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Welcome

The Graduate Faculty in Scientific Computation encourages your interest in this program. Please let us know your questions and suggestions as to how this Handbook could serve you better.

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Program Overview

Introduction

The Graduate Degree Program in Scientific Computation received final approvals in January 1994. It evolved from the Graduate Minor Program in Scientific Computation, which was created in 1990.

The graduate degree program in scientific computation encompasses course work and research on the fundamental principles necessary to use intensive computation to support research in the physical, biological, and social sciences, and engineering. There is a special emphasis on research issues, state-of-the-art methods, and the application of these methods to outstanding problems in science, engineering, and other fields that use scientific computation, numerical analysis and algorithm development, symbolic and logic analysis, high-performance computing tools, supercomputing and heterogeneous networks, and visualization.

Purpose of the Program

Scientific Computation is gradually emerging as an important field of its own in academia and industry. In the last decade, it has become clear that to solve a given scientific problem often requires knowledge that straddles several disciplines. This interdisciplinary program provides a new combination of studies for solving today's scientific computational problems. This degree program builds on the strength of existing programs in formulating real problems based on the physical system or the traditional discipline, and it augments the segments relating to the mathematical and numerical modeling by providing state-of-the-art theories and techniques for scientific computation in an integrated manner.

The Scientific Computation program provides new opportunities and options for graduate training in the problem-solving process and for integrating advances in all segments of the process into a coordinated program of course and thesis study. It offers a new interdisciplinary path of formal course and examination requirements toward a Ph.D. or M.S. degree, and this path should also be augmented by a strong participation in one of the more traditional disciplinary departments.

Sources of Information

Students are also directed to the Graduate School Bulletin for general information about all graduate programs and requirements for graduate students at the University of Minnesota. This handbook supplements that bulletin. Questions about registration, residency, and thesis credit requirements may be directed to the Graduate School at 625-3490. Information about the Twin Cities, campus activities, housing, and transportation may be found on the web.

Program Options

There are four program options: Ph.D. major, Ph.D. minor, M.S. major, and M.S. minor.

Degree Options in the Scientific Computation Program

There are two options for the Ph.D. degree:

1. Ph.D. with supporting program
2. Ph.D. with minor

The course requirements for these options are detailed later.

There is one type of Master's degree offered in the Scientific Computation Program. It will be the type commonly referred to as Plan A, and it requires the student to complete a thesis and a minor as well as a scientific computation core.

Full details on all degree programs are given in following sections.

Course Program: Ph.D.

Each student will choose a program of study in consultation with his or her three-member advising committee.

Course programs for Ph.D. students in Scientific Computation require a minimum of 24 graduate credits, of which at least 12 must be in Scientific Computation degree program core courses (see list in this handbook).

Thesis credits may not be counted toward the 24 credits required for a Ph.D. program in Scientific Computation. Inclusion of 4xxx level courses on a degree program form is subject to adviser and Director of Graduate Studies approval.

The Graduate School will accept only adult special, summer session, and CCE coursework taken at the University of Minnesota before spring semester 2001. Transfer of credits for graduate level work done at other institutions, if applicable, will be reviewed on an individual basis.

Ph.D. Degree Options

Ph.D. with Supporting Program

Students selecting the supporting program option for the Ph.D. degree will be required to take a course program of at least 24 credits, excluding thesis credits, meeting the following distribution requirement:

1. At least 12 credits in the Scientific Computation degree program core.

2. A supporting program of 12 credits. The supporting program should give the course program an interdisciplinary character.

Ph.D. with Minor

Students selecting the minor option for the Ph.D. degree are expected to satisfy the Scientific Computation core requirement and to achieve a competency in the minor field greater than that expected for “supporting programs”—in fact this is a mechanism for the student to establish a strong specialization in a traditional disciplinary area.

For the doctoral degree with a minor, at least 12 semester credits must be taken in the minor field. Many minor programs have greater requirements in terms of credits or examinations for a Ph.D. minor; in such cases the greater requirements will of course be in effect. The minor field must be declared before the student takes the preliminary oral examination.

A core course that happens to be in the designated minor area may be counted toward the core or the minor but not toward both. In any event, no more than four credits in the designated minor area may be counted as core courses for an individual student.

M. S. Degree

There will be one type of Master’s degree offered in the Scientific Computation Program. It will be the type commonly referred to as Plan A, and it requires the student to complete a thesis. For this degree there are explicit Graduate School requirements in terms of course credits and distribution. Details are to be found in the current University of Minnesota Graduate School Catalog. In particular, a program for a Plan A Master’s Degree Program requires a minimum of 20 course credits (14 credits in the major field) and 10 thesis credits culminating in a satisfactory dissertation. Any student wishing to plan a Master’s program will be advised to consult with his or her adviser or the Three-Member Advising-Committee in determining an acceptable program.

A Master’s program should include at least 6 credits drawn from the Scientific Computation degree program core courses listed later, and it must include at least 6 credits in a designated minor. (A core course that happens to be in the designated minor area may be counted toward the core or the minor but not toward both, but a maximum of 3 credits in such courses may be counted toward the core.)

For a Master’s degree, at least 6 semester credits must be taken in the minor field. Many minor programs have greater requirements in terms of credits for a Master’s minor; in such cases the greater requirements will be in effect.

Master’s degrees students are required by the Graduate School to complete at least 60 percent of the coursework for their official degree programs (excluding thesis credits) as registered University of Minnesota Graduate School students. Refer to the Graduate School Catalog for more information about transfer of credits.

Program Procedures

Three-Member Advising Committee

Students entering the program who have not chosen a research adviser will be assigned a three-member advising committee. The TMC will meet with the student before the beginning of his or her first semester in the program to advise on planning a course program and to talk over long- and short-range plans. After every meeting of the TMC, the student should file a report summarizing the meeting. This report should be cosigned by the chairman and given to the program administrator Kathleen Clinton. The TMC will continue to advise the student each semester until an adviser is chosen. The chairman of the TMC will be the adviser for signatures and forms until a permanent adviser is chosen. Membership of the committee will usually be determined to the greatest extent possible from the list of research interests submitted by the student. The responsibilities of the three-member advising committee (TMC) are to:

- a. Advise students on their course program.
- b. Ensure that each student gets a broad range of learning experiences.
- c. Review performance in courses, examinations, and research.
- d. Make recommendations regarding a student's progress to the DGS.
- e. Establish the written and oral prelim examination deadlines for students entering the program at times other than the beginning of fall semester or with transfer credits to be counted toward the Degree Program.

The TMC will play a role in advising students only until he or she has chosen a research adviser. After that the primary advising responsibility falls on the shoulders of the research adviser.

Permanent Adviser (Research Adviser)

Normally, a student should choose a permanent research adviser before the end of the *first* semester in residence. Failure to report the choice of a permanent research adviser before the end of the second semester will cause the student to no longer be considered in good academic standing. The adviser will be a member of the Graduate Faculty in Scientific Computation. The research adviser automatically assumes primary responsibility for advising the student on course work, research, and other academic matters.

The student should use the Advisor Form at the end of this handbook to report the choice of a research adviser, or equivalent information, cosigned by the adviser, may be provided in the form of a letter.

Filing a Degree Program Form

The Graduate School requires each graduate student to file a Degree Program Form for each degree that he/she is a candidate for. The Degree Program Form should typically be filed in the fall semester of the second year in residence. On the form, the student should list the courses that have already been completed and those that will be taken to complete the degree. However, courses taken prior to admission to the Graduate School cannot be included except by petition, and courses taken prior to receiving the bachelor's degree can never be included.

The form is filled out with the help of the student's adviser, who then must approve it. If the student has a minor stated on the degree program, the DGS of that graduate program must also approve it. The degree program then is approved by the DGS in Scientific Computation and ultimately the Dean of the Graduate School. When approving the degree program, the DGS also appoints the degree examining committee. The student and his/her advisor should suggest members of this committee and obtain their agreement to serve on the committee, by using a departmental form ("Prospective Committee Form"). Please do not write the committee members on the Degree Program Form. The committee is assigned by the DGS.

If the Degree Program Form has already been completed and there are changes to it, the student will need to complete a Petition Form, which can be obtained from the Graduate School, at 316 Johnston Hall. If changes are substantial, it may be more appropriate for the student to submit a revised Degree Program Form in lieu of the Petition Form. The Petition Form or the revised Degree Program Form should be presented to the adviser and the Director of Graduate Studies in Scientific Computation.

Examinations

Students in the Ph.D. program will be required to pass written and oral preliminary exams.

The preliminary written exam must be passed first; then the student may schedule the oral exam.

Written Preliminary Examination for the Ph.D.

The Scientific Computation format for the written preliminary examination consists of two parts:

1. a thesis-project proposal
2. a critique or research proposal based on a paper from the scientific computation literature, published within the last 3 years, not in the student's primary thesis research area

Both papers must be submitted on or before the end of the third semester of graduate study in the program.

Paper 1 should be prepared by the student in consultation with his or her adviser(s). Paper 2 should be prepared without the adviser's assistance. The choice of literature paper should be approved by the student's written preliminary examination committee chairman.

Each paper should be *typewritten, double-spaced*, and 8 to 16 pages long. The writing style and quality should be that of a journal article. Background and motivation should be given in an introductory section; the student's own contribution should be clearly identified as such. Proposals should be specific concerning the measurements or calculations to be made, the apparatus or methods to be employed, and the possible significance of the results.

The first paper will describe research actually to be undertaken for the thesis, or at least the first stages of the thesis project. The student's adviser will certainly participate in the formation and details of the research plans, but the organization and writing of the paper should be the student's own. The aim of the research dossier is to demonstrate that the candidate has attained a good understanding of the thesis project including the fundamental background and current literature. In view of the unpredictable nature of research, it is understood that specific projects described in this preliminary paper may differ from those actually reported in the Ph.D. thesis.

The first paper should succinctly describe the research the candidate is engaged in for her/his research. In particular, the following topics should be discussed in a balanced fashion:

- (1) The specific objective, including a discussion of the motivation for and the potential impact of the research.
- (2) A critical assessment of previous work in the scientific literature relevant to the proposed research.
- (3) The thesis research plan, including a discussion of existing practical and/or fundamental problems and how initial experiments to be conducted may influence the direction of subsequent research.
- (4) The research progress made to date.

The second paper is intended to demonstrate some breadth beyond the thesis area and the ability to read the literature at a reasonably critical level. The student will show this first by the quality of the article selected as the basis of the paper, and then by the appropriateness and originality of the extensions proposed for further research, in the case of a proposal, or the commentary offered, in the case of a critique. The latter may take the form of a critical analysis (could the same results have been obtained more simply by other methods, for example, or are there faults in the model used or in the working out of its consequences?) or a comparison with other work (in so far as the authors have not already done so) on the same or a related problem.

Schedule to be followed in satisfying the Written Preliminary Examination in Scientific Computation

The written preliminary examination is to be satisfied in the second year of the candidate's graduate work. The candidate should adhere to the following schedule:

Spring of 1st year: The candidate submits to the DGS of Scientific Computation a list of three faculty members of the Scientific Computation graduate program (not including the advisor(s)) whom the candidate feels would be well suited to serve on the written and oral preliminary exam committees.

Spring of 1st year: The DGS of Scientific Computation will appoint a written preliminary examination committee chairman at this time. Ordinarily this will be a member of the TMC, but not the research adviser. The preliminary examination committee chairperson will be available for consultation during the preparation of the preliminary written examination papers.

September of 2nd year: The student provides the DGS of Scientific Computation or the Scientific Computation administrator with a copy of the paper selected from the scientific computation literature for part 2.

November 1 of 2nd year: The DGS will inform the student of the names of two additional faculty members who, along with the written preliminary examination committee chairman, will constitute the student's written preliminary committee. The student's research adviser will not be a member of this committee.

December 20 of 2nd year: This is the deadline for handing in the papers. The committee chair will ordinarily send a letter to the student to inform the student of the opinions of the committee within three weeks of receipt of the papers. Sometimes this will be in the form of specific criticisms and suggested revisions for the candidate. In other cases the student will be told that he or she has passed or failed.

February 1 of 2nd year. Final drafts of the papers due to the DGS and the preliminary oral exam scheduled. The Degree Program Form must be approved by the Scientific Computation Graduate Program and the Graduate School before scheduling the oral exam. Approval of the Degree Program Form may take as long as six weeks.

The above dates apply to graduate students entering in the Scientific Computation Program as new graduate students in fall semester. For students entering in spring semester or entering the program as advanced graduate students, alternate dates (if appropriate) should be determined at the first meeting with the Scientific Computation TMC.

Oral Preliminary Examination for the Ph.D.

The DGS will appoint a committee consisting of at least **four** members, with at least three from the graduate faculty of Scientific Computation and **one** representing the minor field or supporting program. (A faculty member who is on the graduate faculty of both your major and minor may represent either but not both.) The student is responsible for handing in the form to request assignment of this committee. Please hand in this form at least one month before the proposed date of the examination.

Each Ph.D. candidate must pass the oral preliminary examination. Possible outcomes of the first examination are i) pass, ii) not pass but with option to retake (one time only) the examination, or iii) fail.

Students who have not passed their oral preliminary examination by the end of their second year will no longer be in good standing in the Ph.D. Program. They will be reclassified into the M.S. Program.

It should be noted in the case of retakes of failed exams that there is a Graduate School requirement that ten calendar weeks must pass before a retake of the preliminary oral examination may be scheduled.

The preliminary oral examination will concentrate on the student's understanding of the fundamental scientific computation background for his or her chosen thesis research and will test the student's preparedness to undertake this research. The oral preliminary examination will also test the student's understanding of the papers submitted for the preliminary written exam and their background. The oral preliminary examination will also cover course work, research topics, and material covered in or related to the written thesis proposal.

Final Oral Examination Committee for the Ph.D. degree

At the time the Thesis Title Form and Thesis Statement are submitted (this should be done at least three months prior to the anticipated date of the final oral examination, and it is perfectly acceptable to file these at any time after passing the oral preliminary exam), the student will be asked to submit the departmental Ph.D. Oral Examination Prospective Committee Form found in the with at least four names of prospective committee members, approved by the adviser. Ordinarily, at least three members should be the same as those who served on the preliminary oral examination, but this is not required. It is the student's responsibility to contact each of the faculty members listed regarding their willingness to serve as a committee member or reader.

For the final oral examination for the Ph.D., the adviser cannot serve as the chair. (This rule does not apply to preliminary oral exams or to final oral examinations for the M.S.) For the Ph.D. final oral examination, the chairman, as well as the adviser, must be a full member of the Graduate Faculty of Scientific Computation.

Academic Performance Norms

Ph.D. Students

What follows is a guide to the level of academic performance that will be expected of Ph.D. students. It is necessarily approximate, since decisions regarding students' status are based on an interpretation of the entire record, including any special circumstances.

When a student is doubtful about his or her present academic status, the student will be advised to consult with his or her Three-Member Advising Committee or research adviser or with the Director of Graduate Studies. In the following, whenever grade point average (GPA) is mentioned, it means the GPA in actual courses graded on the A, B ... system, exclusive of seminars and research credits.

Any of the following items on a student's record will be considered to be an indication of substandard performance, will be a cause for concern, and may jeopardize a student's good standing for Ph.D. degree:

- a. Any course grade below B-. *Grades of D, F, and N must be made up or not be included in the Degree Program.*
- b. Low GPA: Students must have a GPA of 3.00 or higher.
- c. Failure on written preliminary examination.

- d. Insufficient progress toward a degree as manifested by too few course credits completed or not meeting the deadlines for taking the preliminary oral exam or passing the preliminary oral exam.

A student will lose good standing if he or she has 12 or more credits of work with the grade of incomplete.

M.S. Students

Students who do not wish to pursue the Ph.D. degree may opt to study for the M.S. degree.

The Graduate School and the program require that M.S. candidates maintain a GPA of 2.8 among those graduate courses ultimately submitted on the M.S. Degree Program Form. When this requirement is not met, M.S. candidates will be dropped from the program. To be considered in good academic standing and therefore eligible for continuation of support, reasonable progress toward completion of the thesis requirements of the M.S. degree program will be expected.

The Graduate School imposes various limits on the total duration of various courses of study leading to graduate degrees. The M.S. degree must be “completed within seven years from the date of the oldest course work on the degree program.” It is possible to petition the Graduate School Dean’s Committee to request either an additional one semester or one year extension in the time limit for either degree. However, it is clear that this Committee is going to be very strict in enforcing long-standing Graduate School policy that “only under the most extraordinary circumstances will a petition be considered to extend the deadline to more than eight years from the date of the earliest [M.S.] program course work.”

A student will lose good standing if he or she has 12 or more credits with a grade of incomplete.

Final Oral Examination for the M.S. Degree

A final oral examination is required for the completion of the Master’s Degree in Scientific Computation. At the time that the Degree Program Form is submitted the student should submit the M.S. Oral Examination Prospective Committee Form with the names of three faculty including at least two members of the scientific computation faculty. The adviser may chair the examination or one of the other faculty may serve as chair. It is the student’s responsibility to contact all three members regarding their willingness to serve.

Thesis Credits

If all coursework is completed, then a student should complete the thesis credits as soon as possible. A Master’s student can complete 10 credits in one semester. A Ph.D. student can complete 24 thesis credits in 24 credits. After the required thesis credits are completed, the student is eligible for FTE registration. The procedures are described under **Other Topics**.

Other Topics

Registration

Graduate School registration occurs at the beginning of the registration period for each semester. The day that you register is determined by your last name and will change each semester. If the class is closed, you should put your name on the waiting list in the departmental office.

Students are required to register no later than the end of the second week of the semester. This deadline applies to registering for a class, adding a course, changing sections of a course, changing the grading option (including to or from audit status), and canceling a course without a "W" appearing on the transcript. All changes in registration require the adviser's signature. Graduate students will be permitted to cancel courses through Friday of the eighth week of the semester with the adviser's signature. Courses canceled after the eighth week will require the signature of both the instructor and Graduate School. No registration changes are permitted after the last day of instruction.

The details of registering for classes can be found in the *Class Schedule* for each semester or on the Web. You may obtain a copy of the *Class Schedule* from any University of Minnesota bookstore.

Graduate students must register fall and spring semesters to maintain their active status. Students who must register solely to meet the Graduate School's registration requirement can register for Grad 999, a zero-credit, zero-fee, non-graded option. Those students who have not registered each year but wish to return must apply for readmission. Prior admission is not a guarantee for readmission. Those readmitted may be required to take additional classes and/or examinations to complete their degree. They may also be required to retake courses and/or examinations (such as the WPE).

Procedures for FTE with One Credit for Advanced Graduate Students

The Office of the Registrar and the Graduate School have developed procedures which will permit eligible Advanced Masters and Doctoral candidates to be certified as "full-time" students when registered for only one credit. Faculty advisers and DGS will affirm that each student is indeed working full time on the thesis or dissertation.

These courses are intended only for advanced master's and doctoral students who have completed all their program coursework and required thesis credits, but still are working full-time on the research or writing of their thesis, papers, capstone project or dissertation. The main impetus for this procedure is to certify as "full-time" for loan deferment purposes, teaching or research assistants who could be employed in the low-tuition-fringe job classes. The procedure is available, however, for any eligible advanced graduate student, whether employed as a graduate assistant or not, thus providing a less expensive (one credit rather than 6 or 3) registration for fellowship or self-supporting students who have loans to defer.

The new courses are (XXXX) 8333, FTE: Master's and (XXXX) 8444, FTE: Doctoral. Students should complete the application form (see link below) each term they register for 8333 or 8444. When it has been reviewed and signed, the form should be filed in the student's departmental file. Certification of full-time status to the federal government will occur automatically several times each term.

The Graduate School data management office will "post-audit" the usage of these courses each term, to assure that only advanced students are registering for them. Doctoral candidates who have completed the equivalent of 36 quarter or 24 semester credits of 8888 can be identified automatically by the 08AD Student Group on their PeopleSoft record.

Masters students who have Graduate School approved Degree Program Forms on file and have completed all registrations on the program, with grades, can request that their Director of Graduate Studies submit a Request For Advanced Masters Tracking Flag form (link below) for them in 316 Johnston Hall. Masters students must apply, **by the term deadline**, (see below) for this official status in order to have the 08AM Student Group added to their record. Masters students are not eligible to register for 8333 or to be hired in a lower fringe assistantship job class unless this process has been completed. We ask that graduate secretaries assist fellowship or self-supporting Advanced Masters students to complete this form as well, to verify their eligibility for the auditing process.

Term deadlines for submission of Request for Advanced Masters Tracking Flag forms:

Fall Term: August 15th

Spring Term: December 15th

Summer Term: May 15th

Students should register **only** for the FTE status. The FTE registration is calculated as a full-time registration. Additional registrations (including audited courses) are considered outside the credit allowance and students are responsible for all attendant tuition and fees.

Support for Graduate Students

Assistantships

All Graduate Assistants *must* register as graduate students during each semester of the regular academic year throughout the term of their appointment or award. *Failure to register by the end of the second week of class will result in termination of graduate assistantships. Benefits such as Graduate Assistant Health Insurance coverage will be adversely affected.* Registration is not required during the summer unless the student wishes to use veteran's benefits.

Tuition is waived for all students appointed at the 50% level (RA or TA) or holding Graduate School administered Fellowships. For students supported between the 25% and 50% levels, the percentage of tuition waived is equal to two times the percentage of support. Any TAs or RAs who must pay tuition and who are appointed at the 25% or above level are charged tuition at the Minnesota resident rate. The Graduate Assistant's spouse may also enroll at the resident tuition rate. A student may arrange to have tuition deducted from the last four semi-monthly payroll checks of each semester. There is a small fee charged per semester for this service.

Eligibility for resident tuition rate, tuition benefit, and Graduate Assistant Health Care requires a 25% time appointment for the whole semester or 195 hours worked during a semester, according to the dates shown above. At 25% time if enrolled for the entire semester, one-half of the graduate assistant's tuition and one-half the cost of the medical insurance premium will be paid as fringe benefits. The formula for increasing these benefits is twice the percentage or hours worked during the semester, so that at 50% time full tuition and medical insurance premiums are paid.

These benefits accrue according to the total amount of time worked during the entire semester. Therefore, a student who has a 50% appointment who begins after the beginning of the payroll period, will not be eligible for a 100% tuition benefit or fully paid insurance premium.

International students on F-1 visas are limited to 20 hours of work per week during classes and finals week. Note that the rule is applied on a weekly basis rather than averaged over a payroll period. Therefore, it is impossible for F-1 international students to work over 20 hours per week to make up for hours not worked if they arrive late. It is important that they and the department understand that there can be no payment for work carried out prior to the authorization date on their immigration documents, normally the date they enter the U.S. or transfer from another U.S. institution.

This information and more can be found in the Handbook for Graduate Assistants which is also available on line at <http://www.umn.edu/ohr/gao/>.

U.S. Department of Energy (DOE) Computational Science Graduate Fellowship Program

The University of Minnesota has been approved as a participating university in the U.S. Department of Energy (DOE) Computational Science Graduate Fellowship Program. The program is administered for DOE by Krell Institute. The program is designed to provide incentive and encouragement to students with outstanding academic records to continue their doctoral studies in preparation for careers in computational science. The program offers an annual stipend and payment of tuition and fees for doctoral study in scientific and technical disciplines using computational science methods. The program is open to U.S. citizens and permanent resident aliens who have completed their first year of doctoral study. Appointments are reviewed annually and may be renewed up to a limit of four years. This program allows the University to accept students with fellowship awards, which means that University of Minnesota graduate students' programs are pre-approved for these awards. (Of course prospective fellowship holders must still compete in the national competition for fellowships with other students who also have acceptable study program plans.) Study and research under the fellowship is to be conducted in the applied science and engineering disciplines with applications in high-performance computing. An on-line application form and more information are found at <http://www2.krellinst.org/csgf/index.shtml>.

Disability Services

The University's mission is to provide optimal educational opportunities for all students, including those with disabilities. In general, accommodations are made on an individualized and flexible basis.

It is the responsibility of students to seek assistance at the University and to make their needs known. The Office for Students with Disabilities provides direct assistance such as information, referral, advocacy, support, and academic accommodations (e.g., interpreters, readers, tutors) for enrolled and prospective students. For more information, contact the Office for Students with Disabilities, Suite 180 McNamara Center, University of Minnesota, 200 Oak Street S.E., Minneapolis, MN 55455 (612/626-1333 voice or TTY).

This publication is available in alternative formats upon request by individuals with disabilities. Please call the Coordinator of the Scientific Computation Program, (612) 626-1458.

Grievance Procedures

An All-University grievance policy exists "to provide just, efficient, and final resolution of grievances between members of the University community regarding the application of University rules and procedures." The Office for Conflict Resolution is located in 662 Heller Hall, 271 – 19th Avenue South, Minneapolis, MN 55455. Email address is conflict.resolution@umn.edu, and phone is 624-1030.

Sexual Harassment

Policies and procedures pertaining to sexual harassment are contained in the University's Senate policy statement of May 17, 1984. As the introduction to the statement notes, sexual harassment undermines the mission of the University and jeopardizes the careers of students, faculty, and staff. The statement defines sexual harassment in this manner: "Unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitute sexual harassment when (1) submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment or academic advancement, (2) submission to or rejection of such conduct by an individual is used as the basis for employment decisions or academic decisions affecting such individual, or (3) such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment."

Individuals seeking information and guidance in matters involving sexual harassment should contact the Sexual Harassment Officer, 419 Morrill Hall. All inquiries will be held in strictest confidence.

Equal Opportunity Statement

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, marital status, disability, public assistance status, age, veteran status, or sexual orientation.

Scientific Computation Core Courses

The courses included in the core for the Ph.D. and Master's degrees are as follows.

Scientific Computation Program

- SciC 8001 Parallel High-Performance Computing (3 cr)
- SciC 8011 Scientific Visualization (3 cr)
- SciC 8021 Advanced Numerical Methods (3 cr)
- SciC 8031 Modeling, Optimization, and Statistics (3 cr)
- SciC 8041 Computational Aspects of Finite Element Methods (3 cr)
- SciC 8090 Topics in Scientific Computation (1–4 cr)
- SciC 8095 Problems in Scientific Computation (1-3 cr)
- SciC 8190 Supercomputer Research Seminar (1 cr)
- SciC 8594 Scientific Computation Directed Research (1–4 cr)

Department of Aerospace Engineering and Mechanics

- AEM 8251 Finite Volume Methods in Computational Fluid Dynamics (3 cr)

Department of Chemistry

- Chem 8021 Computational Chemistry (4 cr)
- Chem 8541 Dynamics (4 cr)
- Chem 8551 Quantum Mechanics I (4 cr)
- Chem 8552 Quantum Mechanics II (4 cr)
- Chem 8561 Thermo., Stat. Mech & Dynamics I (4 cr.)
- Chem 8562 Thermo., Stat. Mech. & Dynamics II (4 cr.)

Department of Civil Engineering

- CE 8022 Numerical Methods for Free and Moving Boundary Problems (3 cr)
- CE 8215 Stochastic Transportation Modeling (3 cr)
- CE 8361 Engineering Model Fitting (3 cr)
- CE 8401 Fundamentals of Finite Element Method (3 cr)
- CE 8402 Nonlinear Finite Element Analysis (3 cr)
- CE 8561 Analysis of Modeling of Aquatic Environments I (3 cr)
- CE 8562 Analysis of Modeling of Aquatic Environments II (3 cr)
- CE 8572 Computational Environmental Fluid Dynamics (3 cr)

Department of Computer Science and Engineering

- CSci 5107 Computer Graphics (3 cr)
- CSci 5108 Fundamentals of Computer Graphics II (3 cr)
- CSci 5109 Visualization (3 cr)
- CSci 5302 Analysis of Numerical Algorithms (3 cr)
- CSci 5304 Computational Aspects of Matrix Theory (3 cr)
- CSci 5403 Computational Complexity (3 cr)
- CSci 5421 Advanced Algorithms and Data Structures (3 cr)
- CSci 5451 Introduction to Parallel Computing: Arch, Algorithms and Program (3 cr)
- CSci 5481 Computational Techniques for Genomics (3 cr)
- CSci 5561 Computer Vision (3 cr)

CSci 8314 Iterative Methods for Linear Systems (3 cr)

Department of Curriculum and Instruction

CI 5364 Computer-Based Instruction: Games and Simulation (3 cr)

Department of Educational Psychology

EPsy 8221 Psychological Scaling (3 cr)

EPsy 8222 Advanced Measurement: Theory and Application (3 cr)

Department of Geology and Geophysics

Geo 5201 Time-series Analysis of Geological Phenomena (3 cr)

Geo 5802 Scientific Visualization (3 cr)

Department of Health Informatics

HInf 5430 Health Informatics I (4 cr)

HInf 5431 Health Informatics II (4 cr)

Hinf 8434 Medical Decision Support Techniques (3 cr)

Department of Linguistics

Ling 5801 Introduction to Computational Linguistics (3 cr)

Ling 5802 Computational Linguistics (3 cr)

Department of Mathematics

Math 5467 Introduction to the Mathematics of Image and Data Analysis (3 cr)

Math 5485 Introduction to Numerical Methods I (4 cr)

Math 5486 Introduction to Numerical Methods II (4 cr)

Math 5487 Computational Methods for Differential and Integral Equations in Engineering and Science I (4 cr)

Math 5488 Computational Methods for Differential and Integral Equations in Engineering and Science II (4 cr)

Math 5535 Dynamical Systems and Chaos (4 cr)

Math 5651 Basic Theory of Probability and Statistics (4 cr)

Math 5705 Enumerative Combinatorics (4 cr)

Math 5707 Graph Theory and Non-enumerative Combinatorics B (4 cr)

Math 8441 Numerical Analysis and Scientific Computing (3 cr)

Math 8442 Numerical Analysis and Scientific Computing (3 cr)

Math 8445 Numerical Analysis of Differential Equations (3 cr)

Math 8450 Topics in Numerical Analysis (1–3 cr)

Math 8571 Theory of Evolutionary Equations (3 cr)

Department of Mechanical Engineering and Industrial Engineering

ME 5228 Introduction to Finite Element Modeling, Analysis and Design (4 cr)

ME 5351 Computational Heat Transfer (4 cr)

ME 8228 Finite Elements in Multi-Disciplinary Flow/Thermal/Stress and Manufacturing Applications (4 cr)

ME 8229 Finite Element Methods for Computational Mechanics: Transient/Dynamic Problems (4 cr)

ME 8345 Computational Heat Transfer and Fluid Flow (3 cr)

Department of Neuroscience

NSc 5201 Computational Neuroscience I: Membranes and Channels. (3 cr)

NSc 5202 Theoretical Neuroscience: Systems and Information Processing(3 cr)

Department of Operations and Management Sciences

OMS 5170 Simulation Modeling and Analysis (4 cr)

OMS 8661 Linear Programming (3 cr)

OMS 8671 Simulation Analysis (3 cr)

OMS 8672 Stochastic Modeling and Analysis (3 cr)

School of Physics

Phys 5041 Mathematical Methods of Physics I (4 cr)

Phys 5042 Analytical and Numerical Methods of Physics II (4 cr)

Department of Psychology

Psy 5036W Computational Vision (3 cr)

Psy 5038W Introduction to Neural Networks (3 cr)

Psy 5960 Topics in Psychology (1-4 cr)

Department of Statistics

Stat 8701 Computational Statistical Methods (3 cr)

Stat 8711 Statistical Computing (3 cr)