POLICIES AND PROCEDURES
M.S. and Ph.D. Degrees in Applied Mathematics
Applied Mathematics Graduate Group
University of California, Merced

Administrative Home: Division of Graduate Studies
Resource Home: School of Natural Sciences

Last Approved by the Graduate Council on December 13, 2013.

1 Scope of Research

Applied Mathematics Graduate Studies (AMGS) at UC Merced explores the applications of mathematics in the development of natural sciences, engineering and social sciences. The Applied Mathematics Graduate Group offers a multidisciplinary research and training program leading leading to a Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees in applied mathematics. The graduate group offers opportunities for students interested in multidisciplinary mathematics projects at the interface between life sciences, physical sciences, engineering and social sciences.

Research projects involve the **modeling of complex systems** across a broad range of fields including protein dynamics, biofluids, organismal biology, molecular dynamics, cold atoms, solar energy, astrophysics, integrated circuits, biomedical imaging, geophysics, wireless communications, energy resource management, finance, and image processing – just to name a few. The faculty members engage actively in **scientific computing** research, including developing, implementing and testing algorithms to solve partial differential equations, optimization problems, and simulate stochastic processes, for example. The newest strategic focus is on **data science**. Data science and engineering is a research field that has emerged alongside the rapid advances in technology that allow for the gathering and storage of massive quantities of data. These massive data sets are beyond the capacity of most traditional methods for analysis. Several faculty members have already established expertise in this field in the areas of genomic sciences, imaging sciences, data mining and mathematical finance, for example.

The course work provides a background in the fundamental tools of applied mathematics, including ordinary and partial differential equations, asymptotics and perturbation methods, numerical analysis and scientific computing.

See Appendix A for the Program Learning Outcomes.

2 Core Faculty

AMGS Faculty is composed of Core Faculty Members, who are responsible for the administration of AMGS and instruction of the Core Courses. Admission of a faculty member to the AMGS as a core member is decided by a vote of the Executive Committee. To remain in good standing, AMGS core faculty members are expected to teach at least two core AMGS courses every three years.

3 Undergraduate Preparation

All incoming students are required to have a Bachelor's degree in an applied mathematics or a related field. In particular, the undergraduate preparation should include courses in advanced calculus, linear algebra, differential equations, and complex variables. See also Section 6.2 regarding preliminary examinations.

4 Graduate Admissions, Enrollment, and Registration Policies

Refer to the Graduate Advisors Handbook[1] for general policies and procedures regarding admissions, enrollment, and registration, including In particular, PELP (Planned Educational Leave), In Absentia (reduced fees when researching out of state), and Filing Fee status. AMGS only accepts full-time students. Exceptions will be only granted for students in the non-thesis M.S. degree program with the permission of the chair of the graduate program, in consultation with the Executive Committee.

5 Program of Study

1. Specific fields of emphasis within the Applied Mathematics graduate program and how they relate to the established three areas for strategic focusing and planning are contained in Table 1.

Complex systems modeling	Scientific computing	Data science
Fluid dynamics	High-performance computing	Computational biology
Coronal mass explosions	Optimization	Mathematical finance
Waves in random media	Applied linear algebra	Image processing
Nonlinear waves	Inverse problems	Power grid reliability
Renewable solar energy	Numerical analysis	Genomics

Table 1: Specific fields of research emphasis within the Applied Mathematics graduate program and how they relate to the established three areas for strategic focusing and planning.

2. There are three plans in the graduate program leading to Masters of Science (M.S.) and Doctor of Philosophy (Ph.D.) degrees: M.S. Plan I, M.S. Plan II, and Ph.D. Plan.

3. The M.S. and Ph.D. degrees in the graduate program do not require licensing or certification.

4. Unit requirements for the M.S. degree.

   The Applied Mathematics group has established the following requirements for the M.S. degree. Two different degree plans are recognized. Plan I (Thesis) is for students wishing to engage in academic research. This degree plan involves the writing of a thesis containing an original research project and results. Students may consider this degree plan if they wish to pursue a doctorate elsewhere or seek a career in research, for example. Plan II (Capstone) is for students who do not wish to engage as deeply in academic research as those pursuing Plan I. Students may consider this degree plan if they wish to pursue a career in teaching, software engineering, or data analysis, for example. The requirements that the Students must meet for each plan are specified below.

   PLAN I (Thesis)

   - Obtain a score of at least 2 on each of the four written preliminary exams;
   - Complete the five required core courses with grade of at least B;

[1] http://graduatedivision.ucmerced.edu/forms-publications

- Complete the Applied Mathematics Seminar for at least two semesters with grade of S ("Satisfactory"); students are expected to attend all seminars in the Applied Mathematics Seminar (MATH 291) when possible;
- Complete at least one Special Topics course with grade of at least B;
- Serve as a half-time Teaching Assistant (TA) for at least one semester (or equivalent);
- Complete MATH 201 *Teaching & Learning in the Sciences* (or equivalent) and MATH 399 *University Teaching*;
- Meet with the faculty committee at least once a year to report progress towards degree;
- Prepare and successfully defend a thesis (see Section 7.3).

PLAN II (Capstone)

- Obtain a score of at least 2 on each of the four written preliminary exams;
- Complete the five required core courses with grade of at least B;
- Complete the Applied Mathematics Seminar for at least two semesters with grade of S ("Satisfactory"); students are expected to attend all seminars in the Applied Mathematics Seminar (MATH 291) when possible;
- Complete at least two Special Topics courses with grade of at least B;
- Serve as a half-time Teaching Assistant (TA) for at least one semester (or equivalent);
- Complete MATH 201 *Teaching & Learning in the Sciences* (or equivalent) and MATH 399 *University Teaching*;
- Meet with the research advisor as necessary to report progress towards degree.
- Complete the capstone requirement (see Section 7.2).

5. Unit Requirements for the Ph.D. Degree.

   The Applied Mathematics group has established the following requirements for the Ph.D. degree. The requirements that the Student must meet are specified below.

   - Obtain a score of 3 on at least three of the four written preliminary exams and 2 on the remaining exam;
   - Complete the five required core courses with grade of at least B and a grade point average of at least 3.25;
   - Complete the Applied Mathematics Seminar for at least two semesters with grade of S ("Satisfactory"); students are expected to attend all seminars in the Applied Mathematics Seminar (MATH 291) when possible;
   - Complete at least two Special Topics courses with grade of at least B;
   - Serve as a half-time Teaching Assistant (TA) for at least two semesters (or equivalent);
   - Complete MATH 201 *Teaching & Learning in the Sciences* (or equivalent) and MATH 399 *University Teaching*;
   - Pass a qualifying examination (see Section 8.2);
   - Give at least one open technical oral presentation while in residence (see Section 8.3);
   - Meet with the faculty committee at least once a year to report progress towards degree;
   - Present and successfully defend a Ph.D. dissertation (see Section 8.4).

5.1 Required and Supporting Courses

Listed below are the required and supporting courses[2].

5.1.1 Required Core Courses

- MATH 221: Partial Differential Equations I
- MATH 222: Partial Differential Equations II
- MATH 223: Asymptotics and Perturbation Methods
- MATH 231: Numerical Solution of Differential Equations I
- MATH 232: Numerical Analysis II

5.1.2 Required Supporting Courses

- MATH 291: Applied Mathematics Seminar
- MATH 292 Special Topics in Applied Mathematics
- MATH 201: Teaching and Learning in the Sciences
- MATH 399: University Teaching

5.1.3 Other Supporting Courses

- MATH 233: Scientific Computing
- MATH 295: Graduate Research
- MATH 298/198: Directed Group Study
- MATH 299 Directed Independent Study

5.1.4 Other supporting courses at UC Merced

There are several existing graduate-level and upper-division undergraduate courses offered by other groups at UC Merced that can be very useful for Applied Math graduate students. At this time, such courses include, among others, PHYS 210: Electrodynamics; PHYS 212: Statistical Mechanics; QSB 282: Bioinformatics; BEST 204: Kinetics and Processing; EECS 260: Optimization; EECS 274: Computer Vision; EECS 276: Machine Learning; EECS 284: Large Scale Data Management; MEAM 135: Finite Element Analysis; MEAM 211: Nonlinear Controls; MEAM 231: Conduction Heat Transfer. In addition, there are many

[2]For course descriptions, see http://catalog.ucmerced.edu

graduate-level Special Topics (292) courses offered at UC Merced that can serve Applied Math graduate students as well. The number of these courses has been gradually increasing and is expected to increase in the future as well.

5.1.5 Other supporting courses at other UC institutions

In Spring 2009, Prof. James Demmel from UC Berkeley at UC Berkeley offered a graduate-level course on Scientific Computing[3] focused on developing understanding and practical knowledge of High Performance Computing (HPC). The course entailed projects using (remotely) parallel computing facilities at the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Lab (LBNL). The course has been taught for several years by Prof. Demmel, who is a leader in the field of HPC. Prof. Demmel was interested in extending this class to UC Merced. To this end, this class was videoconferenced from UC Berkeley. The course was cross-listed as MATH 233: Scientific Computing. Prof. Mayya Tokman served as the instructor-of-record for this course. Several Applied Math graduate students enrolled in this course.

Dr. Phillip Colella from LBNL and UC Berkeley has developed a new graduate-level course on Software Engineering for Scientific Computing[4] that will be very useful for our graduate students. Dr. Colella is the Head of the Applied Numerical Algorithms Group at NERSC and leader in the field of HPC. This course will be webcasted in Fall Semester 2013 and Dr. Colella is interested in extending the class to UC Merced. We are currently working to offer this to our graduate students as a cross-listed course, Math 233: Scientific Computing.

6 General Requirements for Advanced Degrees

6.1 Advisor and Faculty Committee

Initial Graduate Advisors will be assigned from the AMGS faculty to new graduate students. These advisors will mentor the students until such time as they have a graduate research advisor. The Initial Graduate Advisors will be responsible for the initial advising of graduate students, including dealing with coursework requirements and assisting students to identify research advisors matching their interests.

Beginning with their second year of graduate studies, all M.S. and Ph.D. students in the graduate program must have a faculty research advisor. Student in the M.S. Plan I (Thesis) must establish a faculty committee in consultation with the research advisor by the end of their second year of studies and prior to defending the M.S. thesis, whichever comes first. Students in the Ph.D. Plan must establish a faculty committee in consultation with the research advisor by the end of their second year of studies and prior to taking the Ph.D. qualifying examination, whichever comes first.

The M.S. Plan I (Thesis) faculty committee must consist of two to three UC Senate faculty, one of whom is the chair of the committee, who is usually also the student's research advisor. The Ph.D. faculty committee must consist of three to five UC Senate faculty, one of whom is the chair of the committee, who is usually also the student's research advisor. Additional committee members can be non UC Senate faculty. A majority of

[3] See http://www.cs.berkeley.edu/ demmel/cs267_Spr09

[4] See http://www.eecs.berkeley.edu/ colella/CS294_73F2011

committee members must be core faculty of AMGS. The faculty committee must be approved by the chair of the graduate program in consultation with the Executive Committee.

The roles of the faculty committee are detailed in Sections 7 and 8. Once the faculty committee has been established, students should meet with the faculty committee at least once a year to report progress towards degree. See Appendix B.1 for a report template. In addition, students are encouraged to meet with their committee members and solicit their feedback well in advance of submitting an official thesis or research proposal.

All members of the committee must be in attendance for Ph.D. qualifying examinations and dissertation defense. If a faculty committee member's absence from campus for an extended period of time makes scheduling of examinations unreasonably difficult, the student may request that the committee be reconstituted. Reconstitution of the committee may also be justified by a substantial change in the student's dissertation topic or may be required by the departure of a committee member from the university. When membership changes must be made, the graduate advisor in consultation with the student should recommend a new committee member, giving the reason for the change. The change must be approved by the chair of the graduate program with consultation from the Executive Committee.

6.2 Preliminary Exams

Preliminary examinations are offered at the beginning and end of the Spring semester each year. These are four closed-book written examinations in (i) differential equations, (ii) advanced calculus, (iii) complex variables and (iv) linear algebra. The examinations are given at the advanced-undergraduate / beginning-graduate level. For each of the four exams, students receive a score of 1 (Not Pass), 2 (M.S. Pass) or 3 (Ph.D. Pass), as determined by the committee in charge of the examination.

All students in the graduate program are required to take the preliminary exams in the beginning of the Spring semester of their the first year of study. All students must obtain a score of at least 2 on all four exams. A student may retake from one to four of the exams, but exams must be re-taken at the end of the same Spring semester. If the student does not obtain a score of at least 2 on all four exams after two attempts, he or she is disqualified from further study in the graduate program.

6.3 Applied Mathematics Seminar Series

The Applied Mathematics Seminar Series runs in the Spring and Fall semesters, with talks held nearly each week. Talks cover a broad spectrum of mathematical problems and novel applications. All students are required to enroll in MATH 291 *Applied Mathematics Seminar* for at least two semesters, where attendance in the Seminar Series is required. Regardless of enrollment in MATH 291, AMGS students are expected to attend all seminars in the series whenever possible.

7 Master of Science Degree

7.1 Significance

Students may be admitted to the graduate program in Applied Mathematics to work towards a Master of Science (M.S.) Degree. The recipient of a M.S. degree is understood to possess knowledge of a broad field of learning that extends well beyond that attained at the undergraduate level, but is not necessarily expected to have made a significant original contribution to knowledge in that field.

7.2 M.S. Capstone Project

The M.S. Capstone Project should be a written document presenting research accomplished under the supervision of the research advisor. The document must be approved by the faculty mentor. The faculty mentor, in consultation with the chair of the graduate program, may also require that the Capstone Project be approved by additional reviewers. Each reviewer must complete the Capstone Evaluation Rubric (see Appendix B.2). The student must submit the final Capstone Project in PDF form to the chair of the graduate program no later than 30 days after the project has been approved. The student must also file the final Capstone Project with the Division of Graduate Studies.

7.3 M.S. Thesis and Final Examination

All students in M.S. Plan I are required to defend a thesis prior to obtaining the M.S. degree. The defense consists of written and oral components. The dates for the M.S. thesis defense are arranged between the student and the committee.

7.3.1 Thesis Proposal

The M.S. thesis should describe original research in the field. The work must be the student's and it must be original. The student is encouraged to discuss with members of the faculty committee both the substance and the preparation of the thesis well in advance of the planned defense date. Detailed instructions on the form of the thesis and abstract may be obtained from the Division of Graduate Studies.

The student must provide each member of the faculty committee a copy of the thesis proposal (typically five to ten pages) that describes the dissertation research topic, summarizes progress to date, outlines what the student proposes to do, why it is relevant, and what will be learned. Each committee member is allowed 30 days to read and comment on the thesis proposal. If any member of the faculty committee determines that there are significant errors or shortcomings in the thesis proposal or that the scope or nature of the work is not adequate for a M.S. degree, the student must address these shortcomings.

7.3.2 Thesis Defense and Final Examination

The student must schedule a tentative date for the thesis defense in consultation with the faculty committee. The oral component of the defense consists of two parts. The first part is a presentation of the research proposal (see Section 7.3.1). This part is open to the public. The second part is an oral examination that serves to ascertain the breadth of a student's comprehension of fundamental facts and principles from his or her graduate course work. This part is closed to the public – only the student and the faculty committee are present.

At the conclusion of the examination, the faculty committee shall vote on whether both the written thesis proposal and the student's performance on the exam are of satisfactory quality to earn a University of California M.S. degree. A simple majority is required for a pass. Members of the committee may vote to make passing the exam contingent on corrections and/or revisions to the thesis. In such a case, the faculty committee will select one member, normally the graduate research advisor, who will be responsible for approving the final version of the thesis that is filed with the Division of Graduate Studies. Each committee member must complete the Thesis Evaluation Rubric form after the exam – see Appendix B.3.

The student must submit the thesis in PDF form to the chair of the graduate program no later than 30 days after the final examination date. The student must also file the final thesis with the Division of Graduate Studies.

8 Doctor of Philosophy Degree

8.1 Significance

The Doctor of Philosophy degree is granted to students who demonstrate a thorough knowledge of a broad field of learning and have given evidence of distinguished accomplishment in that field. The degree also signifies that the recipient has critical ability and powers of imaginative synthesis as demonstrated by a Ph.D. dissertation containing an original contribution to knowledge in his or her chosen field of study.

8.2 Qualifying Examination

All students in the Ph.D. Plan are required to pass a qualifying exam prior to advancement to candidacy for the Ph.D. degree. The qualifying exam consists of written and oral components. The dates for the examination are arranged between the student and the faculty committee. All members of the faculty committee must be in attendance for Ph.D. qualifying examinations and dissertation defense.

8.2.1 Research Proposal

The student must to provide the faculty committee a written research proposal (typically five to ten pages) that describes the dissertation research topic, summarizes progress to date, outlines what the student proposes to do, why it is relevant, and what will be learned. This proposal needs to be submitted to the faculty committee at least 30 days prior to the oral component (Section 8.2.2). The student must also submit for

approval the "Application For Qualifying Examination" form to the Division of Graduate Studies at least one month prior to the oral component date.

The faculty committee will review the research proposal and determine if the student has outlined a project that is deemed appropriate for a Ph.D. If not, the student will be given 30 days to rewrite the research plan. Once the research plan has been approved, the student may take the oral component of the qualifying exam.

8.2.2 Proposal Presentation & Oral Exam

The oral component of the qualifying exam consists of two parts. The first part is a presentation of the research proposal (see Section 8.2.1). This part is open to the public. The second part is an oral exam, which serves to ascertain the breadth of a student's comprehension of fundamental facts and principles from his or her graduate course work. This part is closed to the public – only the student and the faculty committee are present.

8.2.3 Assessment of the Qualifying Exam

The faculty committee will assess the two parts of qualifying exam. Each committee member must complete the Thesis Evaluation Rubric form after the exam – see Appendix B.4. The result will be determined by a vote of the faculty committee. The committee will notify the student of the result and immediately thereafter submit this result to the Division of Graduate Studies. Possible outcomes of the qualifying examination are:

1. PASS (conditions may not be appended to a pass decision);
2. FAIL;
3. PARTIAL PASS with an option to retake the exam within a specified time period, or to satisfy specific requirements.

8.2.4 Advancement to Candidacy

Upon advancement to candidacy, the faculty committee is charged with guiding the student in research and in the preparation of the dissertation.

8.3 Technical Presentation

All Ph.D. students in AMGS are required to give at least one open technical oral presentation while in residence. This presentation needs to demonstrate original research. This presentation should be in a scholarly setting, such as a conference or seminar. The open presentations given as part of the Ph.D. qualifying examination and dissertation defense may not be counted as one of the required seminars. The topic of the presentation may be the student's own research or it may be any other topic that falls within the areas of study spanned by the group, broadly defined.

8.4 Ph.D. Dissertation and Final Examination

All students in the Ph.D. Plan are required to defend a dissertation prior to obtaining the Ph.D. degree. The defense consists of written and oral components. The dates for the dissertation defense are arranged between the student and the faculty committee. All members of the faculty committee must be in attendance for the Ph.D. dissertation defense.

8.4.1 Dissertation

The Ph.D. dissertation must be creative and independent work that can stand the test of peer review. The work must be the student's. It must be original and deemed by the faculty committee to be publishable in an appropriate peer-reviewed journal. The student must submit to the faculty committee all papers containing results from the Ph.D. work on which s/he is an author. The student is encouraged to discuss with members of the faculty committee both the substance and the preparation of the dissertation well in advance of the planned defense date. Detailed instructions on the form of the dissertation and abstract may be obtained from the Division of Graduate Studies. See Appendix B.5 for a Syllabus for the Dissertation.

The student must provide a copy of the dissertation to each member of the faculty committee, after which each committee member is allowed 30 days to read and comment on it. The student must also schedule a tentative date for the defense and final examination in consultation with the faculty committee. If one or more committee members believe that there are significant errors or shortcomings in the dissertation or that the scope or nature of the work are not adequate, the student must address these shortcomings and potentially reschedule the defense date.

8.4.2 Dissertation Defense and Final Examination

The Ph.D. final exam consists of an open seminar on the dissertation work followed by a closed examination by the faculty committee. During the examination, the student is expected to explain the significance of the research, justify the methods that have been employed, and defend the conclusions of the research. At the conclusion of the examination, the faculty committee shall vote on whether both the written dissertation and the student's performance on the exam are of satisfactory quality to earn a University of California Ph.D. degree. Each committee member must complete the Thesis Evaluation Rubric form after the exam – see Appendix B.6. A simple majority is required for a pass. Members of the committee may vote to make passing the exam contingent on corrections and/or revisions to the dissertation. In such a case, the faculty committee will select one member, normally the graduate research advisor, who will be responsible for approving the final version of the dissertation that is filed with Division of Graduate Studies.

The student must submit the signed dissertation in PDF form to the chair of the graduate program no later than 30 days after the final examination date. The student must also file the final dissertation with the Division of Graduate Studies.

9 Relationship between the M.S. and Ph.D. Plans

With regard to the preliminary exams, all students are required to pass all four exams during their first year of graduate studies. However, the threshold is higher for Ph.D. students. Students in the M.S. plans are required to pass all four preliminary exams with a score of at least 2 on each exam. Students in the Ph.D. Plan are required to pass with a score of at least 3 on any three of the exams and a score of at least 2 on the fourth exam.

With regard to coursework, the M.S. and Ph.D. plans share much in common, though the Ph.D. Plan has higher standards. In particular, students in the M.S. and Ph.D. plans are required to complete the five core courses with a grade of at least B. However, students in the Ph.D. Plan are required to complete these courses with a grade point average of at least 3.25.

The main differences between the M.S. Plan I and the M.S. Plan II is that the thesis in Plan I is expected to be an original contribution, whereas, the Capstone Project need only extend well beyond the undergraduate curriculum. With regard to coursework, students in Plan II are required to pass two Special Topics courses, whereas, students in Plan I are not required to take Special Topics courses.

With regard to research, the recipient of the Ph.D. degree is expected to have made a significant original contribution to knowledge in that field. The recipient of a M.S. degree is understood to possess knowledge of a broad field of learning that extends well beyond that attained at the undergraduate level, but is not necessarily expected to have made a significant original contribution to knowledge in that field.

9.1 Transfer from Ph.D. to M.S. Program

Students in good academic standing and who obtained scores of at least 2 on all preliminary exams may petition to move from the Ph.D. to M.S. program and pursue a terminal M.S. degree. A student working towards a Ph.D. who completes M.S. requirements may petition to be awarded a M.S. Degree. Additionally, a Ph.D. student who has been in residence for at least two semesters, is in good academic standing, and has completed at least three of the core courses may petition the Admissions Committee to pursue a terminal M.S. degree.

10 Timetable and Milestones

All students in the graduate program must pass the preliminary examinations during their first year in the program.

All students in the graduate program are expected to complete the required coursework during their first two years in the program. A student who needs to take the required coursework over a period that extends beyond two years must successfully petition the chair of the graduate program.

Students pursuing the M.S. Plan I (Thesis) and Ph.D. degrees must meet with their faculty committee at least once a year to report progress towards degree. The faculty committee will prepare a summary report of the student's progress, share the report with the student and submit it to the chair of the graduate program.

Students in the M.S. Plan II must meet with their research advisor as necessary to report progress towards degree.

Students pursuing the M.S. Plan I (Thesis) or M.S. Plan II (Capstone) degrees are expected to submit an adequate Capstone Project or successfully defend a thesis by the end of their second year, but no later than their third year, unless they successfully petition the chair of the graduate program to take it in a later year.

Ph.D. students are expected to pass the qualifying examination by their second year in the program, but no later than their third year, unless they successfully petition the chair of the graduate program to take it in a later year. Ph.D. students are expected to defend their dissertation by their fifth year in the program, but no later than their sixth year, unless they successfully petition the chair of the graduate program to take it in a later year.

If a student has made insufficient progress in the preliminary exams, coursework or research, a "Notice of Potential for Unsatisfactory Progress" (see Section 10.1.1) will be made to the student by the chair of the graduate program, research advisor, or faculty committee as appropriate.

10.1 Sample Outline of Courses

A sample outline of the courses and other academic requirements for M.S. and Ph.D. students is presented in Table 2.

Semester	Coursework	Other requirements
1	MATH 221, MATH 231, MATH 201 MATH 291, MATH 298, MATH 399	Study for preliminary exams
2	MATH 222, MATH 232, MATH 223 MATH 291	Pass preliminary exams Seek research advisor
3	MATH 292 (Special Topics) MATH 295 / 299	Assemble faculty committee Work on Capstone Project
4	MATH 292 (Special Topics) MATH 295 / 299	Complete M.S. Capstone Project M.S. thesis defense Pass Ph.D. qualifying exam
5–10	MATH 295 / 299	Prepare research manuscripts Present research at conferences Defend Ph.D. dissertation

Table 2: Sample program for M.S. and Ph.D. students in each semester.

It is envisioned that additional Special Topics courses in Applied Math will be offered beyond those listed in Section 5.1.2. Recognizing the interdisciplinary nature of research in applied mathematics, students may take advanced courses from other disciplines, in consultation with the advisor. A MATH 295 / 298 / 299 course could also be approved as a Special Topics course. In addition, Summer semesters can be used for full or partial-time research.

10.1.1 Notice of Potential for Unsatisfactory Progress

The purpose of a Notice of Potential for Unsatisfactory Progress is to provide the student with a period of time (usually at least one academic semester) in which to make the necessary improvement and successfully complete the degree requirements. Such a notice should be sent in writing to the student; a copy will also be retained in the Graduate Group files and another copy sent to the Graduate Dean. The written communication should include specific details on areas that require improvement, provide an outline for future expectations of academic progress, and set a timeline and / or dates to maintain assessment and continuity in advisement. The student is advised to meet with the chair of the graduate program, research advisor and / or members of the faculty committee as appropriate to discuss how to rectify the situation.

11 Teacher Preparation

All students in the graduate program are required to pass MATH 201: **Teaching & Learning in the Sciences** and MATH 399: **University Teaching** (see Section 5.1.2). Furthermore, all students in the graduate program are required to serve as a half-time TAs for at least one semester (or equivalent) during their residence in the program.

Beyond the requirement of the graduate program, there exist opportunities for grad students to become Teaching Fellows at the Center for Research on Teaching Excellence (CRTE) [5].

12 Graduate Assistantships

Graduate students in Applied Mathematics are normally offered financial support through appointment either as a Teaching Assistant (TA), Teaching Fellow (TF), and/or Graduate Student Researcher (GSR). For detail, see the UCOP's website[6]. Information regarding student fees and expenses can be found at on the Registrar's website[7].

Students in their first semester of residence usually serve as TAs for appropriate courses in the schools of Natural Sciences or Engineering. After the first semester, support may be offered through either funding as a TA or a GSR in the graduate research adviser's group. Graduate students with external fellowships are still required to satisfy the one- or two-semester teaching requirement and will be paid by the school for teaching. While every effort will be made to provide employment as a TA, Teaching Fellow, or GSR for all graduate students in residence, admission to graduate studies carries no guarantee of financial support beyond that specified in the initial letter of commitment of financial support (if any). During the academic year, appointments are limited to 49.9% time. During academic breaks and summer months, students may be appointed at 100% time when research funds to support additional GSR support are available.

[5] http://crte.ucmerced.edu/grants
[6] http://www.ucop.edu/academic-personnel/compensation/2013-academic-salary-scales.html
[7] http://registrar.ucmerced.edu/policies/fees

13 Changes to Policies & Procedures

A student entering AMGS is bound under the Policies and Procedures in place in the student's first semester. If Policies and Procedures change, a student may petition the Executive Committee to work under the new requirements.

A Program Learning Outcomes

The Program Learning Outcomes (**PLOs**) for the Ph.D. degree plan and each of the M.S. degree plans are listed below.

- Upon graduating, students completing the **Ph.D. degree** are expected to be able to:
  1. Formulate well-posed mathematical problems and provide analytical insight for solving them.
  2. Design, implement, and validate potentially novel computational methods for solving mathematical problems.
  3. Give clear and organized written and verbal explanations of mathematical ideas to a variety of audiences including teaching undergraduate students.
  4. Model real-world problems mathematically and analyze those models using their mastery of the core concepts.
  5. Recognize ethical and responsible conduct and learn how to apply them to research.
  6. Make an original and significant contribution to the knowledge in a chosen research subfield of Applied Mathematics.
- Upon graduating, students completing the **M.S. degree, Plan I**, are expected to be able to:
  1. Solve advanced mathematical problems using analytical methods.
  2. Solve advanced mathematical problems using computational methods.
  3. Give clear and organized written and verbal explanations of mathematical ideas to a variety of audiences including teaching undergraduate students.
  4. Model real-world problems mathematically and analyze those models using their mastery of the core concepts.
  5. Recognize ethical and responsible conduct and learn how to apply them to research.
  6. Make an original contribution to the knowledge in a chosen research subfield of Applied Mathematics.
- Upon graduating, students completing the **M.S. degree, Plan II**, are expected to be able to:
  1. Solve advanced mathematical problems using analytical methods.
  2. Solve advanced mathematical problems using computational methods.
  3. Give clear and organized written and verbal explanations of mathematical ideas to a variety of audiences including teaching undergraduate students.
  4. Model real-world problems mathematically and analyze those models using their mastery of the core concepts.
  5. Recognize ethical and responsible conduct and learn how to apply them to research.
  6. Present a capstone project that extends well beyond the undergraduate curriculum.

B Evaluation Rubrics

Listed below are several evaulation rubrics for the M.S. and Ph.D. degrees.

B.1 Applied Math Annual Committee Meeting Evaluation Rubric

This form is intended to provide feedback to the student, the faculty advisor, and the program on the required annual meeting of students with their faculty committees. The completed form should then be transmitted to the committee and the student, with a copy for the student's permanent record.

Part I

Name of student: _____

Semester and year entered program: _____

Degree goal (Ph.D. or M.S.): _____

For Ph.D.: Has the student advanced to candidacy? _____

Committee members present (at least three members must be in attendance, either in person or remotely)

_____ (Faculty advisor)

_____

_____

_____

_____

_____ Date

Part II: To be completed by Faculty Adviser following the meeting

Summarize the progress the student has made toward the degree during the past year (course work, exams, research, publications, presentations). Note any specific or general areas of concern.

If the student has advanced to candidacy, summarize what the student needs to accomplish in order to have a defensible dissertation.

Note any additional recommendations for this student's professional development outside the standard program requirements (e.g., additional coursework or self-study, training in specific skills, English language training, writing instruction, short courses at conferences).

Rate the student on the following Program Learning Objectives (Excellent, Good, Fair, or Poor).

PLO #3: Give clear and organized written and verbal explanations of mathematical ideas to a variety of audiences, including teaching undergraduate students.

PLO #5: Recognize ethical and responsible conduct and learn how to apply them to research.

Part III: To be completed by the student

Summarize the progress you have made toward the degree during the past year (course work, exams, research, publications, presentations). How would you rate your progress? How would you rate your effort?

If you have advanced to candidacy, summarize what you need to accomplish in order to have a defensible dissertation.

Are there any additional activities outside the standard program requirements that you feel would be helpful to your professional development (e.g., additional coursework or self-study, training in specific skills, English language training, writing instruction, short courses at conferences)?

Rate yourself on the following Program Learning Objectives (Excellent, Good, Fair, or Poor).

PLO #3: Give clear and organized written and verbal explanations of mathematical ideas to a variety of audiences, including teaching undergraduate students.

PLO #5: Recognize ethical and responsible conduct and learn how to apply them to research.

B.2 Applied Math Capstone Project Evaluation Rubric

This form is intended to provide a common set of criteria for the assessment of the Captsone Project for the M.S. degree. Each reviewer of the Captsone Project must complete this form following the review.

Please rate each attribute on the following scale: 1 = Excellent, 2 = Good, 3 = Fair, 4 = Poor (failing)

The student demonstrated the ability to:	
Critically read, understand, and discuss literature in the relevant field	
Connect Captsone Project to real-world problems	
Demonstrate command of fundamental analytical and computational concepts related to project topic	
Identify appropriate analytical and computational approaches to address research topic	
Effectively communicate mathematical concepts	
Conduct and present research in a responsible and ethical manner	

Please note any additional comments below.

B.3 Applied Math M.S. Thesis Evaluation Rubric

This form is intended to provide a common set of criteria for the assessment of the dissertation for the M.S. degree. Each committee member must complete this form after the exam.

Please rate each attribute on the following scale: 1 = Excellent, 2 = Good, 3 = Fair, 4 = Poor (failing)

The student demonstrated the ability to:	
Identify an original and meaningful research topic	
Critically read, understand, and discuss literature in the relevant field	
Connect dissertation project to real-world problems	
Demonstrate command of fundamental analytical and computational concepts related to project topic	
Identify appropriate analytical and computational approaches to address research topic	
Effectively communicate mathematical concepts	
Describe computational methods in sufficient detail that numerical experiments could be reproduced	
Evaluate critically and carefully analyze data	
Present figures and tables clearly	
Draw conclusions that are adequately supported by the data	
Conduct and present research in a responsible and ethical manner	

Please note any additional comments below.

B.4 Applied Math Ph.D. Qualifying Exam Evaluation Rubric

This form is intended to provide a common set of criteria for the assessment of presentations and oral exams for advancement to candidacy for the Ph. D. Each committee member must complete this form after the exam.

Please rate each attribute on the following scale: 1 = Excellent, 2 = Good, 3 = Fair, 4 = Poor (failing)

The student demonstrated the ability to:	
Critically read, understand, and evaluate literature in the relevant field	
Integrate ideas within the field and pose an original and significant research problem	
Demonstrate command of fundamental analytical and computational concepts related to research area	
Identify appropriate analytical and computational approaches to address research problem	
Generate and critically evaluate preliminary results	
Effectively communicate mathematical concepts, including the questions to be addressed and their significance	

Please note any additional comments below.

B.5 Syllabus for the Dissertation Towards Fulfillment of the Ph.D. in Applied Mathematics

Purpose

The dissertation is the final and central requirement for the Applied Mathematics Ph.D. degree. The successful completion of this requirement is demonstrated through the production of a dissertation document that describes an original research project and its results, and the defense of the project from challenges and questions offered by the members of the student's faculty committee. The quality of the written dissertation and its defense are evaluated by the faculty committee in order to determine whether the student has successfully completed this final requirement for the Ph.D degree.

Program Learning Outcomes

Candidates for the Ph.D. in Applied Mathematics will:

1. Solve advanced mathematical problems using analytical methods.
2. Solve advanced mathematical problems using computational methods.
3. Give clear and organized written and verbal explanations of mathematical ideas to a variety of audiences including teaching undergraduate students.
4. Model real-world problems mathematically and analyze those models using their mastery of the core concepts.
5. Recognize ethical and responsible conduct and learn how to apply them to research.
6. Make an original and significant contribution to the knowledge in a chosen research subfield of Applied Mathematics.

The Dissertation

The Ph.D. dissertation must be creative and independent work that can stand the test of peer review. The work must be the student's. It must be original and deemed by the faculty committee to be publishable in an appropriate peer-reviewed journal. The student must submit to the faculty committee all papers containing results from the Ph.D. work on which s/he is an author. The student is encouraged to discuss with members of the faculty committee both the substance and the preparation of the dissertation well in advance of the planned defense date. Detailed instructions on the form of the dissertation and abstract may be obtained from the Division of Graduate Studies.

The student must provide a copy of the dissertation to each member of the faculty committee, after which each committee member is allowed 30 days to read and comment on it. The student must also schedule a tentative date for the defense and final examination in consultation with the faculty committee. If one or

more committee members believe that there are significant errors or shortcomings in the dissertation or that the scope or nature of the work are not adequate, the student must address these shortcomings and potentially reschedule the defense date. The defense date must be reported to the Dean of Division of Graduate Studies no later than one week prior to the defense date.

The Dissertation Defense

The Ph.D. final exam consists of an open seminar on the dissertation work followed by a closed examination by the faculty committee. During the examination, the student is expected to explain the significance of the research, justify the methods that have been employed, and defend the conclusions of the research. At the conclusion of the examination, the faculty committee shall vote on whether both the written dissertation and the student's performance on the exam are of satisfactory quality to earn a University of California Ph.D. degree. A simple majority is required for a pass. Members of the committee may vote to make passing the exam contingent on corrections and/or revisions to the dissertation. In such a case, the faculty committee will select one member, normally the graduate research advisor, who will be responsible for approving the final version of the dissertation that is filed with Division of Graduate Studies.

At least two members of the faculty committee must sign the final dissertation. The student must submit the thesis in PDF form to the Chair of the graduate program no later than 30 days after the final examination date. The student must also file the final thesis with the Division of Graduate Studies.

B.6 Applied Math Ph.D. Dissertation and Defense Evaluation Rubric

The form below is intended to provide a common set of criteria for the assessment of Ph.D. dissertations and defenses Each committee member must complete this form at the end of the defense.

Please rate each attribute on the following scale: 1 = Excellent, 2 = Good, 3 = Fair, 4 = Poor (failing)

Introduction	
Identifies an original and meaningful research topic	
Formulates problem clearly and precisely and connects it to physical real-world problems	
Presents the key results of the dissertation and how they address the research problem	
Provides comprehensive literature review and places research work in proper context	

Main contribution	
Identifies appropriate analytical approaches to the chosen research problem	
Results are correct and are presented lucidly and rigorously	
Identifies appropriate computational approaches to the chosen research problem	
Computational methods are described in sufficient detail that numerical experiments could be reproduced	

Results and analysis	
The data obtained are sufficient in quantity and nature to address the research question	
Data are critically evaluated and carefully analyzed	
Figures and tables presented are clear and meaningful	

Discussion and conclusions	
Conveys significance of findings to the field of study	
Discusses the strengths and weaknesses in the work	
Conclusions drawn are adequately supported by the data	
Identifies potential directions of further research	

Mechanics	
Grammatical and spelling errors are sufficiently minor that they do not affect comprehensibility	
Literature citations in the text and bibliography are correct	
Professionalism	
Dissertation work is conducted and presented in a responsible and ethical manner	

Please note any additional comments below.