Going to seminars, giving a few talks, maybe going to some relevant conferences (where you can talk about your work in progress, meet some other people in the field, and renew your enthusiasm for research) are all worthwhile activities.

You will teach your second course for the department. In spring, your advisor will forward an assessment of your progress to the department for consideration of fifth-year funding. Students who have been making reasonable progress are funded.

You need to think about your fifth year teaching requirement. Generally, you will be assigned a course to teach, but in unusual circumstances this will not be the case, and you need to think about an alternative teaching experience, which might start as early as summer term! You need to make a proposal, get a faculty sponsor who can oversee it, have them approve it and submit the proposal to the GPC for final approval. See the section on fifth-year teaching for details.

If you have not yet established a personal web page on the math server, now is the time to do so. You have a budding professional image which you need to advertise. You have taught one or two courses; you have a research topic and advisor; you may have some publications. Keep this site reasonably professional; you want prospective employers to look at it, and you want Google to return a link to this page with a higher priority than your latest YouTube video.

2.5 Year 5

It's summer again. A glimmer of light impacts your eyes blood-shot from long days and nights of working on your thesis; progress has been made. You have some results. Maybe you are starting to write things up; maybe you still have some hard pushing yet to do, but there is that glimmer of light.

You schedule your final official joint meeting with advisor and secondary advisor in late summer or early fall and get a serious assessment of your progress towards finishing in the spring.

You need to start thinking about jobs, cover letters, teaching statements, research statements, interviews. You should draft these documents when you need a break from your thesis and show them to faculty who can critique them. You have thought about your thesis committee; after all, probably many of them are writing letters of recommendation for you. You need a committee member from outside of Dartmouth; consult the graduate office for current rules, and consult your advisor. You did ask people to write letters for you? You have reminded them? You have verified that copies exist in Amy's folder?

Fifth year teaching experience is under control.

Note: It is now department policy, that no student may even schedule their thesis defense until all other requirements for the Ph.D. have been satisfied.

You have submitted an abstract for the joint meetings, and perhaps have filled out the forms for the employment register. Your cover letters for jobs did say you would be at the meetings and happy to meet with interested parties, right?

You are now \TeX ing your thesis (actually you have been all along), and your advisor is vetting it. You are filling in the gaps that have recently been found. You have scheduled your thesis defense when everyone can come. You will provide a final draft of your thesis to all committee members no later than three weeks before your scheduled defense.

Oh, and remember to breathe.

2.6 Timeline Summary

Year 1	Year 2	Year 3+
<p>Late Summer</p> <ul style="list-style-type: none"> Settle in; get your keys and an ID Attempt the written certification exam if prepared in at least one area. Meet with graduate advisor and graduate representative; make course choices for fall and plans for subsequent terms. Take 6 classroom (non-reading) courses this year. 	<p>Summer</p> <ul style="list-style-type: none"> Meet with graduate advisor; review course plans Develop qual plans: Deadline for having passed first qual is second week of the winter term. Got a committee? Met with them? At least four classroom courses this year. 	<p>Summer</p> <ul style="list-style-type: none"> Requirement: Total of 8 classroom courses, nominally three classroom courses each year. Year 3: Teaching Seminar and advisor meetings Year 4: Regular meetings with your advisor Year 5: Crunch time for thesis. You need results if you want people to write for you; Personal web page; Start planning your teaching and research statements for jobs.
<p>Fall</p> <ul style="list-style-type: none"> Meet with graduate and individual advisor Zeroth year status discussions Course plans and revisions Topics Courses and Seminars Initial thoughts about qual areas 	<p>Fall</p> <ul style="list-style-type: none"> Meet with graduate advisor; review course plans Revisit qual plans: Deadline for having passed first qual is the second week of winter term. You are talking to your committee members, right? Should try to attempt that qual this term. Seminars, potential thesis advisors 	<p>Fall</p> <ul style="list-style-type: none"> Years 3,4,5: Annual meeting with advisor and secondary advisor Years 3,4,5: Attending research seminars and giving talks Year 5: Job applications: teaching and research statements written and vetted; cover letters; AMS Winter meetings (submit abstract for talk); Start thinking about thesis committees
<p>Winter</p> <ul style="list-style-type: none"> Meet with graduate advisor; make or review course plans Topics courses? Seminars? Register for Math 107 if you TAed fall and winter Thinking about your written certification exam yet? 	<p>Winter</p> <ul style="list-style-type: none"> Meet with graduate advisor; review course plans Revisit qual plans: Deadline for having passed second qual is the end of the fifth week of spring term. Should plan to attempt towards the end of this term. Seminars, potential thesis advisors Register for Math 107 if you TAed fall and winter 	<p>Winter</p> <ul style="list-style-type: none"> Years 3,4,5: Attending research seminars and giving talks
<p>Spring</p> <ul style="list-style-type: none"> Meet with graduate advisor; make or review course plans Topics courses? Seminars? Register for Math 107 if you haven't yet this year Prepping for written certification exam (given just before start of summer term) 	<p>Spring</p> <ul style="list-style-type: none"> Meet with graduate advisor; review course plans Revisit qual plans: Deadline for having passed second qual is the end of the fifth week of term. Register for Math 107 if you haven't yet this year Advisor form signed by advisor and secondary advisor and given to Army. 	<p>Spring</p> <ul style="list-style-type: none"> Years 3,4,5: Attending research seminars and giving talks Year 4: Determine your fifth year teaching experience. Year 5: Thesis defense. You may not schedule it until all other degree requirements are complete. Corrected thesis submitted on time and in proper format.

3 Advising and Advisors

3.1 The first two years

There is no shortage of people to whom to turn to receive good advice on all aspects of your graduate career, and advice targeted towards students prior to advancement to candidacy is particularly abundant and focused. There are various committees which interact with the graduate program and whose membership changes from year to year. Membership of all committees can be found on the department website via the Department Documents page: https://www.math.dartmouth.edu/intranet/dept_docs/

- **Graduate Program Committee (GPC)** [GPC Chair: Voight in 20-21] An advisor in the broad sense, the GPC is the one place all graduate students should turn for questions on policy. In particular, if you have a question about whether an action or inaction on your part will have repercussions for your graduate career, the Graduate Program Committee (GPC) is the definitive source for answers.

The GPC formulates policy, which is considered, modified, and then approved by the department, and the GPC then carries out that policy. The GPC controls your stipend, grants (or not) extensions to deadlines, and sets the terms for you to regain normal status should you have problems meeting stated requirements and deadlines.

- **Advisor to Graduate Students:** [Orellana in 20-21] The departmental advisor to graduate students monitors all precandidacy students. Students meet at least once per term with this advisor to discuss course planning, progress in courses and towards certification, as well as perhaps zeroth year status considerations. The graduate advisor frequently brings potential policy issues to the GPC, but as a student you are always welcome to bring issues to the GPC.
- **Individual Advisors:** Starting with Fall 2009, each entering student is assigned an individual faculty advisor who will supplement the oversight of the departmental advisor to graduate students. The individual advisor will meet minimally once or twice per quarter with his or her assigned student(s), and of course as often as the student requests. You can talk with your advisor about any problems or questions you may be having, in class or out of it. Your advisor can not only give you advice and encouragement, but help find resources to help you with any difficulty. Perceived or potential problems can then trigger information being passed both to the advisor to graduate students and to the department's Graduate Program Committee (GPC) who have a broader view of the graduate student population.
- **Graduate Representative:** [Winkler in 20-21] In terms of advising, the Graduate Representative serves as a backup to the graduate advisor, though he or she is the official department liaison with the Graduate office and is responsible for a broad collection of tasks from TA assignments to oversight of stipend and grant support for

students. The graduate representative is also the person to talk to about funding to support travel to conferences.

- **Qualifying Exam Committees:** A student preparing for certification must have their qual committees approved by the advisor to graduate students (well) in advance of each exam. The student is advised by their chosen certification committees concerning preparation for the qual (for details, see the section on quals). The student brings certification forms to the qual (obtained from the graduate program administrator) and at the end of the exam, each faculty member fills out the form describing the student's achievement in that area. These forms are then returned to the graduate program administrator who will enter the relevant information into the department database for tracking progress towards candidacy.

Sometime early in the fall of the first year, the student will meet with the advisor to graduate students and their individual advisor to discuss plans for the first year and beyond. The idea is to set up a course of action (which will be modified as necessary) which looks forward through the first two years. Courses, including qual courses, topics courses, and reading courses, will be considered and a timetable discussed which will consider the dovetailing of qual deadlines and available courses. In particular (see the section on quals for details), the coordination of course work supporting the oral qualifying exams requires some advanced planning. The student will summarize this plan in writing, which will be signed by the student and the graduate and individual advisor and filed with the Graduate Program Administrative Assistant, Amy Potter. It should be revisited each term, and updated as necessary, with the student responsible for securing signatures and refileing the document with Amy.

The Advisor to Graduate Students and the Graduate Program Representative as well as the departmentally assigned individual advisor remain available to graduate students throughout their time at Dartmouth, for consultation and advice. Of course, as part of the process of advancing to candidacy the student will choose both a primary and secondary advisor whose efforts will largely supplant those of the departmental advisors after advancement to candidacy.

Students are by no means restricted to seeking advice from the advisors appointed by the department. Feel free to seek informal advice and feedback from any faculty member with whom you feel comfortable. It is not unusual, and not a reflection on your current advising relationship, for assignments to change between the first and second year. Faculty may be going on leave or have other commitments; students may have an idea for an area to work in, and want an advisor in that area. Of course, it is not necessary to get all your advice from one person (finding multiple mentors is highly recommended), so it is certainly not necessary to have your (pre-thesis) advisor in your proposed research area.

3.2 The years following advancement to candidacy

As part of the process of advancement to candidacy, a student must choose not only a thesis advisor, but a secondary advisor as well. Generally, the secondary advisor will be a member of the student's formal dissertation committee, though this is not required. What is important is that the student feels comfortable talking to this advisor, as a principal role for them is to act as an intermediary should there be some confusion concerning expectations of either student or thesis advisor.

The student should meet with their thesis and secondary advisors regularly (but not less than once per year) to discuss their plans and progress. Each fall term, there must be a meeting after which the student will write a report summarizing the meeting, which will be signed by the student and both advisors and filed with the Graduate Program Administrative Assistant. The thrust of this meeting is to provide an expression by advisor and student of where each believes the student is on the road to completing a thesis. It is generally useful for the student to prepare a written summary of their work to date and their plans for the future prior to this meeting.

It is clear that each subsequent meeting is increasingly important: the third year meeting will probably present a broad road map; the fourth year meeting should reflect work underway with clear focus; and the fifth year should hopefully reflect an end-game strategy.

Any unresolved disagreements or conflicts of opinion concerning academic expectations that arise within an advising committee should be referred informally to the Advisor to Graduate Students, the Graduate Program Representative, or the Department Chair. If a resolution cannot be reached via informal channels, contacting the Graduate Program Committee would be the next step. For other serious problems, there are formal grievance procedures discussed later in this document.

4 Qualifying Exams

Taking a simplistic view, there are two necessary tasks to accomplish in graduate school: advancing to candidacy, and writing an acceptable dissertation. Ideally, the goal is to become a competent researcher as well as effective teacher and communicator. While the writing a thesis the more formidable task, it is passing qualifying exams that seems to preoccupy the minds of most graduate students, and indeed the largest component of advancing to candidacy is passing your qualifying exams.

You have two years in which to acquire a knowledge of and facility with core tools in three or four areas of mathematics. That period of time often is stressful and interlaced with periods of introspection. An academic career can be an extraordinarily rewarding one, but it is certainly a highly demanding one, and it is important to assess your commitment to the profession as you start the five-year journey to a Ph.D. This introspection will either help in

your resolve to succeed in the qual process, or in a few cases help you reprioritize your goals in life.

The good news is that everyone who has advanced to candidacy has passed their quals, and most who start the program do so. Most probably look back on the process with a bit of wonderment as to what all the fuss was about, albeit cognizant that it was certainly not a trivial journey.

- **What are the possible outcomes of a second-year qual?** There are three possible outcomes from your attempt at an oral qualifying exam in your second year (listed in ascending order of value): You can fail; you can pass (also referred to as a PhD pass); or you can receive a ‘thesis-ready’ pass.

A necessary condition for advancement to candidacy is to receive a passing mark on both of your oral quals. That means that both members of each of your qual committees sign a form saying you have passed that qualifying exam. In addition, at least two of those four examiners must attest (by signing a form) that you have received a ‘thesis-ready’ pass. This affirmation need not be both members of a single qual committee.

The consequences of failing a qual and the options for students who do not obtain thesis-ready passes are discussed later in this section.

- **What courses should I take?** As stated in numerous published sources (e.g., the ORC), students must take at least 15 courses of graduate quality to qualify for a masters degree. Additionally, they must register for (and successfully complete) three courses per term in order to be considered a full time student (and hence receive a stipend).

For the written certification exam, students will choose three of the five core areas (algebra, analysis, applied mathematics I or II, topology) on which to be examined. Naturally, they need to have taken at least the six core courses which cover those areas: in algebra (101, 111); in analysis (103, 113); in applied mathematics (106, 116),(126,136); in topology (104, 114). First-year students are encouraged to sample courses from all four areas.

In the second year, students are required to take four classroom courses (i.e., non reading courses), and over the next three years, they must take at least 8 classroom courses, roughly 3 classroom courses per year. The teaching seminar does not count as one of these courses.

N.B. In the first two years, a non-classroom course is typically a supervised reading course (127) in which the student pursues a topic to advance their progress toward certification/oral quals. In the event that two reading courses are needed to fill the course load, 127 and 137 should be selected. Note they are both essentially the same course with distinct numbers to make it clear to the Registrar’s office that two different courses are being taken.

- **What about the timing and choice of exams?** Qualifying exams come in two flavors. The written certification exam, and the two oral exams.

The written exam is given just before the start of summer term, and once again just before the start of fall term. The idea is that incoming students have an opportunity to take the certification exam upon entry with the intent of helping guide their choice of first-year courses. This exam covers the contents of three of the five core areas (presented in 101, 103, 104, 106, 111, 113, 114, 116, 126, and 136). Your goal is to pass this exam at the start of the summer term following your first year; it is our expectation that you will. To do so, you must demonstrate proficiency in each of the three core areas you have chosen. Students who do not demonstrate proficiency in one or more areas, but who have been making satisfactory progress in their course work, will be allowed to retake the exam at the end of summer term.

Satisfactory progress is assessed largely by considering the internal course grades you have received in the first year (see §6 on Course Grades). Students are presumed to making satisfactory progress unless notified otherwise by the GPC. Also, students will only be asked to retake the portions of the preliminary exam that they did not pass the first time. Failing to pass a second time (at the Ph.D. level) will result in termination from the Ph.D. program. A student in this position who has passed the written exams at a Master's level is encouraged to stay through the fall term to see whether they can complete the requirements for a Master's Degree (cf. §6).

The formal deadlines for passing (that is not to say taking) the two oral qualifying exams are (respectively) the sixth week of winter and spring terms. Your job is to stay on pace for a successful completion of all exams, and this takes some foresight and planning.

Unlike the written exam, the oral exams are intended to probe an understanding of two areas of mathematics at a level considerably deeper than what is required for the written certification exam. The subject for these two exams is often worked out in cooperation with the student's potential thesis advisor. That is, if you want to work with a given professor, he or she may require you take oral qualifying exams in subjects which prepare you for working in his or her area of research. The two exams can be in areas which overlap with the three core areas, may be entirely new areas, or may even be two exams on different areas of applied mathematics.

- **How should I prepare for a qual?** What do you need to do to get ready for a qual in X or Y? If you think the GPC or the advisor to graduate students knows, you're wrong. It's your job to find out. This process begins — well before you plan to take the exam — by choosing a committee, getting it approved by the advisor to graduate students, and then confirming a syllabus with that committee. All qualifying exam syllabi are supposed to be reviewed every five years and updated as necessary. This means the syllabus a fellow graduate student gave you may be out of date. Confirm the syllabus with your committee. Even with the topics fixed, faculty expectations of

how you demonstrate mastery of them can vary substantially. You should do this as a first step towards starting your review for each qual.

All faculty have been asked to put sample problems on the web for you to try. The sample problems are neither intended to be a comprehensive list, nor intended as a study guide, but intended more as a means to assess your preparedness. It is certainly the case that working through these problems and asking to present selected solutions to your committee is an excellent way for you to get accurate feedback on your level of preparation.

Graduate students seem fond of the unofficial “qual book” which contains the remnants of students’ memories of quals. This can be the source of additional review material, but caution is required. For example, questions are often misremembered by students, making them false or impossible. Other times they can afford an incorrect impression about the types of questions that are typically asked in a qual. A common example is a series of questions which seem to be getting easier. This is actually an indication that the student was in trouble in the exam and the examiners were back-pedaling to find some aspect of the original question the student could answer; it is not an indication of what the expectation of the examiners was, which no doubt is more accurately assessed by looking at the first question in the series.

- **How should I plan for deadlines?** Too often students think of the qual deadlines as the date by which an exam must be attempted, not as the department views the date, one by which the exam must be passed. Aside from the misperception above, there are many ways and reasons to fail meet deadlines. A failed qual imposes a four-week waiting period before the next attempt at the qual. A student planning ahead should plan to take a qual in sufficient time so that a setback will not cause them to fail to meet the department deadlines. Thus preparing so that you feel confident to take the qual four weeks before its deadline is an excellent way to hedge your bets should your assessment of preparedness not coincide with your examiners’.

Of course even if you anticipate deadlines effectively, it could be that you find yourself up against them. The first deadline is six weeks into the winter term, so there is an expectation that most students will use a good deal of the time between terms to fine-tune any last minute preparations for quals. To reiterate, this is an expectation, which is to say that graduate school is not based upon the same model as undergraduate school. As an undergraduate, you are effectively free of academic responsibility from the moment you finish your finals to the moment classes begin for the next term. As a graduate student, this is no longer the case, and frankly the time between terms is often when people get a great deal of work done. To add some official perspective, the Associate Dean for the Sciences recently addressed this matter directly. His statement was quite blunt: Students on Dartmouth Fellowships have a twelve-month contract, and receive a total of four weeks vacation during the year. That is, four weeks per year (outside of staff holidays, e.g., Christmas, New Years) that you are not doing your job. For students in a lab, that means four weeks away from the lab. For mathematics

graduate students, there is more flexibility in where your mathematics is done, but not in how much time is devoted to it.

- **What if I fail to meet a deadline?** So you think you are going to miss a deadline. What should you do? How will the GPC react? Is your stipend in jeopardy?

Let's start with the issue that is dearest to your heart, your stipend. You receive a (12 month) Dartmouth Fellowship (or equivalent grant) which is reconsidered for renewal each year. It is a performance contract, and if you fail to perform satisfactorily, it can be suspended at any time or terminated completely coincident with your separation from the program. A hundred or more students apply each year for admission to this program, and only a handful are admitted. The awarding of fellowships is a competitive process and failure to maintain the expected standards of performance is always grounds for reconsideration of support. Moreover, most of the graduate student support for our department comes from College money, and in supporting our program, there is the continual need for the department to demonstrate the value of the graduate program, and so justify continued financial support. That justification is typically measured by how successful we are in producing Ph.D.s who will add to the profession as a whole. Supporting a student unlikely to finish is not in the best interest of the student, nor in the best interest of the program.

In the first two years, what keeps you in the good graces of the department? Obviously passing your courses and your quals in a timely fashion is a very good start. If things go awry, much hinges on when and how they go awry. Clearly there is no flexibility in the timing of the written certification exam. You have six courses worth of material to assimilate and the exam is given just prior to the start of summer term. Plan ahead.

You have two oral exams to pass, the first must be passed by the end of the sixth week of winter term, and the second by the end of the sixth week of spring term. Most likely you should not prepare for these serially, unless you really need only one term to prepare for and pass a qual. At a minimum you have two terms (summer and fall), to prepare for the first qual, but more than likely your choice of optional courses in the first year has already moved you forward in preparing for one or more of these quals. Indeed one or more of your quals may be in a core area, which gives you a significant head start in your preparation.

Failure to make the first qual deadline clearly impacts your ability to meet the second deadline. This is not a good situation, and obviously a significant concern of the GPC. The following is a minimal list of questions to which the GPC will want detailed responses to support any petition for an extension of deadline.

1. What circumstances led to this request? Why are you unable to meet the current deadline?
2. When did you officially form your committee for this qual (i.e., provide a copy of the signed approval form)? How often have you met with the committee members

in preparation for this qual? Are either or both of the members willing to support your petition for an extension?

3. What is the current assessment of the committee? How much of the required syllabus have you mastered, and does your committee agree with your assessment? Where are the filled-out qual forms if the qual was attempted?
4. Granting an extension (or further extension) will place increased time pressure on your second qual. Can you give a plan of action which allows you to complete it on time? Be sure to identify those factors that delayed your earlier qual, and explain how they will be mitigated in the future.

- **What are the consequences of obtaining an extension?** Even when a petition for an extension of deadline is granted by the GPC, there will always be conditions attached to the approval. Precisely what the conditions are depends highly upon the conditions going in. Some examples:

- A student has passed the written certification exam, yet realizes they will not meet the deadline for their first qual. There is a large spectrum of responses one could receive from the GPC.

Suppose the student has been making good progress towards taking the qual: for example as evidenced by the committee being established well in advance, and the student has been meeting with them so that an appraisal can be made; or that scheduling conflicts among the committee members precludes the exam from taking place before the deadline. Then one can expect the extension to be granted with at most a mild admonishment to get back on track, but without serious concern for the student's standing in the program.

On the other hand, if the qual committee has not been (or was only recently) formed, or if there is no assessment aside from the student's assurance that they are working hard, the GPC will likely be quite firm in their response. It is likely the GPC will issue a warning that these (in)actions place the student's standing in the program in jeopardy, and failure to meet the extended deadline could result in a suspension of stipend until such a time that the student has resolved any delinquent issues.

- A student is on probation as a result of poor grades (a no credit (NC) or cumulatively two low passes (LP) in previous terms). This status is known to the graduate office and the department must be able to provide concrete evidence that the student has made significant progress towards remediating these deficiencies. Asking for an extension makes the student's status even more tenuous. Failure to pass the late qual by the extended deadline could easily result in a suspension of stipend and new conditions and deadlines to avoid separation from the program.

- **What if I fail a qual?** The first thing that happens is that a four-week waiting period is imposed before you may attempt the qual again. This policy was established

by the department to ensure that students take sufficient time to review deficiencies and to encourage students to be well-prepared for a qual. Will the four-week waiting period push you past the deadline? If so, you will need to petition the GPC for an extension documenting your good progress to date (see above).

- **Are there alternative formats for quals or for retaking quals?**

The typical mechanism for assessing a student's knowledge of and facility with material on qualifying exam syllabi is through an oral exam. This format is both flexible and supportive, despite the trepidation that students often feel. In particular, it affords the opportunity for the examiners to intervene with hints or by recasting the problem when a student is stuck; obviously this flexibility is lost in a written exam.

However, there are alternatives which often can be worked out among the student and the committee members. Sometimes an entire exam needs to be retaken; sometimes examiners are content with parts of the exam and want only to reexamine a subset. This subsequent exam may be oral, written, or in the case of attempting to gain a "thesis-ready" pass (for a student who already has a PhD pass), may be evidenced by activities such as assimilating the results of a research paper and presenting the results in a (series of) seminar talk(s).

As an example suppose that the student displays a thorough understanding of algebraic topology, but can't distinguish an exhaust manifold from a differentiable one. In this case the student has failed the qual — and the committee members should submit forms to that effect, noting their assessment — but the student may be reexamined only on the differential topology after the mandatory four-week waiting period. A petition to the GPC may need to be filed if the delay pushes you beyond your deadline.

On the other hand, suppose the student appears well prepared, but suffers a panic attack and the qual grinds to a halt. The examiners may choose to "suspend" the exam for a period of days or a week, until confidence is restored and the committee members have another opening in their schedules. Again the GPC may need to be informed.

- **Can I change my qual committee?** The answer is generally yes, but not always. Certainly if you have not yet taken a qual or failed a qual and will be retaking it in its entirety, you may change your existing committee for a new one, assuming approval by the advisor to graduate students. You should of course reconfirm the syllabus and the new committee's expectations, and out of courtesy inform your old committee of the change.

From the other perspective, some faculty may refuse to continue to be on your committee. For example, if you have failed twice, some faculty will recuse themselves to avoid any appearance of bias.

The place in which a change of committee is clearly not allowed is if you have attempted a qual, and the committee members are content with topics X, Y, but require reexam-

ination of W, Z. You must finish with the existing committee for an examination of W, Z, unless of course you wish to start from scratch with an exam on all topics.

- **How do quals affect my participation in the teaching seminar?** Students who have advanced to candidacy take the teaching seminar during the summer between their second and third year; students who have not advanced to candidacy do not. Students who have not passed their quals by the deadlines certainly have not advanced to candidacy.

Someone not advanced to candidacy by the end of the second year is in jeopardy, and has had no doubt been issued a letter from the GPC indicating conditions (if any) under which they may resolve any outstanding deficiencies. Presuming those conditions are met, the student will TA in the third year of graduate study and take the teaching seminar the following summer.

5 TA Responsibilities

See the document

http://www.math.dartmouth.edu/graduate-students/dept_docs/TAresources.pdf.

6 Course Grades

Graduate students receive two grades in courses in which they are enrolled. There are the formal grades turned into the Registrar consisting of HP, P, LP, NC. A grade of P (pass) is a standard grade; many instructors rarely use HP (high pass) as there is no official notion of a GPA for graduate courses, and it is your certification process and thesis which carry the significant weight.

On the other hand, grades of LP (low pass) and NC (no credit) are taken very seriously by the Graduate Office. Two LPs (cumulatively) or one NC automatically places the student on probation and under scrutiny by the Dean of Graduate Studies, and this means that there must be significant measurable positive progress in the next term to be removed from probation. Failure to do so jeopardizes your receipt of a stipend.

The second grade is an internal grade for departmental use and is given only for first-year courses that are immediately related to the written certification exam. This grading system is distinct from the College grading system as it measures progress toward certification rather than performance in the course. The Grading scheme for the core first-year courses is:

Grade	Meaning
5	Comprehension of all material at Ph.D-acceptable level for certification exam.
4	Comprehension of some material at Ph.D-acceptable level for certification exam.
3	Good comprehension of material at a Master's-acceptable level.
2	Comprehension of some material, but generally below a level acceptable for a Master's degree.
1	Essentially no comprehension of material.

While the main intent of these grades is to provide useful feedback to the student as they work their way through the first year and prepare for the written certification exam, they are also used by the GPC in two situations: they are used to certify that students have satisfied the course requirements for a Master's Degree (awarded to all who advance to candidacy), and may also be considered by the GPC in resolving borderline scores on the written certification exam.

7 Seminars, Colloquia

There are numerous seminars in the department supplemented by weekly colloquia and special lectures series at various times in the year. The obvious starting point for learning about them is the activities link on the department web page. There you will see links to the aforementioned items.

All graduate students should attend the graduate student seminar. This seminar consists of talks by graduate students for graduate students; faculty are not in attendance. Oh, there is also free food.

You should get in the habit of attending colloquia. When you are a newbie, sit in the back and bring something to work on for when you get lost. Sometimes you will get lost in the first ten seconds, sometimes the first ten minutes, sometimes not at all. As you learn more, it will (usually) take a longer time to get lost.

What's the point of coming if you get lost all the time? A very good question with at least three answers. The first is that mathematics is about making connections, and really interesting mathematics comes from making connections among ideas that appear quite disparate. All of a sudden in a colloquium (which are supposed to be aimed at a "general" audience) you find the speaker talking about something which you have seen in a very different context. Following that connection often leads to an interesting research problem. Second, you will be giving many talks in your life (seminar talks, thesis defense, job interview talks), and attending colloquia allows you to form strong opinions about what constitutes a good or bad talk. And last, but not least, is that these speakers have been invited by someone in the department to speak to us. Common courtesy suggests the hosts show up! A

good turn out reflects well on how the department is viewed by the outside which can have all manner of positive effects.

Research seminars are often more specialized, but equally often will have periods in which talks intended to introduce a more general audience to aspects of the field are given. Usually the web pages for these seminars gives information about the subject. Find out who the speaker is and see if they think you will understand. If you are not sure in what area you would like to work, a seminar can be an excellent vehicle to observe not only the types of problems people in the department like to work on, but also the personalities of prospective advisors.

8 Topics/Reading Courses

Both topics courses and reading courses are vehicles for acquiring knowledge outside the standard required courses. Topics courses are offered in areas such as applied mathematics, combinatorics, geometry, logic, number theory, probability as well as advanced courses in algebra, analysis and topology. The topics offered vary from year to year, and to an extent support areas with large numbers of graduate students, but students can make recommendations to the chair, the graduate advisor or representative suggesting topics of interest to a core of students. Also note that upper level undergraduate courses are often suitable courses for graduate students; for example, some can help with qual preparation in fourth areas.

Reading courses are usually more tailored to specific needs and always have a faculty supervisor. A syllabus is jointly constructed by student and faculty, and a schedule of meetings and a list of expectations is established. Often they are used to cover gaps in student knowledge for a qualifying exam, but they also can be used to explore a specialized topic of interest for which there is insufficient graduate student interest to warrant offering an official course.

9 Fifth-Year Teaching Requirements

Dartmouth's graduate program in mathematics has as its goal to produce research mathematicians who are effective and creative in the classroom. The teaching aspect of this training begins with TAing for courses in your first two years, is greatly amplified in the teaching seminar, and then those concepts learned are honed in practice by teaching courses on behalf of the department. With the majority of our graduates heading into academia, each course you teach provides valuable experience for you, and allows faculty in the department to work with you and observe you in action so as to write a strong letter of recommendation concerning your teaching.

In their fifth year, at the discretion of the Chair in consultation with the GPC, students should expect to teach a course in the department. They should know what their responsibilities will be by the end of the spring term in their fourth year. Students teaching in their fifth year need only register for Math 149 in the appropriate term.

In unusual circumstances, a student may gain more benefit from an alternative fifth-year teaching experience. In such a circumstance, the student is required to petition the GPC for permission; this is accomplished in two steps.

- The petition consists of three documents submitted to the GPC in the Spring term of their fourth year. First, the student submits a one-page proposal detailing the proposed teaching experience, the role of the faculty sponsor, and the student's role, including an estimate of their time commitment. Generally, students are expected to spend time comparable to the time necessary to teach their own course. Second, the student submits a letter from the faculty sponsor endorsing the proposal and indicating its pedagogical value to the student. Third, the student submits a letter of support from the student's thesis advisor. At this point, the GPC approves (or denies) the project, giving the student advice on how to improve and revise the proposal. If the proposal is denied, the student will most likely teach a course in the next year.
- Subsequently, at least two weeks before the end of the term preceding the term in which the teaching experience is to take place, or the beginning of the Winter term of the fifth year (whichever is sooner), the student submits a detailed revision of the proposal to the GPC. The revision should address any concerns raised by the GPC and highlight any evolution of the proposal since its initial approval. This allows time for the GPC to review the proposal and ask for modifications, if necessary.

Some recent fifth-year projects:

- Participation in the NSF-sponsored GK-12 program: Martinez (2012-2013), Kinnaird (2013-2014), Engberg (2013-2014).
- Participation in the NSF-sponsored Graduate Research Opportunities Worldwide (GROW) program: Wolff (Summer, 2014)

10 Frequently Asked Questions

While full responses to frequently asked questions are on the web page <http://www.math.dartmouth.edu/graduate-students/FAQ/>, we list all the questions below, and address one particularly important FAQ.

We start with an important question:

Outside Funding and Tutoring: Can I receive outside funding? Can I get a tutoring job? Can I get paid by a summer workshop or REU?

Answer: Financial support for graduate students comes from Dartmouth Fellowships, faculty research grants, departmental grants (e.g., GAANN), and from grants and scholarships obtained by students themselves (e.g., NSF graduate fellowship). Students are encouraged to apply for any external fellowship for which they may be eligible. Outside fellowships

sometimes pay more than Dartmouth Fellowships, and it is certainly something notable to put on your vita. In addition, outside fellowships supplement the limited pool of internal resources, allowing more flexibility in the size of our graduate program.

In terms of graduate students receiving salary in addition to their stipend, we quote from the Graduate Student Handbook downloadable from the Graduate Offices Academic Services and Policies page. The relevant quotation is:

Graduate students who are fully supported (a full tuition scholarship and a full stipend) cannot receive additional payment from Dartmouth College for services rendered and cannot accept employment outside the College while enrolled. Exceptions may be granted in cases of unique academic or professional benefit or documented financial hardship. Any exception will normally not exceed eight hours per week and must have the written approval of the graduate student's advisor, department chair or Graduate Program Committee, and the Dean of Graduate Studies.

The complete list of questions is below (answers on the aforementioned web site):

1. **The most important question:** Who or what is the definitive source for answers about policies affecting your status in the graduate program?
2. **Registering for Classes:** What is the department policy on signing up for independent studies, taking classes outside the department, dropping or adding a class late? What does it mean to sign up for thesis research versus graduate research versus a reading course versus independent research versus supervised teaching, etc.? What classes count towards the 15-course requirement for a master's degree? What should you do if you haven't taken enough "real" classes?
3. **Opting out/auditing of required courses:** What do you do if you don't want to take one of the core courses on which the written certification exam is based (because you've already seen the material)? Can I audit a class?
4. **Grades in Classes:** How do grades in graduate classes work? What does it actually mean if you get a low pass? Do graduate students have classes on days that undergrads get off?
5. **Quals:** What do you do if
 - you think you won't be able to make a deadline (including extended deadlines)?
 - you think you want to change your committee?
 - you're having trouble finding a time before deadline that both committee members can be there?
 - you fail part of a qual (both traditional and non-traditional ways that people have been asked to finish their qual)?

- What circumstances warrant an extension? How does the GPC view missing a deadline? How do qual deadline impact the teaching seminar and advancing to candidacy? What happens if you don't make the deadlines?
6. **Travel Funding:** What kinds of funds are available for graduate students to attend conferences? How do I request funding? What are examples of the kinds of things that have and haven't received funding?
 7. **Teaching Seminar:** What is the teaching seminar? What are my responsibilities within it? What are my responsibilities in addition to it? Does passing the seminar mean I am in charge of my own courses?
 8. **Seminars:** What seminars exist in the department? Should you attend them if you haven't picked an area yet? How do you find out about seminar talks? What about colloquia? What's the point of going to talks if you get lost all the time?
 9. **Being away from the department:** for a day, a week, a month, or forever – when does going on vacation count as a leave of absence? What do you do if you're a first or second year, and your potential advisor tells you you should go to a conference, but the professor teaching your course says you shouldn't? If you don't get GPC approval before leaving to do something math-related, what happens? What's department policy on leaving campus during Dartmouth breaks?
 10. **How much trouble am I in?:** If you're not on probation, do you automatically count as a student in good standing?
 11. **Outside Funding and Tutoring:** Can I receive outside funding? Can I get a tutoring job? Can I get paid by a summer workshop or REU?
 12. **I've passed quals, now what?**
 13. **Finding an advisor:** What are good strategies for finding an advisor (and secondary advisor)?
 14. **Advancing to Candidacy:** What forms? Where do you get the forms? To whom do you turn them? What do you do if you don't have enough thesis passes?
 15. **Having Trouble with a Thesis Advisor:** What do you do if you're having a problem with your thesis advisor? What do you do if you want to change thesis advisors? What's the department policy on interdisciplinary work and thesis advisors outside the math department? What about thesis advisors at other schools?
 16. **Thesis Defense:** What happens if you don't finish your thesis on time or need to reschedule your thesis defense?

17. **Teaching:** What are the policies on using other people's problems or tests? What's the procedure if you're going to fail someone? What do you do if you have problems with your evaluation by the teaching committee? What happens if the department is unhappy with your teaching?
18. **Fifth Year Teaching Experience:** How do I propose a project and to whom? What are some possibilities for what to do?
19. **Who's Who:** What are the roles of the GPC, the Graduate Student Representative, the Graduate Student Advisor, Advisor to First Year Graduate Students, Head of the Graduate Program, the Graduate Admissions Committee, Department Administrator, Department Secretary, etc? What kinds of questions do each group or person handle?
20. **Tea:** How do I handle tea (getting the card, setting up, cleaning up, turning in receipts), plus what to do if you forget or lose the card?

11 Appendices

11.1 Formal Departmental Degree Requirements

(<http://dartmouth.smartcatalogiq.com/en/2015/orc/Departments-Programs-Graduate/Mathematics>, inaccurate as of August 2011)

THE GRADUATE PROGRAM IN MATHEMATICS

Dartmouth College offers programs of graduate study leading to the Ph.D and A.M. degrees in mathematics. With rare exceptions, the A.M. is the first step in the Ph.D. program. The Ph.D. program is designed to meet the need for mathematicians who are highly qualified in both teaching and scholarship. The College provides an environment in which a doctoral candidate can pursue professional study in mathematics and prepare to be an effective teacher.

REQUIREMENTS FOR THE MASTERS DEGREE (A.M.)

In addition to the general College requirements for the master's degree, the department requirements for the A.M. in mathematics are as follows:

- Satisfactory completion of three out of five pairs of core courses: (101, 111), (103, 113) (104, 114), (106, 116), (126, 136). (see Note (1))
- Successful completion of a written certification exam.
- Non-course requirements which parallel those of those continuing in the Ph.D. program. In particular, students must receive credit for Mathematics 107 once during each year while enrolled.
- Completion of at least five terms in good standing. (See Note (2))

- Note (1): Normally this requirement for the A.M. is completed in the first year. Study may be extended into the second year, only if approved. Syllabi for these ten courses are available from the Department of Mathematics.
- Note (2): In addition to five terms in residence, students must obtain credit in fifteen courses of graduate quality with a limit of at most five replaced by approved research or special study.

REQUIREMENTS FOR THE DOCTORS DEGREE (PH.D.)

The requirements for the Ph.D. degree in mathematics are as follows:

1. Successful completion of the A.M. degree (described above).
2. Departmental certification in two advanced areas of study.¹
3. Admission to Ph.D. candidacy by the departmental Graduate Program Committee as a result of its second review, which takes place at the end of the spring term of the second year of graduate study. This review will take account of all the relevant information that the Graduate Program Committee can gather, such as the students record in courses and seminars, the students performance during the certification process, and an estimate of the students ability to write an acceptable thesis.
4. Completion of a doctoral thesis of acceptable quality, and its defense in an oral examination.
5. Successful completion of the teaching seminar and teaching two courses in the three years after passing to candidacy. Preparation for the teaching seminar includes such activities as TAing in the years before admission to candidacy. This requirement is met by receiving credit for Mathematics 107 once during each year preceding admission to candidacy, credit for Mathematics 147, and credit for Mathematics 149 twice during the three years following admission to candidacy.

11.2 Departmental Amplification of Requirements

The following statements represent current department policy. While policy does change from time to time based upon votes of the faculty, any exceptions to this policy must be explicitly approved by the GPC.

1. Every graduate student is required to register and complete three courses per term. Before the end of the first year, students are expected to take at least 6 of 101, 103, 104, 106, 111, 113, 114, 116, 126, and 136 (covering three core areas) as well as 3 or more topics courses of their choice. In addition, each student should register for 107 during the second term of each year in which they serve as a teaching assistant. Students

¹Syllabi for each area of certification are available from the Department of Mathematics

should take at least four classroom courses during their second year, and roughly three classroom course in each of the years after advancing to candidacy (a minimum of 8 courses are required in years 3-5). Upon advancing to candidacy, students are expected to take 147 in the summer term of their third year, and must register for 149 in each teaching term (see also item 6).

Students who supplement standard coursework with reading courses (127, 137) must have a supervisor for each such course. Students using reading courses to aid in their preparation for a qualification exam are encouraged to pick one of their (potential) committee members as the reading course supervisor. While these are expectations for typical graduate students, the Advisor to Graduate Students may grant alternate course plans at his/her discretion (see below for information regarding advisor meetings). [Approved April 2010]

2. The department has syllabi on file for algebra, analysis, topology and various other areas of certification including flavors of applied mathematics, combinatorics, differential geometry, logic and set theory, and number theory. A qual need not be taken in one of these areas, but the Graduate Program Committee must pass on the suitability of an area for which there is no syllabus and arrange to have a syllabus made. In the Spring term of 2008, the faculty passed the following motion:

Any syllabus which has not been updated in the last 5 years should be updated by the relevant faculty and posted on the department website. Every syllabus should be revisited and updated (if necessary) at least every five years. If a particular qualification area allows or encourages students to collaboratively create a syllabus in consultation with a committee, this should be explicitly stated on the syllabus.

Students looking at syllabi should be wary that faculty members in that area may be revising a syllabus at any time. Consequently, students should, at an early point in their studies, form a committee and set a fixed syllabus for the qualification exam. A shared understanding of the syllabus requirements is essential to the successful completion of a qualification exam.

3. Advancement to Candidacy: On the basis of all available information, the Graduate Program Committee decides whether it is in the student's best interest and Dartmouth's best interest for a student to continue studying towards a Ph.D. degree at Dartmouth. The typical requirements for advancement to candidacy, in addition to passing the written certification exam and two oral quals, are certification by two of the student's four qual examiners as being "thesis ready" in their area (this language is intended to allow the possibility of one examiner from each qual), selection of a thesis advisor, a secondary advisor, and the approval of the Graduate Program Committee. The primary and secondary thesis advisors must indicate their acceptance of the student by signing the advisor form obtained from and returned to Amy prior to GPC consideration.

4. The Graduate Office establishes requirements for the composition of a dissertation committee and for the presentation and submission of the thesis.

No student may schedule their thesis defense until all other requirements for the degree have been satisfied.

5. Students prepare for the teaching seminar through activities such as TAing in the years before admission to candidacy. Students receive credit for Math 107 for acceptable performance in two quarters of TAing each year before admission to candidacy, Math 147 and Math 148 for passing the teaching course, and Math 149 for acceptable performance in one quarter of teaching each year after admission to candidacy. The Graduate Program Committee may occasionally approve substitution of other professional activities to meet TAing or teaching requirements, subject to the proviso that each student must earn credit for Math 107 at least once, credit for Math 147, and credit for Math 149 at least twice.

11.3 Grievances

Here are departmental guidelines about what you should do if you have a grievance.

First of all, what is a grievance? You may have a grievance if you feel that you are being treated unfairly or inappropriately, whether by a faculty member, a fellow student, or anyone else with whom you interact as a graduate student. These grievances can be anything from alleged violations of the terms of agreements and guidelines, to more subtle disputes about the fairness of an advisor's oversight, perceived issues of departmental favoritism, remuneration, joint publication, bias concerning gender, race, sexual orientation, et cetera, or concerns about personal conduct.

The first thing to do with a possible grievance is to try to solve it informally within, or with the help of, the department. Two important points about this are:

1. We will maintain your confidentiality to the utmost of our abilities.
2. If you try for an informal resolution and are not satisfied, you can then go on to formal procedures.

Here are the steps we suggest you follow:

1. Try to resolve the issue with the other person or people directly involved. If you can't do this, or it seems too risky to attempt it, then go on to the next step.
2. Consult your advisor, the Advisor to Graduate Students [Orellana in 20-21] or the Graduate Program Representative [Winkler in 20-21]. You should feel free to talk to any of these people with whom you feel comfortable and who you feel has enough distance from the problem to be an effective advisor. If this person can't help you reach an effective resolution, go on to the next step.

3. Talk to the Department Chair [Groszek in 20-21] or to the Graduate Program Committee [GPC Chair: Voight in 20-21]. The department chair or the GPC may be able to suggest some appropriate action by the department that will resolve the situation. This is still an informal resolution, and if you are still dissatisfied, it is time to take matters out of the department.
4. Talk to the Assistant Dean of Graduate Studies (Gary Hutchins.) He will try once again to help you reach an informal resolution, and if that fails, will be able to tell you what formal action to take. This may be to request a hearing from the Dean of Graduate Studies, to approach the Office of Institutional Diversity & Equity, or to follow some other formal procedure.

Addendum from the Office of Graduate Studies

If the Dean, working together with the aggrieved student and appropriate faculty member(s) or representatives of the mathematics graduate program, is unable to reach a satisfactory resolution, the student can request in writing a formal hearing and ruling by the Dean of Graduate Studies and the Committee on Student Grievances. Formal hearings are conducted as described in the Graduate Handbook (see sections titled “Committee on Student Grievances” and “Formal Hearing” under Academic and Conduct Regulations).

Please note that reports of scientific misconduct, violations of the academic honor principle, and certain issues of professional and personal conduct (sexual harassment, discrimination, and others described in the graduate handbook under code of conduct—non-academic regulations) are handled in the Graduate Office as described in the graduate handbook. Graduate students are encouraged to use the informal channels described in their program’s grievance policy to discuss these issues, to clear up possible misunderstandings, to clarify potential grievances, and to decide whether further steps are necessary. A student who after such discussion feels there may be a violation or a grievance requiring some action should report this to the Graduate Office.