INFORMATION FOR MS STUDENTS

IN ENGINEERING SCIENCES AND APPLIED MATHEMATICS 2016-2017
September 1, 2016

Dear Graduate Students,

This handbook is prepared to aid you in earning a Masters of Science degree in Applied Mathematics. Please read it carefully and be aware of the requirements and responsibilities described. The information contained in this handbook is more specific than that in the Graduate School Bulletin. You should also familiarize yourself with the general regulations of The Graduate School.

Please feel free to come in to see me if you have any questions, problems, or points of concern.

David Chopp, Professor and Chair
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INFORMATION FOR GRADUATE STUDENTS

Welcome to the Engineering Sciences and Applied Mathematics Department. Please keep and refer to this booklet through completion of your MS degree. Every effort has been made to anticipate your questions—from arrival through final checkout. You are responsible for knowing this material!

I. COURSE ADVISER

During New Student Week, you will meet with your adviser who will assist you in selecting courses for your first quarter of study. The advisor must be consulted about course selection. The adviser will continue to be your course adviser through the completion of your MS degree. Responsibility for meeting published deadlines and degree requirements rests with the student. The Northwestern University Academic Calendar is available at [http://www.registrar.northwestern.edu/calendars/index.html](http://www.registrar.northwestern.edu/calendars/index.html). The Graduate School deadlines and requirements can be found on their website at [http://www.tgs.northwestern.edu/academics/degree-requirements/index.html](http://www.tgs.northwestern.edu/academics/degree-requirements/index.html)

Also see [The Graduate School 2016 New Student Guide](http://www.tgs.northwestern.edu/academics/degree-requirements/index.html).

Students whose goal is to enter the PhD program at Northwestern at the end of their MS program are strongly advised to discuss this option with his or her course adviser at the first meeting as this will significantly influence course selection for the MS degree. Students pursuing this track typically take the same courses as the students in the first year PhD program and also take the Preliminary Examinations when they are offered in the Winter and Spring quarters. Because space is limited in the PhD program, successful completion of the MS degree does not guarantee admission to the PhD program.

II. MS DEGREE IN ENGINEERING SCIENCES AND APPLIED MATHEMATICS

A. Residency and Course Load

The minimum residence requirement for the MS degree is three consecutive quarters at Northwestern. Course and 499 (research) units should total to 3-4 units each quarter to maintain full-time status. To complete the MS degree in 3 quarters, 4 units per quarter will be required.

B. Course Requirements

Students must take at least twelve graded academic courses listed in the Graduate School catalog. At least nine of these twelve classes must be 400 level courses. To view available Graduate School courses, search for classes in CAESAR ([http://www.northwestern.edu/caesar/](http://www.northwestern.edu/caesar/)) and set Course Career to the Graduate School. P/N grades are not allowed. Enrollment in the core curriculum is mandatory. In addition to five core courses, seven elective courses are required. According to University policy, students must maintain a 3.00 average to receive the MS degree. Satisfactory progress in the program is determined by department review of course grades, and faculty recommendations.

Student GPA is calculated according to the following scale: A = 4, A- = 3.7, B+ = 3.3, B = 3, B- = 2.7, C+ = 2.3, C = 2 and will appear on the graduate student transcript.

1) Core Courses in Engineering Sciences and Applied Mathematics

The following courses comprise five units of the graduate core curriculum for the MS degree in engineering
sciences and applied mathematics.

ES_APPM 411-1,2 Differential Equations of Mathematical Physics (2 units)

ES_APPM 420-1 Asymptotic and Perturbation Methods in Applied Mathematics (1 units)

ES_APPM 446-1 Numerical Solution of Partial Differential Equations (1 units)

ES_APPM 448-0 Numerical Methods for Random Processes (1 units)

**Waiving Core Courses:**
Students who are sufficiently prepared in the subject matter of a core course may petition for a waiver from the course requirement. The instructors may require documentation, e.g. text used, course outline, lecture notes, exams, etc. The signed form should be given to Beth Siculan to be placed in the student’s file. Please note that the waiving of a course does not decrease the total number of courses required. Substitution of ES_APPM 311-1,2 in place of ES_APPM 411-1,2 may be done if recommended by your advisor and approved by the Chair.

### 2) Elective Courses

The remaining of the seven courses for the MS are to be selected by the student in consultation with his or her adviser and must be approved by the advisor. Of those electives one must be a course in numerical methods, three must be in mathematical modeling, and three courses must have mathematical content. More specifically:

- **Numerical Elective:** Students must take either ES_APPM 444 or 445 in the spring quarter to satisfy this requirement.

- **Mathematical Modeling Electives:** Students are expected to select 3 classes where mathematics is applied to areas of application. Courses typically taken to satisfy this requirement within ESAM are 421-1, 421-2 and a special topics class offered in our yearly graduate modeling sequence. If classes are taken outside of the department, the course sequence should have a theme, e.g., financial mathematics, fluid mechanics, etc. As an example, one popular theme has been Economics, where students have selected three classes from among ECON 311, 360, 381 and 383. Another example is Financial Engineering and courses students have taken include: IEMS 326, 373, 473; STAT 365.

- **Mathematical Content Electives:** Students are expected to select 3 classes where mathematics is the focus of the class. For example, within ESAM students may wish to complete the 411 and 420 sequences by taking 411-3, 420-2, 412-0. If taken outside of ESAM, the classes should have a theme, e.g., stochastic methods, operations research, etc. As an example, one popular theme has been Statistics, where students have selected three classes from among IEMS 303, 315, 435, 460, 461, 462; Stat 350, 420-2. Another example is Machine Learning and Data Science and courses students have taken include: EECS 349, IEMS 490 (Machine Learning), ESAM 495 (Modeling with Data).

Up to two units of the modeling or mathematical content electives may be used for a Masters research project, ES_APPM 499. Any courses taken for the MS must be an extension of the student's background rather than a repetition of work done as an undergraduate.

### C. BS/MS Program

Students who enter the ESAM MS program via the BS/MS program at McCormick have the same requirements for the MS degree as listed above. Graduate courses taken as an undergraduate prior to entering the ESAM MS
program can be applied toward the MS degree requirements with department approval. No course used to fulfill requirements to receive the BS degree may also be used toward fulfilling the MS degree. For information about this program, please contact Bruce Lindvall, Assistant Dean for Graduate Studies at McCormick.

**D. Preliminary Examinations**

The preliminary examinations are **not** required of students to complete the MS degree. However, students interested in pursuing a PhD degree at the completion of their MS degree may optionally take the preliminary examinations if approved by his or her course adviser.

There is one exam for each of the topics of advanced calculus, differential equations, linear algebra, and complex variables. The exams are based on advanced undergraduate material. Sample examinations from previous years as well as a list of textbooks that cover the topics are available upon request from the student’s course adviser. They are offered within the first two weeks of the Winter quarter and are given as four separate 2-hour exams scheduled so that they do not conflict with the students’ courses.

Students who fail one or more exams will be given an opportunity to retake a new exam on the same subject(s) within the first two weeks of the following Spring quarter. Students are required to pass all four exams before they may be allowed to enter the PhD program. **Because space is limited in the PhD program, passing the preliminary examinations as a MS student does not guarantee admission to the PhD program.**

**E. Versant Language Examination**

The Versant Language exam is **not** required of students pursuing the MS degree. However, it is mandatory for international students whose country of origin is not Australia, Canada, New Zealand, or United Kingdom when pursuing a PhD degree. If an international MS student is interested in pursuing a PhD at Northwestern at the completion of their MS degree, he or she may optionally take the Versant Language Examination if approved by his or her course advisor. Students in the MS program that wish to take the Versant Examination must notify his or her course advisor no later than the fifth week of the Winter quarter to be registered for the Spring testing. It is mandatory for international students to pass the Versant Language exam in order to be admitted into the ESAM PhD program from the MS program. For more information about the Versant test as well as English language tutoring resources, see the [Versant testing page](#).

**F. Admission into the PhD Program**

MS students in good standing may wish to be considered for admission into the PhD program. Because space is limited admission is very competitive, and students should be aware of this. Students interested in pursuing the PhD are strongly encouraged to discuss this option with their MS advisor. The following is a list of necessary conditions that must be met if a student wishes to be considered for the PhD program:

1. The student must take the 1st year PhD sequence of classes. Please see the ESAM PhD Graduate Student Handbook for the list of courses.
2. The student must take the written preliminary exams, see Section D above.
3. International students must satisfy The Graduate School’s spoken English proficiency requirement before the end of spring quarter of their 1st year of study, see Section E above and: [http://www.tgs.northwestern.edu/funding/assistantships/graduate-and-teaching.html](http://www.tgs.northwestern.edu/funding/assistantships/graduate-and-teaching.html)
4. Identify a PhD thesis advisor before the end of the Spring quarter of the 1st year of study.
Because admission is very competitive, the department recommends that MS students seeking admission pursue all their options for graduate study. This includes applying to other programs and schools, applying to other programs of study within Northwestern, and actively pursuing employment for after graduation. If the student seeks admission, he/she must inform the ESAM MS student advisor. A decision will be make before the end of the Spring Quarter.

G. Graduate Student Tracking System (GSTS)
Students are expected to maintain their current information in the Graduate Student Tracking System (GSTS, http://gsts.northwestern.edu). The Graduate Student Tracking System allows students to track their progress and activity in one place. Students log in with their NetID and use the tool to communicate with their program on their plan of study, coursework, milestones, and annual progress.

H. Academic Standing
The Graduate School details procedures for determining Good Academic Standing, Probation, and Exclusion. See the Graduate School website at http://www.tgs.northwestern.edu/academics/academic-services/satisfactory/index.html for details.

I. Filing for Graduation
For graduation, the student must apply for a MS degree in Caesar at the beginning of Spring quarter. For the exact deadline date to receive a degree at the end of the Spring quarter, see the graduate school website.

J. Appeals Process
The faculty make every effort to ensure that each student's progress is carefully reviewed and the resulting feedback is accurate and constructive. There may be, however, instances in which a student feels that a review decision is unjust or is based on incomplete or inaccurate information. If this occurs, there are appeal channels available to the student.

First, the student should discuss his/her concerns with their course adviser in order to resolve any misconception or misperception. If the adviser and the student are not able to resolve the concern, an appeal may be directed to the Department Chair. The University policy for academic-related grievances is provided in The Graduate School Catalog. For non-academic matters, such policies are provided in the Northwestern Student Handbook.

III. GENERAL INFORMATION

A. Pass/No-Credit Option
Students working toward an MS or a PhD in Engineering Sciences and Applied Mathematics may not use courses taken on a P/N basis to satisfy course requirements. Graduate students may, with the approval of their adviser, take courses on a P/N basis after satisfying the departmental course requirements.

B. Academic Honesty
Students are strongly advised that originality is essential in all homework, projects, exams, theses, etc. associated with graduate work. Students are required to do their own work. Ideas, data, or word-for-word quotations taken from other sources (including the work of fellow students and other group members) must be appropriately referenced; otherwise plagiarism will have been committed. The following statements should help
define what is meant by "appropriately referenced":

a. All ideas, data, mathematical expressions, and word quotes taken from the works of others should be clearly and directly referenced to the original author. This is best accomplished by listing a reference number after the material with the numbered references appearing at the end of the manuscript. The following format is also acceptable:

"The equation can be derived following the approach of Jones as follows:..."

b. Word for word quotes must have quotation marks at the beginning and end and be referenced in the manner described above.

c. Photocopied figures should be referenced as described in a. above.

d. Redrawn figures or plots made from other people's table of data can be appropriately labeled “after Smith”.

e. Each person should receive proper recognition for contributions made.

Special note: group collaboration on homework assignments is at the discretion of the professor. Unless otherwise stated, students are expected to turn in their own original work.

In accordance with Graduate School regulations, "All cases of alleged academic dishonesty involving students of The Graduate School are to be referred by members of the faculty to the Dean of The Graduate School” as well as the Associate Dean of Graduate Studies of McCormick. A student found guilty of academic dishonesty runs the risk of being dismissed immediately from the graduate program.

On Being a Scientist by the Governing Board of the National Research Council is available at http://www.nap.edu/catalog.php?record_id=12192#toc. Northwestern University’s Guidelines for Investigators in Scientific Research is available online at http://www.research.northwestern.edu/ori/misconduct/. These two documents discuss ethical standards in the scientific community. Students should be familiar with the contents of these two documents. The Department expects the highest levels of integrity from students and faculty.

C. Student Support and Conflict Resolution

Students should speak with the Department Chair to interact in a confidential manner when concerns arise.

D. Consumption of Alcoholic Beverages

Consumption of alcoholic beverages in the Technological Institute, except at official departmental functions and such recognized events as post-defense celebrations, is incompatible with sound safety and work-place practices and is therefore unacceptable. We expect our students to abide by Illinois laws concerning all controlled substances.

E. Student's File

In addition to the information contained in GSTS, folders are kept in the department offices for each student. They contain additional materials not currently maintained in GSTS such as application materials, approved study programs, grades for completed courses, records of completed examinations, names of committee members, current address, phone numbers, etc. In accordance with Government regulations a student is allowed access to his file after submitting a written request to the department. Educational records cannot be released to
any outside agency without the student's written consent. Students applying for credit cards, etc., which require employment and/or salary verification by the department, must inform the department that such a request may be forthcoming. Verification of employment may also be done through NU’s Employment Verification Infoline at https://www.theworknumber.com.

F. Change of Address
The Department Office must be notified of any change of address. Students may change address through the HR website https://nuhr.northwestern.edu and also in Caesar. Be sure to change your address in both as the two systems are separate.

The US Citizenship & Immigration Services (USCIS) requires every international student and scholar to report a change of address within 10 days of their move. It is critical for F-1 and J-1 students to update their address in CAESAR immediately upon their relocation. For J-1 and H-1 scholars they will need to inform the international office as soon as possible. All F-1 students, J-1 students and scholars, and H-1B scholars will also need to complete a change of address form (AR-11) available on the USCIS website at: http://uscis.gov/. Failure to do so will be a violation of their F-1 or J-1 status and could result in severe consequences for them and their dependent(s)!

G. International Students
Upon arrival all international students must register immediately with the International Student Office, 630 Dartmouth Place, Evanston Campus, who will act as adviser on all matters concerning employment practice, visa renewals, etc. International students interested in pursuing the Ph.D. degree are required to pass the Versant English Test in order to fulfill The Graduate School’s spoken English proficiency requirement http://www.tgs.northwestern.edu/funding/assistantships/graduate-and-teaching.html, also see http://groups.linguistics.northwestern.edu/esl/versant.htm.

H. Colloquium Series
The Department organizes the colloquium series that generally meets on Mondays at 4pm. Its primary purpose is to broaden the education of each graduate student by bringing to campus the leaders in our field. Attendance is recommended for all graduate students.

I. Safety
The department has taken a number of steps to help provide a safe work environment. In the event of an alarm requiring evacuation of the building, all members of the department are expected to evacuate using preferably the stairwell at the north end of the hall near the main office. Proceed to the ground floor, then go north out the exit at the end of the C or D wing. After exiting the building, go to the department rally point at the entrance of Sargent Hall and report to the Safety Coordinator, Beth Siculan, so we can ensure everyone’s safe exit from the building.

J. Computing Facilities
Linux computers are available for general academic and research use in the student offices. Not all computers in student offices are for general use, but are for specific research projects. Contact the Department computing manager, David Chopp, if you have any questions about which computers are available for general use. New students are assigned a user ID based on their NU net ID that allows them to log in to any of the department Linux computers, and also allots storage space that is on a shared server that can be accessed from any of the Linux computers. The Manager must be consulted prior to addition or deletion of any software or hardware on these systems, or in the event of system malfunctions.
Students may also access the department network via their own personal computer. To obtain access, send an email to the Department computing manager (chopp@northwestern.edu) with: Name, office #, operating system, whether it is a laptop or desktop, and the Ethernet MAC address. An Ethernet connection is required to use the department printers, wireless connections are not on our local subnet, and hence will not allow access to the printers.

**K. Student Lounge**

The graduate student lounge is located in room M443. It is managed by the ESAM graduate student leadership. All students are expected to comply with the rules set by the graduate student leadership to keep the lounge as a pleasant place for students to gather. Access to the student lounge is by an access code for a numeric pad on the door. Contact Beth Siculan if you do not know the access code. Please do not share the access code with non-ESAM people. Use of the lounge is intended only for ESAM students, faculty and staff.

**L. Fax, Mail, Photocopying, and Printing**

**Postal Service.** Mail is delivered once a day to the Department Office. The student mailboxes are in M426; you will find your mail and messages in your assigned box above your name label. It is advisable to check your mailbox daily. Use of the University mailing address for personal mail is not allowed by NU regulations.

**Photocopying, Copy Cards, and Faxing.** A photocopying machine for research and teaching related copying is available in the Department Office. Copy cards for use in copying machines at the library are available through the Wildcard Office or at Seeley Mudd Library. Photocopying services are also located at Norris Center and 2020 Ridge for large orders. Personal copying should be kept to a minimum on the department machine. A fax machine is located in the Department Office. Long distance faxes require an access code. See the department for personal faxes.

**Printing.** A black and white and printer is provided in the Student Lounge, M443. The black and white printer should be used, with duplexing turned on to save paper. Use of the printers is for academic and research purposes only, and not for personal use. Information about accessing the printers from the Department provided computers or your personal computer can be found on the Department website under student resources.

**M. Kitchen, Large Conference Room, and Supply Cabinet**

**Kitchen.** Kitchen use is restricted to ESAM department members. Please comply with the kitchen rules that are posted. After washing your dishes, be sure to dry them and remove them promptly. Do not leave personal items in the kitchen. The microwave and toaster oven should not be left unattended while in use. Clean up any food that splatters, drips or spills. Remember, it is easier to clean up the mess when it is still fresh. As a courtesy to other department members, please only take tea and other supplies on a single-use basis. Finally, to prevent flooding, make sure the hot water dispenser is completely turned off after use. There is no janitorial service to clean up this space, so it is your responsibility to keep the area clean and clear of personal belongings.

**Large Conference Room (M416).** If you need to enter/exit the conference room, please do so through the Tech hallway, not the department office. The conference room should be left in the condition that it is found. If chairs or other furniture are moved, they should be returned to their original position. Do not leave food in the room; properly dispose of any garbage. This room acts as a classroom and event space, and should be kept tidy at all times.

**Supply Cabinet (M426).** Limited supplies (pens, notebooks, etc.) are available for research purposes. These supplies are not for personal or class use. Please only take one of each item at a time.
N. Automobile Regulations
The University Police Parking Division controls the NU parking lots. Students requiring a sticker that will enable them to park in the various University parking lots should obtain an application from the Parking Office located at 1841 Sheridan Road, Evanston (open Monday through Friday, 8:00 A.M. to 4:00 P.M.). Applications are issued upon presenting your University I.D. card, driver's license and payment of a fee. Additional information can be found at www.northwestern.edu/up/parking. For your information, all students who park cars on campus are required to register the car with the Parking Office. Bicycles should also be registered.

O. The SIAM Student Group
The Northwestern Student chapter of SIAM (Society for Industrial and Applied Mathematics) was established in 2011. Each year (usually at the end of the Spring Quarter) an election is held to fill the offices of President, Vice President, Secretary/Treasurer, Activities Chairman, and Faculty Representative. The Officers serve as liaison to the Faculty and Department administration in representing the students’ interests. They also organize various social and professional activities throughout the year. Students are automatically members and are encouraged to participate. For international students the club provides valuable interaction for the development of English proficiency.

P. U-Pass
All full-time students will receive a U-Pass, which allows unlimited rides on the CTA. Information about use of the U-Pass and distribution dates is available at

http://www.tgs.northwestern.edu/campus-life/housing-transportation/u-pass.html

Q. Bike Riding and Skateboarding
For obvious safety reasons, bike riding and skate boarding are prohibited in the corridors of Tech. In addition, bikes may not be stored in public spaces in the building, in particular the stairwells where they can pose an evacuation hazard.